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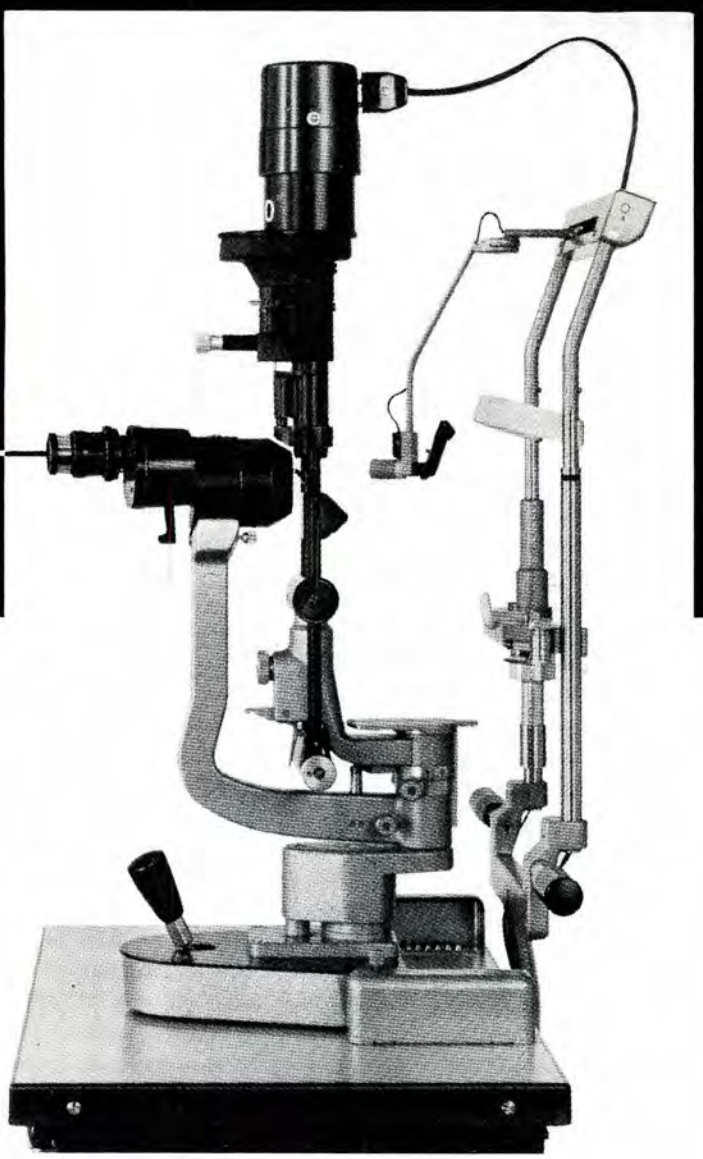

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Features

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EDITORIALS

A Pot Pourri on Contact Lenses*

Contact lenses have been the most outstanding innovation in non-medical or non-surgical aspects of vision care in recent years. Progress has been steady and rapid over the past four decades in both the science and art of contact lens fitting. But have not our successes in this area led us to neglect the less spectacular procedures at our disposal?

For example, has the trend to simplify fitting procedures, to make the fitting less tiresome, less time-consuming for both patient and practitioner really resulted in improved quality of service? Has this trend improved the main objective, the end result of fitting — namely, an optical device to correct a specific visual problem?

Optometry earned its reputation because of its expertise in doing skillful and accurate eye examinations and by prescribing a variety of aids capable of satisfying the vocational and avocational needs of their patients. Contact lenses have limited abilities to satisfy the multifarious demands of our modern society and industry. Practitioners, perhaps because of the popularity of contact lenses and for fear of being considered old-fashioned, may not discuss openly the very limited optical performance of contact lenses when compared with conventional ophthalmic lenses. Could we not be doing a disservice to the patient and the profession?

A well-fitted contact lens must meet at least two criteria: it must cause no insult to the cornea and its physiology, and it must provide as accurate a refractive result as would a conventional spectacle lens. If we are interested in meeting vocational and avocational needs, we should ask ourselves whether even the well-fitted contact lens satisfies these needs. The answer would be in the affirmative for the majority of pre-presbyopes, but as age increases, the number of successful patients falls drastically. This is a challenge for the profession and the industry. Will contact lens designs ever be as numerous and complete as those available with spectacle lenses in order to meet *all* vision demands?

Optometrists should not forget that the contact lens is but one of the many devices and procedures available in the performance of their duty as vision care professionals. There is a "glamour" of a sort in contact lenses, but optometrical vision care is much more than the fitting of contact lenses.

Although the human visual system has a certain flexibility and can tolerate other than the optimum refractive correction, it is this writer's opinion that the fitting of soft contact lenses has tended to produce sloppy refraction. A spectacle lens in error by 0.50D sphere, or even 0.25 cylinder would likely be rejected and sent back to the laboratory for correction. Are we as prompt to reject a contact lens when over-refraction reveals that it is not the proper correction? What happens to this incorrect lens? Is it destroyed? Will the laboratory accept its return, or is it simply one more "slightly used" lens in an ever growing inventory?

Why should such an attitude prevail when one considers the tremendous amounts of money and effort expended on research?

It would seem that the answer to the preceding question is simply that clinicians and researchers have overlooked the primary objective of any lens —namely that it is a refractive device intended to compensate an optical or muscular defect of the human eye.

Researchers have done an outstanding job in helping to explain corneal physiology, in the development of materials more compatible with the requirements of corneal physiology, in the production of all necessary solutions. But have our efforts to improve the contact lens *as a refractive device* been on a par with our efforts to understand corneal physiology? Bifocal and toric lenses do exist, but fitting is still very much a hit and miss affair despite the improvements realized in the design of toric lenses. There is still a long way to go, particularly in providing a wider range of cylindrical powers and axis orientations, not to mention design parameters. Can we look forward to the day when soft lenses will permit, as is possible with rigid lenses, the practitioner to calculate the results of his/her prescription when placed on the eye? This is not beyond the realm of possibility, but our understanding of the performance and flexure of soft lenses, the nature and physical properties of present day materials, appears to be inadequate at the moment.

Will bifocal contact lenses ever become truly versatile and practical devices, a worthy competitor to the present array of multifocus spectacle lenses? Limitations of existing designs are barriers to the desire to continue with contact lenses when presbyopia is reached. The potential for future growth seems restricted by the limits of present designs: poorer acuity than with SV lenses, small near point fields, discomfort and lack of variation in near point powers.

What clinical procedures are available to better evaluate refractive results? Is the contrast sensitivity technique the ultimate, or are attempts yet being made to find "the ultimate", a simple, inexpensive test which all practitioners can readily integrate into their office routine?

Have we abandoned our efforts to provide the practitioner with an accurate tool to check all soft lens parameters? All offices have a vertometer of sorts to verify spectacle lenses, even though the laboratories have these instruments as well. It would appear logical that practitioners should be as well equipped to verify soft lens parameters as they do with rigid lenses, and regular spectacle lenses. Practitioners' confidence would be enhanced because they would know exactly with what they are working.

Improvement in contact lenses as optical corrections will not be achieved by any *reduction* in available lens parameters whatever the reason: to enhance production capabilities, to simplify fitting, or to reduce costs. Single base curve series, single diameters fitted to different corneae of different dimensions may not cause damage to the corneae, but what kind of *refractive* result ensues? Why do contact lens manufacturers and designers try to evade the basic rules of optics? It takes specific curves to produce specific powers for the materials involved. Is lens flexure adequate justification for the scrapping of scientific parameters? Why do clinicians let themselves be swayed by manufacturers? Why do clinicians not boycott firms who refuse to provide lenses with *all* the required parameters?

What effect on acuity, accommodation, binocular relationships, aniseikonia and stereopsis results from the single base curve series? Has anyone ever taken the time to investigate the variations in resulting refractions for a series of eyes all having the same degree of optical error, but with different corneal diameters and curvatures? Will a lens with specifications 8.4/-3.00/13.5 properly correct patients with keratometer readings of 40D, 42D, 44D, 46D, 48D, all of whom are -3.00 diopter myopes? What happens with corneal diameters of 10.5, 11.0, 11.5? How many of these will give plano over-refraction? Plano over-refraction may be achieved by changing lens powers, but this may involve the introduction of variable and unwanted cylindrical effects. Certainly it involves a considerable inventory, which is contrary to the goal of reducing costs. Moreover, can the practitioner afford a significant inventory of several makes of lenses?

Speaking of inventory raises the question of the dubious merit of *fitting* from inventory. What technical advantage, other than patient convenience, is to be realized from fitting from inventory? The patient loses any assurance that he or she will obtain a new and unused lens, free from aging deterioration. What happens to a lens found to be unsatisfactory after a few days, or even a few weeks? Does it go back into inventory as a "new, unused lens"? Is there any possibility that such a lens was not properly asepticised and disinfected, thus presenting some risk for future patients? Can the practitioner afford to discard the lens? If it could be done, would it?

There follows then a serious economic consideration. Professional fees should take into account the possibility of having to refit or exchange lenses, as well as to build and maintain an adequate inventory for trial purposes. Are such fees realistic considering the existence of price cutting outlets with slogans such as "Satisfaction guaranteed or money refunded"?

Does not the fierce competition between corporations and the offering of lenses at lower and lower cost reduce the sources of funds available for research and development? Do discounts for volume purchase serve only to encourage the price cutters to enter the field?

In the rush by multinational corporations to corner the market, to mass produce lenses, one must seek their true motivation — quality vision care, or profits. Cannot the trend to reduce parameters more honestly be interpreted as profit based, rather than aimed at improving care? The clinicians must bear some responsibility also. One would have to look long and hard through the literature to find any objections being raised by optometrists. Is the reduction in parameters the first step in the production of over the counter "throwaway" lenses, a feeling out of the market, of acceptability to the public and the professionals? Could not this lead to a situation similar to that of the "glazed goods" sold over the counter in department stores and other retail stores?

Would this be in the patient's best interest? Would not this approach involve risk that the patient would judge a symptom to be, instead, a dirty lens and simply exchange it for one at hand?

Among the many solutions available to practitioners and patients are decongestants. We question the indiscriminate use of such solutions by patients, but some optometrists tolerate their use, and even *recommend* them. A red eye is a warning, a symptom that something is wrong. Does not their use place some patients at risk? A red eye during an adaptation period is not unexpected. If only an adaptation symptom, it will cease in a few days, perhaps even hours. But a red eye beyond the adaptation period needs to be examined closely and decongestants avoided. Of course, a true red eye should be differentiated from an eye which is described as "bloodshot" by the patient, but which is normal for that particular individual. The wearing of contact lenses may draw attention to the presence of prominent scleral vessels and the contacts may be

blamed. It is just such a situation which enhances the value of a prefitting, coloured photograph of the anterior eye. Who can say that it would not become an indispensible piece of evidence in the event, say, of suggestion of malpractice? Even more applicable, would it not allay any anxiety in the patient that the lenses were the cause of the redness?

Finally, what must one think of extended wear lenses? The key to their successful use and eventual acceptance by optometrists lies in the optical, chemical and physiological properties of the materials used in their manufacture, in essence, the *durability* of the material. However, have we also looked at the relationship between materials and the specific metabolism of the individual patient? Would a criteria for selection of a patient be found in such a relationship?

Whether long term effects on ocular tissues and physiology will limit their popularity and usefulness has yet to be determined with certainty. Are only the more venturesome practitioners and patients interested at the present time? Will their introduction follow the same pattern as did the introduction of hard lenses? Will everyone jump on the bandwagon once their safety has been demonstrated, or perhaps before?

But what is the motivation behind the use of extended wear lenses? Historically, they were the brainchild of John de Carle of London, but could he, as an individual, have caused their widespread demand? What part have the professions, the public, the manufacturers played in their popularity? Is it the desire of the individual to always see clearly, at least at far, or is it a desire to eliminate the bother of daily removal and cleaning? What has the profession to gain from their introduction? From a corrective, or optical aspect, can the technique really be described as "progress"? Physiologically, there has certainly been progress which has led to a better understanding of the cornea and its function.

*Written as a Guest Editorial for the Contact Lens Journal, November, 1984.

The very nature of the device implies a much greater responsibility on the part of the practitioner and demands greater attention be paid to after care. Have criteria to permit safe patient selection been determined? Have adequate after care procedures and tests been established so that users are subject to minimal risk? Should the professions endorse or oppose the direct advertising of extended wear lenses by the manufacturers to the public? Would controls be in the public interest or would consumer groups fight them as contrary to the public right of freedom of choice?

Progress in contact lens work is a direct outcome of the research efforts and funds directed to this science. Whether this research is due to the work of individuals, small, independent firms or multinational corporations is immaterial. Understandably, individuals do not possess the funds and facilities available to large corporations, but it must be recognized that, were it not for the many individual pioneer actions, the larger corporations would not have become involved. The rapid growth and development in the industry has resulted from the infusion of research funds by the larger corporations. Without them, progress would have been slower, but can we not ask if quality vision care would not have been better served by slower growth and less emphasis on profit for profit's sake?

Contact lenses have been a boon to vision care, and do serve to meet a very real demand. However, have they also become an obsession that blinds us to other modalities in vision care? Is it perhaps time to rethink our priorities and objectives as vision care practitioners, even if they happen to conflict to some degree with those of some colleagues and manufacturers, or even with popular trends?

As guardians of human vision, optometrists must answer these and many other questions before the profession gives unqualified approval to the direction in which contact lenses are moving.

G. Maurice Bélanger

An Opportunity to Publish!

There is a saying in academia — "Publish or Perish". In essence, it means that promotion and tenure, in the university world, depends upon research by individuals and the publication of their findings.

In the less formal world of clinical practice, all practitioners have an opportunity to publish if they wish to undertake research projects, to report on unusual case findings or to present a literature search of a particular topic. Unfortunately, few clinicians feel inclined to take up the pen for the benefit of their colleagues.

There is, however, a group of practitioners who have a real opportunity to contribute to optometric literature. Not only can these optometrists enhance the reputation of the profession by their submissions, they can also enhance their own knowledge and reputations as writers and teachers. Let us not forget that "what is conceived clearly will be expressed clearly."

I am referring to those Canadian optometrists who have applied for membership in the American Academy of Optometry. As part of their admission requirements, they must prepare ten case reports dealing with a number of different ocular and visual conditions taken from their office files. Experience has shown that these case reports are usually exceptional conditions or routine cases which have been treated in an exceptional manner. The preparation of such reports can be very demanding, particularly for those who are not gifted writers. It is a pity that their efforts should be read, for the most part, by such a limited audience. In many situations, Academy candidates fail to recognize that their reports could benefit some colleagues in helping them to better manage similar problems in their own offices.

The Canadian Journal of Optometry invites all Academy Fellows, whether new or long-term holders of the Fellowship, to select one or two from their Academy reports and submit them for publication. And may we note that, in so doing, "You may become your colleagues' keeper!"

GMB

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Blue Free Fundus Examination

A.P. Cullen*
B.R. Chou**

Abstract

The hazard to the retina of both near ultraviolet (UV-A) and short wavelength visible (blue) radiation, particularly in the very young and in aphakics is well recognized. Instruments with xenon flashtubes, halogen bulbs and other sources rich in these wavelengths increase this potential hazard during long or repeated diagnostic procedures and in teaching environments. The advantages and disadvantages of using short wavelength blocking filters during direct and indirect ophthalmoscopy, three-mirror funduscopy and fundus photography are described and evaluated. Filters which block all wavelengths below 450mm are recommended.

Abrégé

Le risque à l'intégrité de la rétine des jeunes et des aphaques par les rayons ultraviolets inférieurs (UV-A) bleus à courtes ondes du spectre visible, est un phénomène reconnu. Ce risque est rehaussé par l'emploi prolongé d'instruments dont la source d'illumination est une ampoule Xénon éclair, une ampoule halogène ou autre ampoule émettant une haute teneur de rayons nocifs, soit dans une situation de diagnostie ou d'enseignement. Ce travail est un exposé des avantages et désavantages de filtre capables d'atténuer ces rayons nocifs durant l'ophtalmoscopie directe ou indirecte, la photographie de la rètine ou le gonioscopie à miroirs. Les filtres qui éliminent toutes les ondes inférieures à 450nm sont recommendés.

Introduction

The hazard to the retina due to short-wavelength non-ionising optical radiation (UV-A and blue regions of the spectrum) is well known. Tso and his collaborators[1,4], Ham et al.[5,9] and others[10,12] have demonstrated that the majority of cases of photic retinopathy arises from a photochemical mechanism. Much of the evidence suggests that this hazard is greatly increased as the short-wavelength component of the radiant energy reaching the retina is increased. Such lesions have characteristics which differ from those of the classically described thermal retinopathy[5].

The recommended maximum permissible exposure (MPE) for the retina is approximately 3 $J.cm^{-2}$ in visible light. This value is based on the ANSI Z-136 guidelines[13] for laser safety. The MPE is 2 orders of magnitude below the threshold radiant exposure which yields a 50% probability of producing an ophthalmoscopically visible retinal lesion in monkeys[14]. Ham et al.[5] produced ophthalmoscopically visible retinal lesions in a monkey with a laser at 442 nm with an exposure of 3 $J.cm^{-2}$. Sperling[10] produced extensive histologically detectable damage to the retinal pigment epithelium of monkeys with incoherent blue (~ 463 nm) light at an exposure of 0.36 $J.cm^{-2}$. It would appear therefore that the appropriateness of the MPE may be in doubt in the case of exposures with predominantly blue light.

Retinal Hazards of Ophthalmic Instruments

With this recognition of the photochemical retinal hazard has come the realization that ophthalmic instruments may themselves be potential sources of that hazard.

Prolonged exposure to low-intensity visible light has been implicated as an etiologic factor in retinal damage observed in the rat[15], mouse[16], rabbit[17] and monkey[1,9]. Tso et al.[18] have used the indirect ophthalmosocope to produce retinal lesions in the monkey. Robertson and Erickson[19] demonstrated similar effects in the human. Bloome[20] has discussed the increased risks of photic retinopathy associated with the high retinal irradiance levels and repeated exposure to the blue light required for fluorescein angiography.

It is generally agreed that aphakic patients are at far higher risk of photic maculopathy than phakic individuals of the same age since the shortwave filter effect of the aging yellowing crystalline lens has been lost.

Calkins, Hochheimer and D'Anna[21] have made estimates of critical exposure times for the retina with ophthalmoscopes, slit lamps, operating microscopes and overhead surgical lamps. They used integrated retinal irradiances which did not take into

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account the spectral power distribution of the light sources. With indirect ophthalmoscopes they found an average safe time for MPE in a stabilized retinal image to be 42 seconds at design voltage (6.5V). This MPE fell to 23 seconds if the maximum voltage was used. Sliney[22] has calculated retinal irradiances for various ophthalmic instruments to determine MPE, assuming a stable retinal image and a tungsten-halogen light source. These data are shown in Table 1.

It is therefore desirable to remove the UV-A and blue components of the radiation produced by the light source of an ophthalmic instrument. The object of this study was to evaluate how this would affect the diagnostic value of the fundus examination.

Table 1
Critical Exposures to Non Ionising Radiation for Photochemical Lesion

After Calkins et al.[21] and Sliney[22]

Instrument	Retinal Irradiance	MPE(sec)
Direct Ophthalmoscope	25 mW.cm^{-2}	120
Indirect Ophthalmoscope	70	40
Fundus camera (aligning)	25	120
Biomicroscope (medium voltage)	217	13
Operating microscope	1000	13

Assume stable retinal image, halogen source, safe retinal dose limit with visible light of 3 J.cm^{-2}.

A thermal lesion requires a retinal irradiance on the order of 3 W.cm^2 and a total radiant exposure of 6.9 x 10^3 J.cm^{-2} (5). (Ham et al.[5])

Procedure

Subjects for this study were those with selected ophthalmoscopically detectable fundus lesions, detected during routine optometric assessments in the University of Waterloo Optometry Clinic since 1980, under normal controls. Following pupillary dilation with 1 to 3 drops of tropicamide ½%, the fundi were photographed with a Zeiss fundus camera. Colour slide film (Extrachrome 64 and/or Kodachrome 25) was used. Each fundus was photographed in white light (xenon flash). The illumination was modified by inserting Kodak Wratten 8 (light yellow) and 15 (medium yellow) gelatin filters (Figure 1) into the beam path just posterior to the regular filter/aperture wheel[23]. Following exposure to these three types of illumination, the subject was asked to indicate a preference for one or more of the illuminants.

Results and Discussion

Examples of the photographic results are presented in Fig. 2. The normal fundus shown in Figures 2a and b was photographed on Ektachrome 64. The fundus in xenon light filtered by the Wratten 15 (KW15) filter shows no reduction in the details of fundus structures. There is a slight increase in definition of retinal and choroidal vasculature which more than offsets the very subtle loss of nerve fibre layer visibility. The annulus at the periphery of the photograph (2a) which creates a blue sheen is caused by the failure to insert the appropriate aperture cone in the camera back. The KW15 filter reduces this effect and permits an effectively larger field of view.

Figures 2c and d compare the disc of the same eye using Kodachrome 25 with and without a Kodak Wratten 8 (KW8) filter. Once more there is no loss of any disc detail. The peripapillary pigmentation, lamina cribrosa and disc vessels are equally well recorded. For routine ophthalmoscopy it is evident from these figures that the observer has to adapt to a yellowish, rather than a white or greyish, appearance to the cup and an orange, rather than pinkish, appearance to the neural tissue of the disc.

Figures 2e and f are photographs of a disc coloboma on Kodachrome 25 taken in xenon light with and without the KW15 filter. In this instance it is evident that the reduction of blue light reflected from the coloboma permits better visualization of the adjacent structures.

Observation of the fundi of subjects with nuclear sclerosis of the crystalline lens was facilitated by the introduction of either yellow filter. Although the subjects appeared to experience little reduction in after-image duration, their subjective responses tended to favour the use of the KW15 filter. This may be due in part to the overall reduction in retinal illuminance at the same flash settings.

The use of restricted spectrum illumination for fundus examination has been discussed since the invention of the ophthalmoscope. The literature has been reviewed in detail by Cullen[24], who also described monochromatic ophthalmoscopic examination[23,25]. He found that short wavelength light is reflected by the superficial retinal structures and the vitreoretinal interface. Longer wavelengths penetrate the retina to a greater degree; radiation of wavelengths longer than 585 nm may penetrate to the sclera in those eyes with minimal melanin in the choroid. Since shortwave light is also scattered to a greater extent by the ocular media, blue light, with the exception of a few isolated conditions, is of limited diagnostic value. Similar conclusions were drawn by Delori et al[26] and by Ducrey et al.[27].

The light source in almost any type of ophthalmoscope, slit lamp or fundus camera is one of three types; tungsten lamp, quartz-halogen tungsten lamp, or xenon flash tube. The first two are incandescent, and differ in the filler gas and composition of the envelope. The relative spectral outputs for these sources are shown in Figure 3.

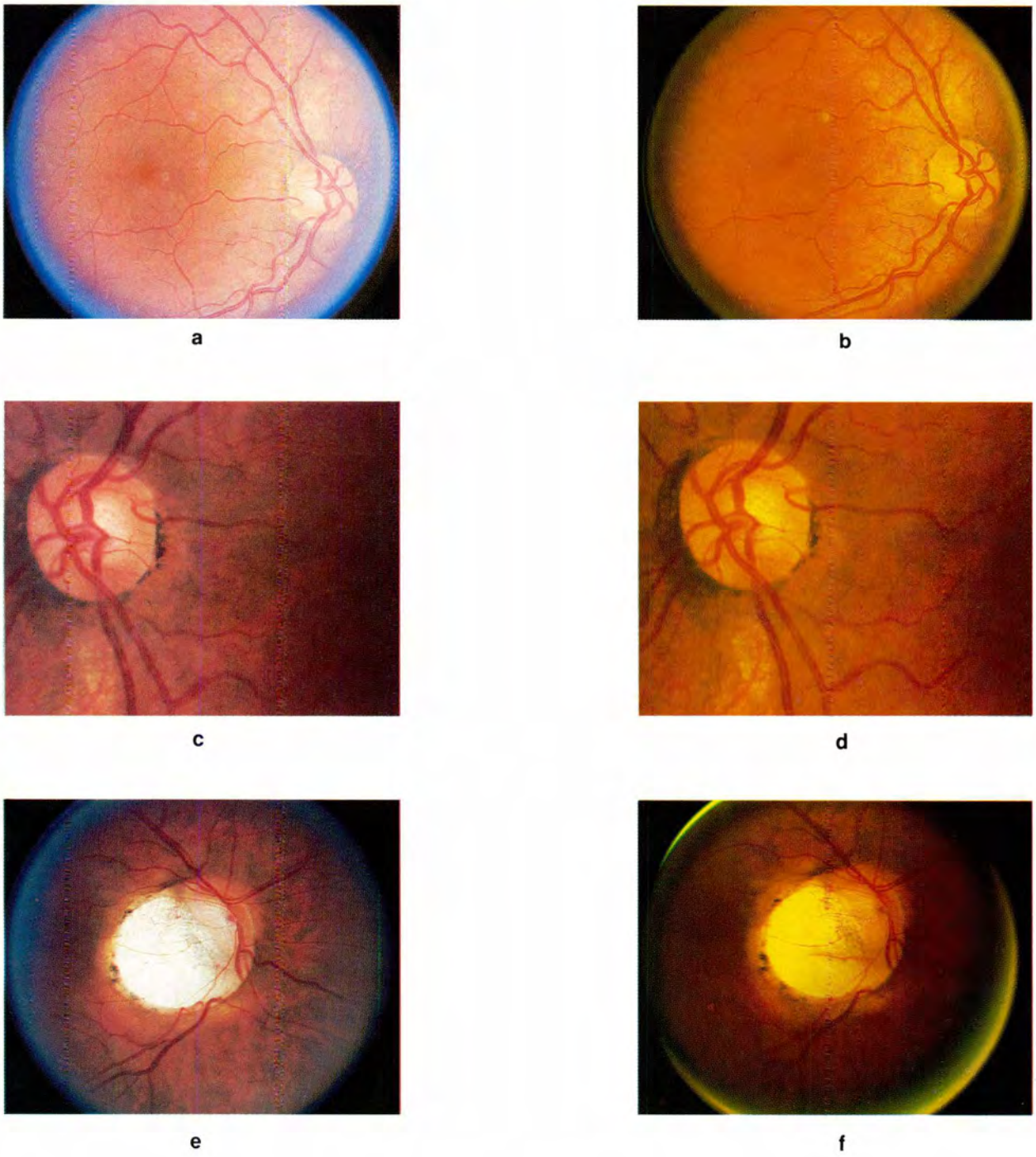

Fig. 2

a. Normal left fundus photographed in xenon light with Ektachrome 64 film.
b. Same fundus photographed with KW15 filtered xenon light on Ektachrome 64.
c. Magnified view of same optic disc in xenon light photographed on Kodachrome 25.
d. Same view as c but with light filtered by KW8 gelatine filter.
e. Disc coloboma photographed in xenon light on Kodachrome 25.
f. Disc coloboma photographed with xenon light filtered by KW15 on Kodachrome 25.

Increasing the operating voltage of a given lamp increases the overall radiance as well as the colour temperature which shifts the peak of the spectral distribution to shorter wavelengths.

The quartz-halogen lamp has been favoured recently as the light source for ophthalmic instruments because it is designed to retard lamp blackening. This results in a longer useful service life than its tungsten counterpart which soon shows a drop in light output as the tungsten is deposited on the glass envelope. Quartz-halogen lamps operate at a higher temperature for a given voltage than tungsten lamps, which results in a higher colour temperature (as advertised by the manufacturers), due to the higher shortwave (blue) contribution to the spectral power distribution. Ham et al.[6] found that for extended exposures (1000 seconds) the threshold radiant exposure in monochromatic blue (441.6 nm) light for an ophthalmoscopically visible lesion was three orders of magnitude lower than that in the near infrared (1064 nm): 30 $J.cm^{-2}$ and 24000 $J.cm^{-2}$ respectively. At short exposures (up to 10 seconds) the threshold at 441.6 nm was 0.91 $J.cm^{-2}$, while between 514.5 and 1064 nm it ranged from 14.5 to 56.1 $J.cm^{-2}$. The variation of threshold exposure with time indicated the *cumulative* nature of the photochemical mechanism at low irradiance level and extended exposure times. Similar results were found with broad band radiation from a solar spectrum simulator[5] and with other radiation sources[12]. Mild photochemical lesions are reversible while thermal damage is irreversible. Given the increasing body of evidence linking blue light to photochemical retinopathy, quartz-halogen bulbs, if used unfiltered in prolonged and/or repeated fundus examination, may provide a potential retinal hazard.

In addition to the aphakic patient, there are others who may be at higher risk of retinal damage. These are individuals who are receiving systemic photosensitising or phototoxic drugs, or drugs which may have a photoallergenic effect. Such drugs include chloroquine derivatives, psoralen type drugs, fluorouracil, sulfonamides, sulfonylureas, chlorthiazides, phenothiazines, tetracyclines, griseofulvin, estrogen, and progesterone[28].

Blue light does have a diagnostic value, however. Because it is best reflected from the vitreoretinal interface and the superficial nerve fibre layer, blue light emphasizes retinal edema, minor vitreoretinal disturbances and separations, cotton wool spots, vitreous haze, preretinal membranes, nerve fibre atrophy, retinal folds and traction lines[25].

Conclusions

While halogen sources offer some distinct advantages over tungsten filament lamps for evaluation of external structures, ocular media and internal vitreoretinal changes, the blue-rich illumination may be a disadvantage for routine ophthalmoscopy for the following reasons.

(1) Its diagnostic value is limited due to the reduction of visibility of deeper fundus structures.
(2) Patient comfort is decreased.
(3) For high-power instruments (e.g. some indirect ophthalmoscopes, slit lamps, etc.) a photochemical hazard may exist during prolonged or frequently repeated procedures, based on current research data.

We recommend that for routine and prolonged fundus examination, especially with binocular indirect ophthalmoscopes, alignment and focussing of fundus cameras and extensive retinal photography, a yellow filter with a short wavelength cutoff between 450 and 500nm should be used to eliminate the blue light hazard from these clinical procedures.

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Concluded on p. 167

Ophthalmic Preparations of Interest to Optometrists

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Editor's Note:

This paper is essentially a tabulated listing of nearly 200 ophthalmic preparations. It is too lengthy to publish in one issue of the CJO, so it will be presented in parts. The subject is tabulated in the following sections:

- **Tear Supplements and Substitutes, Comfort Solutions.**
- **Vasoconstrictors, Decongestants, Astringents and Antihistamines.**
- **Topical Antibiotic, or other Antibacterial Preparations.**
- **Mydriatics / Cycloplaegics or both.**
- **Ophthalmic Ointments.**
- **Enzymatic Cleaners, Proteases and Lipases.**
- **Thermal Disinfection and Rinsing of Soft Lenses, Storage Solutions.**
- **Chemical Cleaning and Disinfecting Solutions or Systems for Soft Lenses.**
- **Solutions Designed for Use With Hard Lenses.**
- **Solutions Designed for Use With Hard Gas-Permeable Lenses.**
- **Diagnostic Aids.**
- **Ocular Lubricants, Eyewashes, Irrigating Solutions, Cushioning Solutions or Ointments.**
- **Topical Anaesthetics.**
- **Hypertonic Solutions or Ointments.**
- **Drugs to Treat Glaucoma.**

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Readers will also note that some preparations will appear under more than one of the above descriptive headings.

9. Chemical Cleaning and Disinfecting Solutions or Systems for Soft Lenses.

Product (Manufacturer or Distributor)	Viscosity Agent	Vasoconstrictor	Preservative	Buffer	Purpose or Other Ingredients
B-H Soft Lens Storage & Rinsing Solution (Barnes-Hind)			chlorhexidine gluconate 0.003%, thimerosal 0.002%, disodium edetate 0.1%	boric acid	Chemical disinfection, rinsing and storage of soft lenses. Conditioning agents and sodium chloride.
B & L Soflens Soaking Solution (Bausch & Lomb)			alkyltriethanol ammonium chloride 0.03%, thimerosal 0.002%,		Chemical disinfection and soaking of soft lenses.
Flex-Care (Alcon)			thimerosal 0.001%, disodium edetate 0.1%, chlorhexidine gluconate 0.005%	boric acid, sodium borate, phosphate buffer	Chemical disinfecting solution used for rinsing and storing soft contact lenses. Sodium chloride. Isotonic. Tonicity about 289 mOsm.
Flexsol (Alcon)	povidone, polyoxyethylene glycol (Adsorbobase)		chlorhexidine digluconate 0.005%, disodium edetate 0.1%, thimerosal 0.001%	boric acid, sodium borate, phosphate buffer	Storing, chemical disinfecting and conditioning solution for soft contact lenses. Water soluble polymers and sodium chloride. Isotonic.
Hydrosoak (Trans-Canada Contact Lens)			thimerosal 0.0025%, disodium edetate 0.1%, chlorhexidine gluconate 0.0025%		For storing and chemical disinfection of soft contact lenses. Isotonic.

Product (Manufacturer or Distributor)	Viscosity Agent	Vasoconstrictor	Preservative	Buffer	Purpose or Other Ingredients
Lensan A (Corneal Lens Supplies Ltd.)			hydrogen peroxide 3%		Chemical disinfection and cleaning of soft lenses and silicone lenses. pH 5.5.
Lensan B (Corneal Lens Supplies Ltd.)			thimerosal 0.001%, disodium edetate 0.1%		Biocatalyst solution to neutralize hydrogen peroxide and to rinse soft lenses. Sodium chloride 0.85%. pH 7.4.
Lensan C (Corneal Lens Supplies Ltd.)			none. (in a pressurized container)		Biocatalyst to hasten neutralization of hydrogen peroxide in a contact lens disinfecting system.
Lensept (AOCO) (Softcon)					For disinfecting soft lenses chemically. Contains hydrogen peroxide 3% and purified water.
Mira-Soak (CooperVision)			thimerosal 0.001%, chlorhexidine gluconate 0.005%, disodium edetate 0.1%	sodium borate	Chemical disinfecting solution for soft lenses. Sodium chloride 0.28%, water, Poloxamer 407 0.1% (Pluronic), and potassium chloride.
Pliacide (CooperVision)	polyvinyl alcohol		iodine 0.1%, potassium iodide 0.02%	boric acid 0.5%	For chemical disinfection for soft lenses. Used with Nutra-Flow.
Soft Mate Hydrogen Peroxide Disinfectant Solution (Barnes-Hind)					Chemical disinfection of soft lenses. Hydrogen peroxide 3%.
Unicare All-in-One Solution (ICN)			thimerosal 0.0015%, disodium edetate 0.15%	sodium borate 0.2%, boric acid 1.0%	Cleaning, chemical disinfection and rinsing soft lenses. Pluronic F-127, 0.4%, sodium chloride 0.3%. pH 7.2.

10. Solutions Designed for Use With Hard Lenses.

Product (Manufacturer or Distributor)	Viscosity Agent	Vasoconstrictor	Preservative	Buffer	Purpose or Other Ingredients
B-H Cleaning and Soaking Solution (Barnes-Hind)			benzalkonium chloride 0.01%, disodium edetate 0.2%	buffers, boric acid	Cleaning and soaking solution for hard lenses. Nonionic surfactant; potassium chloride. pH 8.5.
B-H Hard Lens Comfort Drops (Barnes-Hind)	hydroxyethylcellulose		benzalkonium chloride 0.005%, disodium edetate 0.02%	sodium phosphate monobasic and dibasic	Hard lens comfort solution. Nonionic surfactants. Isotonic. pH 8.0.
B-H Soft Wetting Solution (Barnes-Hind)	hydroxyethylcellulose, polyvinyl alcohol 2%		benzalkonium chloride 0.004%, disodium edetate 0.02%		Wetting solution for hard lenses. Sodium chloride. Isotonic. pH about 6.2.
B & L Lens Lubricant (Bausch & Lomb)	povidone 1.67%, polyethylene glycol, (Adsorbobase)		thimerosal 0.004%, disodium edetate 0.1%	phosphate	Lubricant for hard and soft lenses. Comfort solution.
Boston Lens Cleaner (Polymer Tech Corp)					Cleaning rigid gas-permeable and other hard lenses. Anionic, sulfate surfactant, sodium chloride.
Boston Lens Conditioner (Polymer Tech Corp)			chlorhexidine gluconate 0.006%, disodium edetate 0.05%		Wetting and soaking solution for rigid gas-permeable and hard lenses.
Clean-N-Soak Cleaning and Soaking Solution (Allergan)			phenylmercuric nitrate 1/25000 (=0.004%), disodium edetate	phosphate	Chemical disinfection, cleaning and soaking of hard lenses. Cleaning agents, Miranol detergent and hydrochloric acid. Sodium hydroxide, and sodium chloride.
Clens (Alcon)			benzalkonium chloride 0.02%, disodium edetate 0.1%	phosphate	Daily cleaning solution for hard lenses. Polyoxane derivatives Pluronic, F-108 a nonionic surfactant.
Clerz 2 Lubricating and Rewetting Eye Drops (CooperVision)	hydroxyethylcellulose 0.4%		disodium edetate 0.1%, sorbic acid 0.1%	boric acid, sodium borate 0.22%	Hard and soft contact lens rewetting, comfort, and conditioner solution. Poloxamer 407 1%, sodium chloride 0.1% and potassium chloride 0.3%. Isotonic.

Product (Manufacturer or Distributor)	Viscosity Agent	Vasoconstrictor	Preservative	Buffer	Purpose or Other Ingredients
Dual Clean (Sterile) (Sherman Labs)			thimerosal 0.004%, disodium edetate 0.1%		Cleaning and storage solution for hard lenses. Contains nonionic surfactants.
Gel-Clean (Barnes-Hind)			thimerosal 0.004%	sodium hydroxide	Daily cleaning of hard lenses. Nonionic surfactant Neutronyx; thixotropic gel. pH 7.0.
Hydrocare Lenswet (Allergan)	polyvinyl alcohol 3.0%, (Liquifilm)		thimerosal 0.002%, disodium edetate 0.01%	sodium phosphate	Rewetting, comfort and conditioner solution for soft, hard and gas-permeable lenses.
Hypotears (CooperVision)	polyvinyl alcohol, polyethylene glycol, (Lipiden polymeric system)		benzalkonium chloride 0.01%, disodium edetate 0.03%		Ocular lubricant, artificial tears. Not for use with soft lenses. Dextrose. Hypotonic. pH about 5.5 Osmolality about 220 mOsm/L.
LC-65 Daily Contact Lens Cleaner (Allergan)	polysorbate 80		thimerosal 1:100,000 =(0.001%), disodium edetate 0.1%	sodium phosphate	Daily cleaner for hard, hydrogel and hard gas-permeable contact lenses. Amphoteric nonionic surfactant, (Miranol), stabilizers and sodium chloride.
Lensine-5 (CooperVision)	hydroxyethylcellulose 0.4%, polyvinyl alcohol 0.25%, polyethylene glycol 8000 0.25%		benzalkonium chloride 0.01%, disodium edetate 0.05%	sodium chloride, potassium chloride	Multipurpose cleaning, storing and wetting solution for hard and hard gas-permeable lenses. Poloxamer 407. pH 8.2.
Liquifilm Wetting Solution (Allergan)	hydroxypropyl-methylcellulose 0.35%, polyvinyl alcohol 2.0%		benzalkonium chloride 0.004%, disodium edetate 0.2%	none	For wetting hard lenses. Contains sodium chloride and potassium chloride. Hypotonic; pH about 5.2.
One Solution (Barnes-Hind)	hydroxyethylcellulose, polyvinyl alcohol		benzalkonium chloride 0.01%, disodium edetate 0.1%	sodium phosphate monobasic and dibasic	Hard contact lens wetting, soaking and cleaning solution. Contains wetting agents and nonionic surfactant. Isotonic. pH 7.0.
Polyclens (Alcon)	hydroxyethylcellulose, oxyethylene, octyphenol		thimerosal 0.004%, disodium edetate 0.1%	borate buffer, sodium chloride, sodium hydroxide	Daily cleaning of soft, hard and gas-permeable lenses. Surfactants, Tween 21 and microscopic polymeric beads designed to remove protein and lipids.
Pre-Sert (Allergan)	polyvinyl alcohol 3%		benzalkonium chloride 0.004%, disodium edetate 0.02%		Wetting and cushioning solution for use with hard contact lenses.
Soaclens (Alcon)	polyvinyl alcohol, hydroxyethylcellulose		thimerosal 0.004%, disodium edetate 0.1%	phosphate	Chemical disinfection, soaking and wetting hard lenses and hard gas-permeable lenses. Surfactant. Isotonic. pH about 7.0.
Soakare Solution (Allergan)			benzalkonium chloride 0.01%, disodium edetate 0.25%	boric acid, sodium hydroxide	Soaking and disinfecting solution for hard lenses.
Soquette (Barnes-Hind)	polyvinyl alcohol		benzalkonium chloride 0.01%, disodium edetate 0.2%	sodium phosphate monobasic and dibasic	Hard contact lense storage and soaking solution. pH 7.4.
Titan (Barnes-Hind)	hydroxyethylcellulose, polyoxyethylene glycol		benzalkonium chloride 0.002%, disodium edetate 2%	trisamino	Cleaning hard contact lenses daily. Nonionic surfactant, Pluronic.
Total (Allergan)	polyvinyl alcohol 2.5%, hydroxypropyl methylcellulose 0.2%, polysorbate 80		benzalkonium chloride 0.004%, disodium edetate 0.02%	sodium phosphate	All purpose solution for hard and gas-permeable lenses. Contains dextrose, potassium chloride, sodium chloride, sodium hexametaphosphate and hydrochloric acid or sodium hydroxide to adjust pH. Isotonic.
Transol (Smith & Nephew)	polyvinyl alcohol 2%, hydroxyethylcellulose 0.54%		benzalkonium chloride 0.004%, disodium edetate 0.02%	sodium hydroxide 0.003%	Wetting hard lenses. Contains sodium chloride 0.9%, rhodamine 0.0001% and purified water.

11. Solutions Designed for Use With Hard Gas-Permeable Lenses

Product (Manufacturer or Distributor)	Viscosity Agent	Vasoconstrictor	Preservative	Buffer	Purpose or Other Ingredients
All Purpose Sterile Solution (Bausch & Lomb)			benzalkonium chloride 0.017%, disodium edetate 0.17%		Used to disinfect, clean and hydrate hard gas-permeable lenses.

Product (Manufacturer or Distributor)	Viscosity Agent	Vasoconstrictor	Preservative	Buffer	Purpose or Other Ingredients
B-H Cleaning Solution for Gas-Permeable Hard Contact Lenses (Barnes-Hind)	hydroxyethylcellulose		thimerosal 0.004%, disodium edetate 2%	trisamino	For cleaning rigid gas-permeable lenses. Nonionic surfactant.
B-H Wetting & Soaking Solution for Gas-Permeable Hard Contact Lenses (Barnes-Hind)	hydroxyethylcellulose, polyvinyl alcohol, povidone		thimerosal 0.002%, chlorhexidine gluconate 0.003%, disodium edetate 0.02%	sodium phosphate monobasic and dibasic	Wetting and soaking solution for gas-permeable lenses. Nonionic surfactant. Isotonic. pH 7.0.
B & L Concentrated Cleaner for Gas-Permeable Hard Lenses (Bausch & Lomb)	hydroxyethylcellulose, polyvinyl alcohol		benzalkonium chloride 0.02%, disodium edetate 0.1%	phosphate	For cleaning gas-permeable hard lenses. Sodium chloride, Tyloxapol. Isotonic.
Boston Lens Cleaner (Polymer Tech Corp)					Cleaning rigid gas-permeable and other hard lenses. Anionic, sulfate surfactant, sodium chloride.
Boston Lens Conditioner (Polymer Tech Corp)			chlorhexidine gluconate 0.006%, disodium edetate 0.05%		Wetting and soaking solution for rigid gas-permeable and hard lenses.
Duracare Storing and Wetting Solution (Allergan)	polyvinyl alcohol (Liquifilm)		benzalkonium chloride 0.004%, disodium edetate		For storing and wetting gas-permeable contact lenses
Hydrocare Lenswet (Allergan)	polyvinyl alcohol 3.0%, (Liquifilm)		thimerosal 0.002%, disodium edetate 0.01%	sodium phosphate	Rewetting, comfort and conditioner solution for soft, hard and gas-permeable lenses.
Hydrocare Protein Remover Tablets (Allergan)	polyethylene glycol				For weekly cleaning of soft and hard gas-permeable lenses. Protein remover, papain, Prolase 300.
LC-65 Daily Contact Lens Cleaner (Allergan)	polysorbate 80		thimerosal 1:100,000 =(0.001%), disodium edetate 0.1%	sodium phosphate	Daily cleaner for hard, hydrogel and hard gas-permeable contact lenses. Amphoteric nonionic surfactant, (Miranol), stabilizers and sodium chloride.
Lensine-5 (CooperVision)	hydroxyethylcellulose 0.4%, polyvinyl alcohol 0.25%, polyethylene glycol 8000 0.25%		benzalkonium chloride 0.01%, disodium edetate 0.05%	sodium chloride, potassium chloride	Multipurpose cleaning, storing and wetting solution for hard and hard gas-permeable lenses. Poloxamer 407. pH 8.2.
O_2Care Granules (N & N)	viscosity builders		2-bromo-2-nitro 1,3-propanediol 0.001%, disodium edetate 0.02%	buffers	For cleaning and soaking hard gas-permeable lenses. Isotonic.
Oxycare (Trans-Canada)					Weekly cleaner for soft lenses and for hard gas-permeable lenses. Contains sodium percarbonate, no enzymes.
Polyclens (Alcon)	hydroxyethylcellulose, oxyethylene, octyphenol		thimerosal 0.004%, disodium edetate 0.1%	borate buffer, sodium chloride, sodium hydroxide	Daily cleaning of soft, hard and gas-permeable lenses. Surfactants, Tween 21 and microscopic polymeric beads designed to remove protein and lipids.
Soacleans (Alcon)	polyvinyl alcohol, hydroxyethylcellulose		thimerosal 0.004%, disodium edetate 0.1%	phosphate	Chemical disinfection, soaking and wetting hard lenses and hard gas-permeable lenses. Surfactant. Isotonic. pH about 7.0.
Total (Allergan)	polyvinyl alcohol 2.5%, hydroxypropyl methylcellulose 0.2%, polysorbate 80		benzalkonium chloride 0.004%, disodium edetate 0.02%	sodium phosphate	All purpose solution for hard and gas-permeable lenses. Contains dextrose, potassium chloride, sodium chloride, sodium hexametaphosphate and hydrochloric acid or sodium hydroxide to adjust pH. Isotonic.

12. Diagnostic Aids

Product (Manufacturer or Distributor)	Viscosity Agent	Vasoconstrictor	Preservative	Buffer	Purpose or Other Ingredients
Fluoresoft (Union Optics Canada)					Diagnostic agent. High molecular weight fluorescein 0.35% in isotonic saline.

Product (Manufacturer or Distributor)	Viscosity Agent	Vasoconstrictor	Preservative	Buffer	Purpose or Other Ingredients
Fluor-I-Strip A.T (Ayerst)	polysorbate 80		chlorobutanol 0.5%	buffers	Diagnostic agent. Fluorescein sodium 1 mg. Not considered to be an O-T-C product.
Fluress (Barnes-Hind)	povidone		chlorobutanol 1.0%	boric acid	Diagnostic agent. Contains sodium fluorescein 0.25% and benoxinate HCl 0.4%. pH about 5. Isotonic.
Ful-Glo (Barnes-Hind)					Diagnostic aid. Sodium fluorescein USP 600 ug in each strip.
Isopto Carpine (Alcon)	hydroxypropyl methylcellulose 0.5%		benzalkonium chloride 0.01%	boric acid	Cholinergic miotic. Contains pilocarpine HCl 0.5%, 1%, 2%, 3%, 4%, or 6%, sodium citrate and sodium chloride.
Miocarpine (CooperVision)	methylcellulose 0.33%		benzalkonium chloride 0.01%, disodium edetate 0.1%	buffers	Cholinergic miotic. Pilocarpine HCl 0.5%, 1%, 2%, 3%, 4%, or 6%. Boric acid, potassium chloride and sodium carbonate. Prescription may be required.
Mydplegic (CooperVision)			benzalkonium chloride 0.01%, disodium edetate	boric acid, sodium carbonate	Anticholinergic cycloplegic and mydriatic. Cyclopentolate HCl 1% and potassium chloride.
Mydriacyl (Alcon)			benzalkonium chloride 0.01%, disodium edetate 0.01%	buffers	Anticholinergic mydriatic and cycloplegic. Contains tropicamide 0.5%, or 1% and sodium chloride. Isotonic.
Neo-Synephrine (Sterling Products)		phenylephrine HCl 2.5%	benzalkonium chloride 0.01%	sodium phosphate	Sympathomimetic ocular decongestant, and mydriatic. Sodium chloride.
Ophthaine (Squibb)	glycerin 2.45%		chlorobutanol 0.2%, benzalkonium chloride 0.01%		Topical anesthetic. Contains proparacaine HCl 0.5% and butanol. Sodium hydroxide or hydrochloric acid to adjust the pH.
Ophthetic (Allergan)	glycerin 2.45%		benzalkonium chloride 0.01%		Topical anesthetic. Contains proparacine HCl 0.5%, sodium chloride 0.194% and purified water.
Pontocaine (Winthrop)			chlorobutanol 0.4%		Topical anesthetic. Tetracaine HCl 0.5% and sodium chloride. Also available as a 0.5% ointment.
Rose Bengal (Smith & Nephew)			none		Diagnostic dye in 0.3 ml unit doses called minims. Rose bengal 1%.
Rose Bengal Strips (Barnes-Hind)					Diagnostic dye. Sterile strips contain rose bengal, 1.3 mg per strip.

13. Ocular Lubricants, Eyewashes, Irrigating Solutions, Cushioning Solutions or Ointments

Product (Manufacturer or Distributor)	Viscosity Agent	Vasoconstrictor	Preservative	Buffer	Purpose or Other Ingredients
Adapettes (Alcon)	povidone, hydroxyethylcellulose, polyoxyethylene glycol (Adsorbobase)		thimerosal 0.004% disodium edetate 0.1%	phosphate	Lubricating and rewetting solution for use with all contact lenses. Used for mucin deficiency. Isotonic.
Adapt (Alcon)	povidone, hydroxyethylcellulose, polyoxyethylene glycol (Adsorbobase)		thimerosal 0.004%, disodium edetate 0.1%	phosphate	Cushioning solution for hard and hard gas-permeable contact lenses; also used as an artificial tear for eyes with aqueous deficiency. Isotonic.
B-H Soft Lens Comfort Drops (Barnes-Hind)	hydroxyethylcellulose, polyethylene glycol		thimerosal 0.004%, disodium edetate 0.1%	sodium borate, boric acid, potassium phosphate	Rewetting, lubricating soft lenses. Nonionic surfactant. Isotonic. pH 8.0.
B & L Lens Lubricant (Bausch & Lomb)	povidone 1.67%, polyethylene glycol, (Adsorbobase)		thimerosal 0.004%, disodium edetate 0.1%	phosphate	Lubricant for hard and soft lenses. Comfort solution.

Product (Manufacturer or Distributor)	Viscosity Agent	Vasoconstrictor	Preservative	Buffer	Purpose or Other Ingredients
Borwas (Hilarys)				boric acid 1%, sodium borate 0.2%	Eyewash.
B.S.S., Balanced Salt Solution (Alcon)			none	sodium acetate, 0.39%, sodium citrate 0.17%	Ocular irrigation. Sodium chloride 0.49%, potassium chloride 0.075%, magnesium chloride 0.03% and calcium chloride 0.048% mOsm 270.
Duolube (Herdt & Charton)			none		Ocular lubricant. Non-medicated ointment containing white and liquid petrolatum.
Duratears (Alcon)			methylparaben 0.05%, propylparaben 0.01%		Ocular lubricant. Containing white petrolatum 94%, anhydrous liquid lanolin and mineral oil 3%
EFA Steri-Opt (Accurate)					Ophthalmic solution. Sodium chloride 0.48%. Isotonic.
Enuclene (Alcon)	hydroxypropyl methylcellulose 0.85%		benzalkonium chloride 0.02%	boric acid, sodium phosphate	Used to clean and lubricate artificial eyes. Tyloxapol 0.25%.
Eye-Stream (Alcon)			benzalkonium chloride 0.013%	sodium acetate 0.39%, sodium citrate 0.17%	Ocular irrigation. Sodium chloride 0.49%, potassium chloride 0.075%, magnesium chloride 0.03%, and calcium chloride 0.048%. Isotonic.
Gonio-Gel (Herdt and Charton)	methylcellulose 2.5% (4000 cps), propylene glycol		methylparaben, propylparaben		Lubricant and optical bond for use with a gonioscopic lens. Sodium chloride, purified water. Index of refraction 1.336.
Hydrosol (Trans-Canada Contact Lens)	polyvinyl alcohol 2%		thimerosal 0.0025%, disodium edetate 0.1%, chlorhexidine gluconate 0.0025%		Soft lens comfort drop.
Hypotears (CooperVision)	polyvinyl alcohol, polyethylene glycol, (Lipiden polymeric system)		benzalkonium chloride 0.01%, disodium edetate 0.03%		Ocular lubricant, artificial tears. Not for use with soft lenses. Dextrose. Hypotonic. pH about 5.5. Osmolality about 220 mOsm/L.
Isopto Tears (Alcon)	hydroxypropyl methylcellulose 0.5% or 1%		benzalkonium chloride 0.01%	phosphate and citrate buffers	Artificial tears, lubricant. Sodium chloride. Duration of action about 60 minutes. Isotonic.
Lacril Artificial Tear (Allergan)	hydroxypropyl methylcellulose 0.5%, gelatin A 0.01%, polysorbate 80		chlorobutanol 0.5%	sodium acetate, sodium citrate, acetic acid, sodium borate	Ocular lubricant, artificial tear. Potassium chloride, sodium chloride, calcium chloride, magnesium chloride, and dextrose; pH 5.82.
Lacri-Lube (Allergan)			chlorobutanol 0.5%		Ocular lubricant ointment. Contains white petrolatum 55%, mineral oil 42.5% and nonionic lanolin derivatives.
Liquifilm Forte (Allergan)	polyvinyl alcohol 3% (Liquifilm)		thimerosal 0.002%, disodium edetate	sodium phosphate	Ocular lubricant, artificial tear. Dextrose. Isotonic. pH 5.4.
Murine Supplemental Tears (Abbott)	hydroxypropyl methylcellulose 0.01%		benzalkonium chloride 0.01%, disodium edetate 0.05%		Eyewash, tear supplement. Isotonic. pH about 7.7.
Murocel (Herdt & Charton)	methylcellulose 4000 cps, 1%		methylparaben 0.023%, propylparaben 0.01%		Ocular lubricant. Purified water, and sodium chloride 0.34%.
Muro Tears (Herdt & Charton)	hydroxypropyl methylcellulose 0.5%		benzalkonium chloride 0.01%, disodium edetate 0.03%	boric acid, sodium borate	Ocular lubricant. Contains sodium chloride, potassium chloride, and dextran 40.
Neo-Tears (Barnes-Hind)	hydroxyethylcellulose, polyvinyl alcohol, polyethylene glycol		thimerosal 0.004%, disodium edetate 0.02%	sodium phosphate monobasic and dibasic	Ocular lubricant, artificial tear. Prolongs BUT. Water soluble polymers, sodium chloride, potassium chloride and carbowax 0.65%. Isotonic. pH about 7.0.
Optrex Eye Lotion (Laurentian)			chlorobutanol 0.02%, Nipasept 0.025%	boric acid 2.0%, borax 0.5%	Eyewash. Contains witch hazel 12.95%, allantoin 0.05%, zinc sulphate 0.004%, and salicylic acid 0.025%.
Optrex Medicated Drops (Laurentian)	glycerin 1%		chlorobutanol 0.06%, Nipasept 0.03%	boric acid 1.08%, sodium borate 0.225%	Eyewash. Contains witch hazel 12.5%, and allantoin 0.08%.

Product (Manufacturer or Distributor)	Viscosity Agent	Vasoconstrictor	Preservative	Buffer	Purpose or Other Ingredients
Pre-Sert (Allergan)	polyvinyl alcohol 3%		benzalkonium chloride 0.004%, disodium edetate 0.02%		Wetting and cushioning solution for use with hard contact lenses.
Soft Mate PS Comfort Drops (Barnes-Hind)			potassium sorbate 0.13%, disodium edetate 0.1%	boric acid, sodium borate	Comfort drops for soft lenses, rewetting and lubrication. Nonionic surfactant. Hypotonic.

14. Topical Anesthetics

Product (Manufacturer or Distributor)	Viscosity Agent	Vasoconstrictor	Preservative	Buffer	Purpose or Other Ingredients
Alcaine (Alcon)	glycerin		benzalkonium chloride 0.01%		Topical anesthetic. Proparacaine HCl 0.5%. Hydrochloric acid or sodium hydroxide to adjust pH.
Ophthaine (Squibb)	glycerin 2.45%		chlorobutanol 0.2%, benzalkonium chloride 0.01%		Topical anesthetic. Contains proparacaine HCl 0.5% and butanol. Sodium hydroxide or hydrochloric acid to adjust the pH.
Ophthetic (Allergan)	glycerin 2.45%		benzalkonium chloride 0.01%		Topical anesthetic. Contains proparacine HCl 0.5%, sodium chloride 0.194% and purified water.
Pontocaine (Winthrop)			chlorobutanol 0.4%		Topical anesthetic. Tetracaine HCl 0.5% and sodium chloride. Also available as a 0.5% ointment.

15. Hypertonic Solutions or Ointments

Product (Manufacturer or Distributor)	Viscosity Agent	Vasoconstrictor	Preservative	Buffer	Purpose or Other Ingredients
Adsorbonac (Alcon)	povidone, hydroxyethylcellulose, polyoxyethylene glycol (Adsorbobase)		thimerosal 0.004%, disodium edetate 0.1%	phosphate	Hypertonic solution. Will decrease corneal edema. Sodium chloride 2% or 5%.
Muro 128 (Herdt & Charton)	hydroxypropyl methylcellulose, propylene glycol		methylparaben 0.023%, propylparaben 0.01%		Relieves corneal edema. Both a hypertonic solution and an ointment are available. Both contain sodium chloride 5%.

16. Drugs to Treat Glaucoma

Product (Manufacturer or Distributor)	Viscosity Agent	Vasoconstrictor	Preservative	Buffer	Purpose or Other Ingredients
E-Pilo (CooperVision)			benzalkonium chloride 0.01%, disodium edetate 0.01%	mono and dibasic sodium phosphate	Combination drug used for glaucoma therapy. L-epinephrine bitartrate 1%, pilocarpine HCl 1%, 2%, 3%, 4%, or 6%, mannitol 5% and sodium bisulfite. Prescription may be required.
Epinal (Alcon)			benzalkonium chloride 0.01%	boric acid	Sympathomimetic mydriatic used for glaucoma therapy. L-epinephrine as the borate 1%, acetylcysteine and ascorbic acid. Prescription may be required.

Product (Manufacturer or Distributor)	Viscosity Agent	Vasoconstrictor	Preservative	Buffer	Purpose or Other Ingredients
Epitrate (Ayerst)	polyoxypropylene-polyoxyethylene-diol		chlorobutanol 0.55%, disodium edetate		Sympathomimetic mydriatic used for glaucoma therapy. L-epinephrine bitartrate 2%, sodium metabisulfite and sodium chloride. Prescription may be required.
Eppy-N½% or N1% (Barnes-Hind)	polyoxyl 40 stearate, povidone		benzalkonium chloride 0.01%	boric acid	Sympathomimetic mydriatic used for glaucoma therapy. Contains, epinephryl borate USP 0.5% or 1%, and erythorbic acid. Prescription may be required. pH 7.4.
Glaucon (Alcon)			benzalkonium chloride 0.01%		Sympathomimetic mydriatic mostly used for glaucoma therapy. Contains epinephrine HCl 1% or 2% and sodium metabisulfite. Prescription may be required.
Isopto Carbachol (Alcon)	hydroxypropyl methylcellulose 1%		benzalkonium chloride 0.005%	borate	Cholinergic miotic. Contains carbachol 1.5% or 3% and sodium chloride. Isotonic.
Isopto Carpine (Alcon)	hydroxypropyl methylcellulose 0.5%		benzalkonium chloride 0.01%	boric acid	Cholinergic miotic. Contains pilocarpine HCl 0.05%, 1%, 2%, 3%, 4%, or 6%, sodium citrate and sodium chloride.
Miocarpine (CooperVision)	methylcellulose 0.33%		benzalkonium chloride 0.01%, disodium edetate 0.1%	buffers	Cholinergic miotic. Pilocarpine HCl 0.5%, 1%, 2%, 3%, 4%, or 6%. Boric acid, potassium chloride and sodium carbonate. Prescription may be required.
Miostat (Alcon)			none	citrate/acetate	Cholinergic miotic. Contains carbachol 0.01% and sodium, potassium, calcium and magnesium chlorides. Prescription may be required.
Ocusert Pilo-20 Ocusert Pilo-40 (Alza) (Ciba-Geigy)					Cholinergic used for glaucoma therapy. The pilocarpine is bound to alginic acid. P-20 releases pilocarpine at rate of 20 ug/hr for a week. P-40 releases 40 ug/hr for a week.
Propine (Allergan)			benzalkonium chloride 0.004%, disodium edetate		Sympathomimetic used for glaucoma therapy. Dipivefrin HCl 0.01%, sodium chloride, mannitol, sodium metabisulfite and hydrochloric acid to adjust pH. Sterile, isotonic solution. Prescription may be required.
P.V. Carpine Liquifilm (Allergan)	polyvinyl alcohol 1.4%		chlorobutanol 0.5%	sodium acetate, citric acid	Cholinergic mostly used for glaucoma therapy. Pilocarpine nitrate 1%, 2%, or 4%, sodium chloride, menthol, camphor, phenol and eucalyptol. Prescription may be required.
Timoptic (Merck, Sharp, Dohme)			benzalkonium chloride 0.01%	monobasic and dibasic sodium phosphate	Beta blocker used for glaucoma therapy. Timolol maleate 0.25% or 0.50% and sodium hydroxide. Prescription may be required.

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TABLE I

SOFT LENS CHEMICAL DISINFECTION SYSTEMS

	System	Lubricants	Clean (daily)	Clean (weekly)	Rinse	Disinfect	Soak, store
Alcon	1. 3-solution system	Adapettes	Preflex	Clean-O-Gel	Normol	Flexsol	Flexsol
	2. 2-solution system	Adapettes	Polyclens	Clean-O-Gel	Flexcare	Flexcare	Flexcare
Allergan	Hydrocare System	Hydrocare Lenswet	LC-65 Daily Contact Lens Cleaner	Hydrocare Protein Remover Tablet	Hydrocare Preserved Saline Solution	Hydrocare Cleaning/Disinfecting Solution	Hydrocare Cleaning/Disinfecting Solution
Barnes-Hind	1. Cold system	B-H Soft Lens Comfort Drops	B-H Soft Lens Cleaning Solution	B-H Soft Lens Weekly Cleaner	B-H Storage & Rinsing Solution	B-H Storage & Rinsing Solution	B-H Storage & Rinsing Solution
	2. PS System	Soft Mate PS Comfort Drops	Soft Mate PS Daily Cleaning Solution		Soft Mate PS Saline	Soft Mate Hydrogen Peroxide Disinfectant Solution	Soft Mate PS Saline
Bausch & Lomb	B & L Soflens Care System	B & L Lens Lubricant	B & L Daily Cleaner	B & L Soflens Cleaning Tablets	B & L Saline no Thimerosal Solution	B & L Soflens Soaking Solution	B & L Soflens Soaking Solution
Contactasol, Kelvin, Trans Canada	Contactasol Care System	Hydrosol	Hydroclean		Hydrosoak	Hydrosoak	Hydrosoak
CooperVision	1. I-Septic System	Clerz	Pliagel		Nutraflow	Pliacide	Nutraflow
	2. Miracare System	Clerz	MiraFlow		Pliasol	MiraSoak	MiraSoak
Corneal Lens Supplies Ltd.	Lensan				Lensan B or Lensan C	Lensan A	
ICN	Unicare System		Unicare		Unicare	Unicare	Unicare
Softcon Products	Septicon System		Softcon Lens Cleaner Solution		Lensrins	Lensept	After rapid disinfection in hydrogen peroxide lenses are stored in Lensrins.
Union Optics	Bilosa System		Bilo-Clean		Bilo-Saline	Bilo-Clean	Bilo-Saline

TABLE II

THERMAL DISINFECTION SYSTEM FOR SOFT LENSES (if less than 50% water content)

	Lubricants	Clean (daily)	Clean (weekly)	Rinse	Thermal Disinfection	Soak, Store
Alcon (Alcon Disinfection System)	Adapettes	Preflex or Polyclens	Clean-O-Gel	Boil-N-Soak or Alcon Preserved Saline	Boil-N-Soak or Alcon Preserved Saline	Boil-N-Soak or Alcon Preserved Saline
Allergan (Hydrocare Disinfection System)	Lenswet	LC 65	Hydrocare Protein Remover Tablets	Hydrocare Special Saline Solution or Hydrocare Preserved Saline or Sorbisal	Hydrocare Special Saline Solution or Hydrocare Preserved Saline or Sorbisal	Hydrocare Special Saline Solution or Hydrocare Preserved Saline or Sorbisal
Barnes-Hind (B-H Thermal Disinfection System)	B-H Soft Lens Comfort Drops	B-H Soft Lens Cleaning Solution	B-H Soft Lens Weekly Cleaning Solution	B-H Soft Lens Buffered Salt Solution or B-H Soft Lens Preserved Saline	B-H Soft Lens Buffered Salt Solution or B-H Soft Lens Preserved Saline	B-H Soft Lens Buffered Salt Solution or B-H Soft Lens Preserved Saline
Bausch & Lomb (B & L Aseptron System)	B & L Lubricant	B & L Daily Cleaner	B & L Soflens Cleaning Tablets	B & L Saline Cleaning Solution or B & L no Thimerosal Saline or B & L Saline	B & L Saline Cleaning Solution or B & L no Thimerosal Saline or B & L Saline	B & L Saline Cleaning Solution or B & L no Thimerosal Saline or B & L Saline

TABLE II

THERMAL DISINFECTION SYSTEM FOR SOFT LENSES (if less than 50% water content)

	Lubricants	Clean (daily)	Clean (weekly)	Rinse	Thermal Disinfection	Soak, Store
CooperVision (Perma-Therm or Pliasol Thermal Disinfection System)	Clerz	Pliagel or Miraflow		Pliasol or Permasol or Unisol	Pliasol or Permasol or Unisol	Pliasol or Permasol or Unisol
Hydron Canada (Hydron Disinfection System)				Solusal	Solusal	Solusal

TABLE III

CARE SYSTEMS FOR HARD LENSES

	Lubricant	Cleaning	Wetting	Soaking and Disinfecting	Other
Alcon	Adapt	Clens	Soaclens	Soaclens	Adapettes Rewetting Solution
Allergan	1. Allergan Lenswet	LC-65	Liquifilm Wetting Solution	Clean-N-Soak	
	2. Allergan Lenswet	LC-65	Total	Total	
	3. Allergan Lenswet	LC-65	Liquifilm Wetting Solution	Soakare	
Barnes-Hind	1. B-H Hard Lens Comfort Drops	B-H Cleaning & Soaking Solution	B-H Wetting Solution	B-H Cleaning & Soaking Solution	Gel-Clean Weekly
	2. B-H Hard Lens Comfort Drops	Titan	B-H Wetting Solution	Soquette	
	3. B-H Hard Lens Comfort Drops	One Solution	One Solution	One Solution	Gel-Clean Weekly
CooperVision	Lensine-5	Lensine-5	Lensine-5	Lensine-5	

For most patients hard lenses are more comfortable if a wetting solution is first applied.

TABLE IV

CARE SYSTEMS FOR HARD GAS-PERMEABLE LENSES

	System	Lubricant	Cleaning	Wetting	Soaking and Disinfecting	Other
Allergan		Lenswet	LC-65	Total	Total	Protein Remover Hydrocare Tablets
Alcon		Adapettes	Polyclens	Soaclens	Soaclens	Adapt Cushioning Solution
Barnes-Hind			B-H Cleaning Solution for Gas-Permeable Lenses	B-H Wetting & Soaking Solution for Gas Permeable Lenses	B-H Wetting & Soaking Solution for Gas Permeable Lenses	
Bausch & Lomb			B & L Concentrated Cleaner for Gas Permeable Lenses	B & L All Purpose Sterile Solution	B & L All Purpose Sterile Solution	
CooperVision		Clerz	Lensine-5	Lensine-5	Lensine-5	
N and N	O_2 Care		O_2 Care Granules	Water	O_2 Care Granules	
Plastic Contact Lens			Boston Lens Cleaner	Boston Lens Conditioning Solution	Boston Lens Conditioning Solution	

TABLE V

DISINFECTION METHODS FOR VARIOUS LENS TYPES

Lens material	Oxygen permeability	Water absorption	Thermal disinfection and storage	Chemical cleaning, disinfection and storage	Other
PMMA	poor	1.5%	no	Can use benzalkonium chloride, chlorobutanol, thimerosal or other preserved solutions.	
CAB	better	2 or 3%	no	Cannot use benzalkonium chloride or chlorobutanol preserved solutions.	Tend to warp so their edges are thicker and this may cause discomfort. Debris sticks to these lenses.
PMMA - silicone copolymers	fairly good	less than 1%	Do not use heat as it will warp the lenses.	Do not use benzalkonium chloride or chlorobutanol preserved solutions.	Do not wet readily, debris accumulates on the surface. Do not polish with Silvo as the ammonia will craze lenses.
Pure rigid silicone lenses	good	less than 1%	Can use thimerosal-preserved solutions but not quaternary ammonium compounds like benzalkonium chloride or chlorobutanol.		Surface is naturally hydrophobic but is given treatment to make it hydrophilic, so lenses cannot be repolished.
Soft silicone lenses	best	less than 1%	Can use thermal disinfection. Can use distilled water or thimerosal-preserved solutions for thermal disinfection.	Cannot use quaternary ammonium preserved solutions. Can use chemical disinfection by thimerosal.	Tend to accumulate surface deposits so need both daily cleaning and periodic enzymatic cleaning.
Hydrogel lenses	good (varies with water content)	30 to 70%	Can be thermally disinfected if lens has less than 50% water content. Use a saline solution made with distilled water. Heat tends to shorten lens life, and to discolor the lenses but properly done kills all microorganisms except spores.	Cannot use benzalkonium chloride or chlorobutanol preserved solutions. Among the chemical disinfectants used are iodine, hydrogen peroxide, potassium sorbate, and thimerosal.	If of high water content tend to absorb preservatives from solutions especially chlorhexidine. Protein, lipids and calcium deposits accumulate and these can bind chemicals, harbor microorganisms and lead to lens discoloration.

Continued from p. 156

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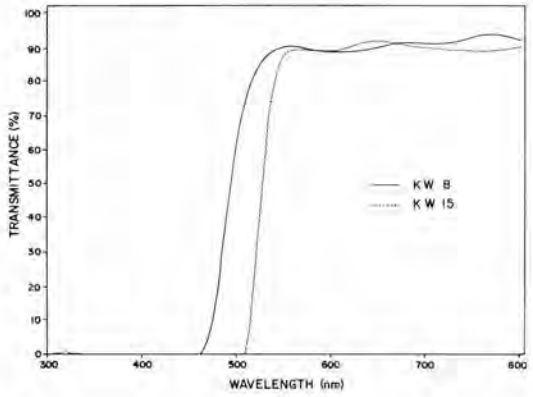

Fig. 1
Spectral transmittance of Kodak Wratten 8 (light yellow) and Wratten 15 (medium yellow) gelatine filters.

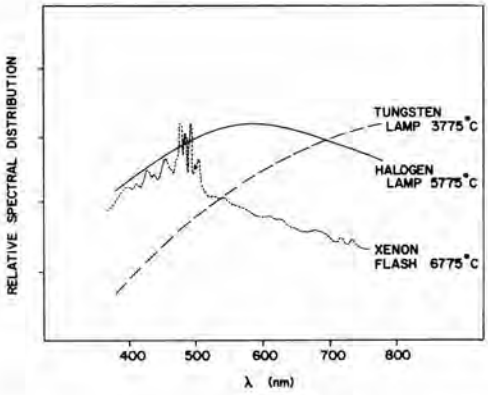

Fig. 3
Relative spectral output from light sources used in ophthalmic diagnostic instruments.

CONTACT LENS

Effect of Double Refraction Within the Pupil Area on Visual Performance

M. Millodot*
V.A. Brown**

Abstract

Standard visual acuity and contrast sensitivity were measured in subjects wearing their spectacle correction and the same but with a 2mm hole in the centre of the lens. It was found that visual acuity only diminished from 6/5.7 to 6/6.9 on average and that the contrast sensitivity differences were small and not systematic. This experiment supports the feasibility of simultaneous type of bifocal contact lenses.

Abrégé

Le contraste de luminosité et l'acuité visuelle sont comparés chez des sujets portant leurs propres lunettes et une deuxième lunette ayant un trou de 2mm percé au centre de la lentille. Une faible diminution de l'acuité de 6/5.7 à 6/6.9 a été notée. Les différences dans le contraste de luminosité étaient peu significatives et sans répartition organisée. Ce projet supporte le concept d'un verre contact double foyer dit a vision simultanée.

It has been suggested by a contact lens manufacturer (Bronstein, 1976; Medicana Inc. Montreal) that the portion for near should be placed in the centre of the lens, thereby providing simultaneous distance and near vision. Distance vision is provided by an annular region surrounding the near portion and both portions can provide a foveal image. Such a unique concept is understandable as far as near vision is concerned since at near, pupil size diminishes and more or less corresponds to the near portion of the lens. Thus, there is no need to displace the lens as is the case with other bifocal lenses (Molinari, 1983).

If vision appears unaffected at near, what about distance vision while looking simultaneously through the two portions, one providing focused images and the other, out-of-focus images? The blurred image may contribute some reduction in the contrast of the clear image. To assess how well a person sees through such a lens combination, it is not sufficient to use the standard test chart of visual acuity where the contrast of the optotypes is highest and constant. It is also necessary to measure the contrast sensitivity function (CSF) as this provides an evaluation of the detection of objects of reduced contrast and variable size and this is a more complete measure of visual sensitivity than the conventional acuity measure. In this article, we report measurements of CSF as well as Snellen visual acuity in myopic people wearing successively their distance correction and the same but with a hole centered along the visual axis.

Materials and Methods

Four observers (8 eyes) participated in this investigation. They were prepresbyopes ranging in age between 30 and 45. Two were myopic (OU -2.25D for one and OD -2.25D and OS -1.75D for the other). The other two observers were emmetropic. They were rendered myopic -2D in both eyes by being fitted with hydrophilic contact lenses of +2D.

The subjects were then corrected with two pairs of spectacles. In one pair there were two white ophthalmic lenses of -2D each. In the other pair there were the same lenses but with a 2mm hole in each lens. The hole was carefully centered in the middle of the pupil. This central portion of the lens corresponds in effect to a +2D addition. All data were collected monocularly. The subject was instructed to insure that the hole was within his primary line of sight.

Snellen visual acuity was measured using letters on a white translucent substrate transilluminated to 160 cd/m^2 placed 6 metres away from the subject.

Contrast sensitivity measurements were obtained using a Commodore 4032 microprocessor which controlled a Farnell DSG2 waveform generator. The programme used to operate the system was written in this laboratory by Brown (1984).

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The target consisted of vertical sinusoidal gratings presented on an oscilloscope display (Joyce electronics). The spatial frequency of the gratings (number of cycles per degree of visual angle) and contrast were controlled by the microprocessor. The grating pattern had a mean luminance of 528 cd/m^2 and subtended 15 x 10.4 degrees at the viewing distance of 1.14 m.

Contrast thresholds were measured by an ascending method of limits. Measurements were made in the following sequence of spatial frequency: 0.5, 1, 2, 3.99, 8 and 11.20 c/deg. Five independent readings were taken for each grating condition with each eye. The mean of the contrasts at which a grating passed from invisibility to visibility defined the contrast threshold. Contrast sensitivity is the reciprocal of the threshold contrast.

Pupil diameters were also measured using the Canon Auto Refractor television screen.

Results and Discussion

The results of the standard acuity test are given in Table 1. With the hole in the lens, standard acuity is reduced significantly ($p<0.05$) although that decrease is relatively small since it was of the order of one line and only in one eye did it reach two lines on the acuity chart. Subjects 3 and 4 in particular showed greater loss with the hole in the lens than subjects 1 and 2. The reason which may account for this difference is that subjects 3 and 4 had smaller pupils (about 3.5mm in diameter each) than subjects 1 and 2 whose pupils were about 4mm. Indeed, a small pupil provides a small central portion surrounding the near portion and in these circumstances visual acuity is diffraction limited. Obviously pupil size plays an important role when corrected with such an optical system.

Table 1

Decimal visual acuity at distance of each subject with and without the hole in their ophthalmic lenses.

Subject	Without hole	With hole
1 R	0.90	0.67
L	1.17	0.95
2 R	0.67	0.67
L	0.97	0.93
3 R	1.20	1.07
L	1.17	1.07
4 R	1.0	0.80
L	1.20	0.80
Mean	1.04 (20/19)	0.87 (20/23)
SD	(0.19)	(0.16)

It is interesting to note, though, that the subjects did not really feel that their vision was poorer. All they experienced was the slight shadow cast by the thickness of the hole made in the ophthalmic lens. The reason why vision did not appear appreciably poorer is shown in Fig. 1, where the contrast sensitivity function of all subjects' eyes is plotted in the two conditions. The results are in good agreement with those obtained on a large sample by Ginsburg et al (1984). Differences between testing with the lens with and without the hole were small and not systematic. Hence vision of more complex objects of various contrasts and details remained little affected and less than the conventional Snellen acuity.

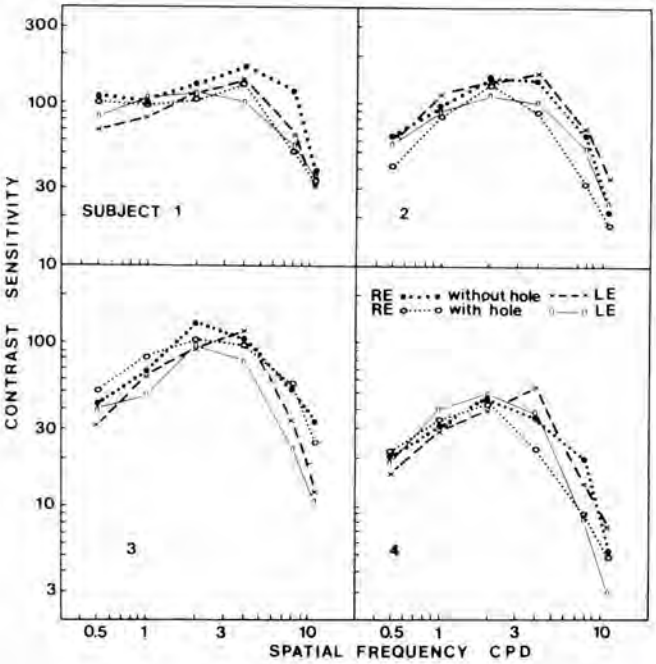

Fig. 1 Contrast sensitivity as a function of spatial frequency (in cycles per degree) for the right and left eye of the four subjects with their correction, and with their correction with a 2mm hole in the centre of the lens.

The fact that the eye is viewing simultaneously through both distance and near powers in front of the pupil is not unique. Several bifocal contact lenses are like that and are called simultaneous type (e.g. Bass lens, Bausch and Lomb Soflens, PAI bifocal lens and Ciba Vision bisoft contact lenses) although in these contact lenses the power from distance to near in the first two types varies in a progressive fashion. These lenses are not truly bifocal lenses but varifocal contact lenses. Only the Bass lens uses the centre portion for near, and the periphery for distance. In the present investigation light passing through the distance portion of the lens (indicated as 0 in Fig. 2.) is focused on the retina when looking at distance. Light passing through the hole (shown as 2 in Fig. 2.) is focused in front of the retina and thereby producing a blurred image on the retina surrounding the other focused image. This

Continued on p. 198

Treatment of a Vertical Imbalance with Vertical Vergence Training

K.M. Robertson*
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L.D. Kuhn***

Abstract

The use of vertical prism in the treatment of vertical deviations has been done successfully in many cases. However, prism adaptation does occasionally occur. Obviously, vertical prism cannot correct the cyclophoria which is secondary to a paresis of one of the obliques. This is less apparent with the paretic superior or inferior rectii muscles. This case report describes the successful visual training program for an incomitant hyperphore who had indicated adaptation to relieving prisms.

Abrégé

L'utilisation d'un prisme vertical pour corriger une déviation verticale est une technique poursuivie avec succès dans nombre de cas. Toutefois, il y a des situations où le patient s'adapte au prisme. Il est évident qu'un prisme vertical ne peut corriger une cyclophorie secondaire à une paralysie d'un muscle oblique. Une paralysie d'un muscle droit inférieur ou supérieur masque cette tendance à la cyclophorie. Ce travail décrit le succès obtenu avec un programme de réhabilitation chez un hyperphore manifestant une adaptation à un prisme vertical.

L.U. an 18 yr. old female, was first seen in the binocular vision clinic at the University of Waterloo on February 6, 1984. She had been referred to the clinic by the second of two optometrists to see her in private practice because of an increasing right hyperphoria. The first of the two optometrists had examined L.U. in May 1982 and noted a 2½Δ right hyperphoria at 6M and 3Δ at 40cm. It was decided that no therapy would be prescribed at that time. She was next seen by a second optometrist in November 1982, at which time the hyperphoria was measured at 4Δ and 8Δ at 6m and 40 cm respectively. It was decided by this optometrist to provide relieving spectacle prisms for reading and close work in the form:

OD plano 1½Δ B.D.
OS plano 1½Δ B.U.

Approximately one year later, in December 1983, L.U. returned to this optometrist complaining of headaches associated with her spectacles. It was found at this point that the hyperphoria had increased, indicating an adaptation to the relieving prisms. She was then referred to the binocular vision clinic for an assessment. The spectacles were not worn in the period between this last visit to the referring optometrist and her first visit to the clinic, a span of just less than three months.

In her first visit to the binocular vision clinic, L.U. complained of problems with reading, primarily that her eyes felt tired and sore after as little as one hour of reading. It was also reported that there was some vertical diplopia at near that could be eliminated by blinking. She presented normal visual acuities unaided, her refraction being emmetropic O.U.. Pupil responses, external and internal appearances were unremarkable. Adequate amplitude of accommodation of 13 D. was demonstrated by both eyes. There was normal stereoacuity (40" at 40cm), normal sensory fusion and no suppression. Versions and ductions were full and free with the following results.

6M	40cm
ortho with 2Δ right hyperphoria	4Δ exophoria with 5-6Δ right hyperphoria
BO 8/25/8 BI x/6/4	BO 8/16/14 BI x/12/10
+V.V. x/6/3 (B.D.O.D.)	+V.V. x/8/5 -V.V. x/4/2
-V.V. x/4/2 (B.U.O.D.)	

It was decided at this time to attempt to control the vertical imbalance by increasing the vertical vergence limits. Three training sessions at two week intervals in combination with daily home training was prescribed. During the three training sessions

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between February 6, 1984 and March 30, 1984, the following therapy was performed:

- anti suppression training
- accommodative facility training
- positive and negative fusional vergence training using prism bars
- vertical vergence training using prism bars.

L.U. was also given free fusion cards and loose prisms (of 7Δ and 10Δ) to train lateral and vertical vergences respectively at home on a daily basis. She was reassessed on March 30, 1984 and commented that the headaches and diplopia were less frequent, even when wearing the spectacles previously prescribed. The relevant clinical findings were as follows:

6M	40 cm
ortho with 2Δ right hyperphoria	4Δ exophoria with 4Δ right hyperphoria
BO x/35/14 BI x/10/8	BO 20/30/20 BI x/14/12
+V.V. x/10/8	+V.V. x/10/8
-V.V. x/12/8	-V.V. x/12/8

Stereoacuity had also increased, now measured at 20" at 40 cm L.U. was advised to discontinue use of the spectacles and to continue home training on a daily basis with free fusion cards and loose prisms of 10Δ and 12Δ.

She was last seen on April 27, 1984 with the following clinical findings:

6M	40 cm
3Δ exophoria with 2Δ right hyperphoria	4Δ exophoria with 4Δ right hyperphoria
BO 10/>40 BI x/10/8	BO 10/>40/>40 BI 16/20/14
+V.V. x/12/8	+V.V. x/14/10
-V.V. x/8/5	-V.V. x/8/6

Headache frequency was significantly decreased and diplopia was absent. It was decided that the vertical vergence reserves were of a sufficient magnitude to eliminate the need for the relieving prisms of the spectacles. The vertical imbalance easily could be controlled by the vertical fusional vergences. A maintenance program of vertical vergence training using a 10Δ loose prism once a week was established in order to maintain the adequate vertical reserve. The findings of this case seem to indicate that where relieving prism therapy in a vertical imbalance proves unsuccessful due to adaptation, vertical vergence training can provide reserves sufficiently adequate to successfully control the imbalance.

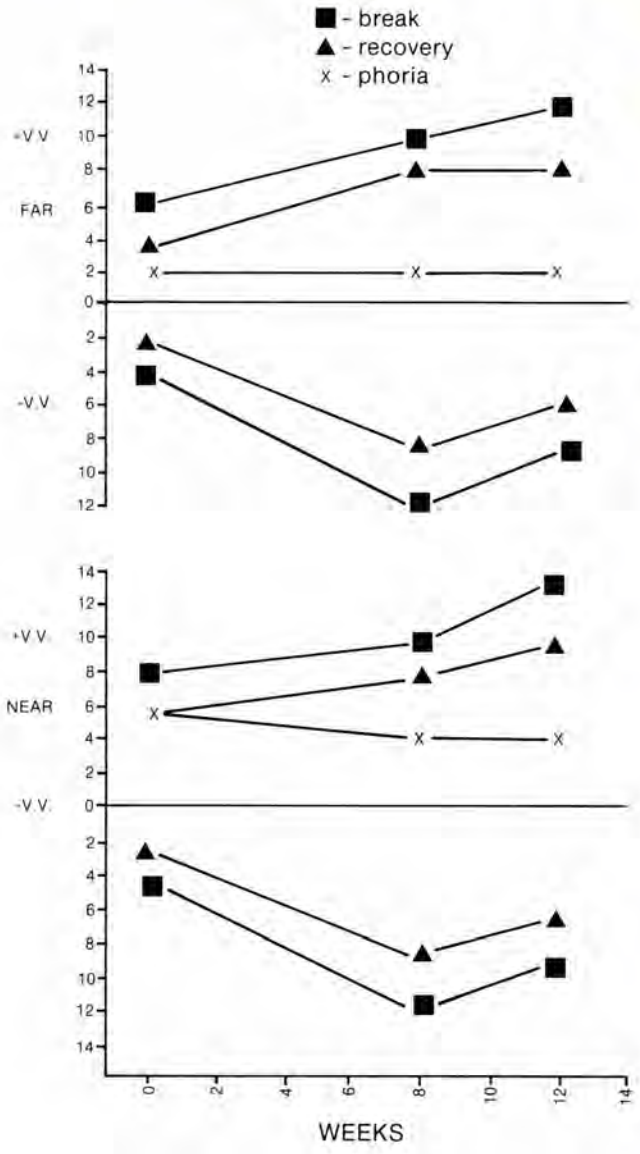

Fig. 1 Graph showing the increase of the opposing vertical vergence reserve with training.

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Clinical Evaluation of a Hydrogen Peroxide Disinfecting Solution for Hydrogel Lenses

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Abstract

A 6-month clinical study was conducted to evaluate a soft lens care regimen containing 3 percent hydrogen peroxide as a disinfecting solution. There was a statistically significant increase in daily lens-wearing time and improvement in corrected visual acuity over the course of the study. No adverse reactions and no chemical or physical changes to the hydrogel lenses occurred during the study. The data show that the hydrogen peroxide disinfecting regimen was safe, comfortable, convenient to use and effective.

Abrégé

L'efficacité d'un régime de désinfection de lentilles souples, dont l'agent actif est un peroxide d'hydrogène de 3% a été étudié pendant six mois. La durée du port des lentilles ainsi que l'acuité visuelle ont accusées une amélioration durant la période du projet. Aucune réaction adverse a été rapportée ni aucun changement chimique ou physique au matériel des lentilles. Ces résultats démontrent que ce régime est commode, confortable, sans risques et efficace.

Introduction

The disinfection of soft contact lenses is an important part of the lens-care regimen, as the hydrophilic nature of the lens material is capable of supporting the growth of potential pathogens.[1,2] Those organisms that are not removed by a cleaning agent must be killed to protect the eye from potential infection.

Initially, soft lenses were disinfected by boiling in saline solution. However, it was found that thermal disinfection had several disadvantages. The heating unit was not always electrically or mechanically reliable; heat shortened the lens life and caused an absorption of denatured protein onto and into the lens material. Finally, heat was not always compatible for use with lenses having a high water content. Chemical agents were sought as an alternative method of disinfection.

Hydrogen peroxide has a long history of use as a disinfecting agent, although its method of action is not completely understood. It is known that a free hydroxyl radical is formed in the presence of metallic ions, which may originate from the bacteria. The free radical destroys the organism's cell wall through oxidation.[3]

The study described in this report demonstrates the clinical safety and efficacy of a Barnes-Hind disinfecting regimen containing hydrogen peroxide in a population of hydrogel lens wearers.

Materials and Methods

A total of 30 subjects wearing hydrogel lenses were entered into the 24-week, open-label study. Written informed consent was obtained from each subject prior to study participation.

The subjects removed their lenses daily for cleaning and a 10-minute disinfecting cycle in hydrogen peroxide. The lenses were then soaked a minimum of 4 hours in a preserved saline solution. Each subject received an ocular examination at the initial visit and at 2, 4, 8, 12, 16, 20 and 24 weeks. In addition, the investigator conducted a lens cleanliness examination and the subjects evaluated lens comfort at each visit.

The study materials included:

A. Barnes-Hind Soft Lens Cleaning Solution
B. Barnes-Hind 3% Hydrogen Peroxide Solution
C. Barnes-Hind Soft Lens Preserved Saline Solution
D. Hydra Mat® II
E. Hydrogel lenses — maximum water content of 55%.

The data were statistically analyzed where all tests and *p* values corresponded to a 2-sided test against

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the null hypothesis. Statistical results were considered significant when p values were 0.05 or less.

Results

Thirty (30) Caucasian subjects wearing hydrogel lenses 8 or more hours per day were entered into the study. The lenses ranged in age from newly dispensed to 9 months and the water content ranged from 38 to 50%. The subjects' demographic data are shown in Table 1.

A total of 27 subjects (90%) completed the 24-week study. Two (2) subjects discontinued due to scheduling conflicts and one subject discontinued contact lens wear due to a sensitivity to the thimerosal-preserved saline. There were no discontinuations related to use of the hydrogen peroxide solution.

Table 1. — Demographic Data

No. Subjects (%)	Age Range (Yrs.)	Mean Age (Yrs.)
Male 7 (23.3)	12 - 40	23.3
Female 23 (76.7)	15 - 65	28.5
Total 30 (100.0)	12 - 65	27.3

The subjects reported lens comfort upon insertion and during wear at each visit. These evaluations demonstrated that the hydrogen peroxide disinfecting regimen provided comfortable lens wear. A total of 195 on-study lens insertion evaluations (96.5%) and 197 during wear evaluations (97.5%) were reported as comfortable. Eight (8) subjects reported transient stinging, burning or itching sensations. The addition of a second saline rinse or use of a non-preserved saline to the regimen eliminated the discomfort experienced by 7 of these subjects. One (1) subject chose to discontinue contact lens wear. The results of the comfort evaluations are shown in Table 2.

Lens comfort was further supported by the fact that daily lens-wearing time increased from a mean of 11.8 hours, initially, to 13.1 hours at study-end. This was a statistically significant increase ($p<0.05$) over the course of the study. Therefore, clinically meaningful daily lens-wearing time improved during the study.

Seventeen (17) lenses were replaced during the study due to non-solution-related problems. Ten (10) lenses were torn and 1 was lost. Three (3) subjects (3 lenses) required an increase in corrective power. One (1) subject requested a lens type change and 1 subject experienced decentration of both lenses. Those lenses replaced on-study were excluded from the subsequent cleanliness evaluations data.

Lenses were examined under magnification to evaluate the type, extent and thickness of surface deposits. The examinations show that lens cleanliness was maintained at the pre-study level for a majority of the lenses. A total of 328 on-study evaluations (94.8%) showed the lenses to be clean and completely free of debris. The 18 evaluations (5.2%) of surface debris identified 9 as film and 9 as protein. All of the surface deposits involved 25% or less of the lens surface and showed a slight to moderate thickness. The slight debris build-up on the 18 lenses had no clinical or optical significance throughout the study. The cleanliness results are summarized in Tables 3, 4 and 5.

There was a statistically significant ($p<0.05$) improvement in corrected visual acuity during the study, some of it due to prescription changes (3 lenses). The increase in 6/6 vision at the final visit (85.2%) compared to the initial visit (61.7%) shows that the hydrogen peroxide and cleaning regimen maintained the lenses in a condition conducive to good visual acuity.

Keratometry measurements were recorded for each subject at the initial and final visits. No clinically meaningful or unexpected changes were observed.

There were no occurrences of edema, conjunctivitis, iritis, ulceration or ocular infection during the study. Initially, inactive neovascularization was observed in 3 subjects and corneal staining in 2 subjects. No clinically meaningful changes in these signs occurred on-study.

Table 2. — Lens Comfort

Visit	Total Subjects*	Upon Insertion/ Subjects (%)		During Wear/ Subjects (%)	
		Yes	No	Yes	No
Initial	30	30(100.0)	0	30(100.0)	0
2-week	30	28(93.3)	2(6.7)	28(93.3)	2(6.7)
4-week	30	29(96.7)	1(3.3)	29(96.7)	1(3.3)
8-week	30	28(93.3)	2(6.7)	29(96.7)	1(3.3)
12-week	29	29(100.0)	0	29(100.0)	0
16-week	28	27(96.4)	1(3.6)	27(96.4)	1(3.6)
20-week	28	27(96.4)	1(3.6)	28(100.0)	0
24-week	27	27(100.0)	0	27(100.0)	0

*The reductions in number of subjects were due to study discontinuations or a missed visit.

Table 3. — Lens Cleanliness: Type of Deposit

Visit	Total No. of Lenses*	Debris/No. of Lenses (%)		
		None	Film	Protein
Initial	60	60(100.0)	0	0
2-week	58	56(96.6)	2(3.4)	0
4-week	57	51(89.5)	5(8.8)	1(1.7)
8-week	56	52(92.8)	2(3.6)	2(3.6)
12-week	50	50(100.0)	0	0
16-week	44	44(100.0)	0	0
20-week	42	39(92.9)	0	3(7.1)
24-week	39	36(92.3)	0	3(7.7)

*Lenses were excluded from data analysis after replacement. Additional reductions in lens numbers were due to a missed visit or study discontinuations.

Table 4. — Lens Cleanliness: Extent of Deposit*

Visit	Total No. Lenses #	Grade/No. of Lenses (%)	
		Grade 0	Grade 1
Initial	60	60(100.0)	0
2-week	58	56(96.6)	2(3.4)
4-week	57	51(89.5)	6(10.5)
8-week	56	52(92.9)	4(7.1)
12-week	50	50(100.0)	0
16-week	44	44(100.0)	0
20-week	42	39(92.9)	3(7.1)
24-week	39	36(92.3)	3(7.7)

*0 = none, Grade 1 = less than 26% of lens surface.
#Lenses were excluded from data analysis after replacement.
Additional reductions in lens numbers were due to a missed visit or study discontinuations.

Table 5. — Lens Cleanliness: Thickness of Deposit*

Visit	Total No. of Lenses#	Grade/No. of Lenses (%)		
		Grade 0	Grade 1	Grade 2
Initial	60	60(100.0)	0	0
2-week	58	56(96.6)	1(1.7)	1(1.7)
4-week	57	51(89.5)	3(5.3)	3(5.3)
8-week	56	52(92.8)	2(3.6)	2(3.6)
12-week	50	50(100.0)	0	0
16-week	44	44(100.0)	0	0
20-week	42	39(92.9)	3(7.1)	0
24-week	39	36(92.3)	3(7.7)	0

*0 = none; Grade 1 = slight, very finely scattered deposits with no apparent depth; Grade 2 = moderate deposits with a slight depth build-up, but still transparent.
#Lenses were excluded from data analysis after replacement.
Additional reductions in lens numbers were due to a missed visit or study discontinuations.

Ten (10) subjects developed mild study-emergent slit lamp signs. Nine (9) subjects experienced transient corneal staining between 4 and 16 weeks. In no case was the staining observed at more than 2 consecutive visits in any subject. There was 1 occurrence of mild injection at 12 weeks which resolved by the next visit. None of the slit lamp signs appeared to be solution-related. The study-emergent slit lamp findings are summarized in Table 6.

Table 6. — Slit Lamp Signs

Visit	No. Subjects/Sign	
	Staining	Injection
Initial	0	0
2-week	0	0
4-week	3	0
8-week	6	0
12-week	2	1
16-week	3	0
20-week	0	0
24-week	0	0

Discussion and Conclusions

This hydrogen peroxide disinfecting solution provides an excellent replacement for heat disinfection and for those individuals who are sensitive to disinfecting solutions containing preservatives.

Clinically satisfactory lens comfort and cleanliness were maintained during the study. This is supported by the statistically significant increase in daily lens-wearing time and improvement in corrected visual acuity. There were no clinically meaningful or unexpected changes between the initial and final keratometry measurements for any subject. The mild non-clinically significant slit lamp signs observed on-study were expected among hydrogel lens wearers and were not solution-related. There were no adverse reactions and no chemical or physical changes to the hydrogel lenses. Based on the data from this study, the Barnes-Hind hydrogen peroxide disinfecting regimen was safe and effective.

Acknowledgement

This work was supported by a grant from Barnes-Hind/Hydrocurve, a Revlon Vision Care Company.

Appendix I

PATIENT INSTRUCTIONS FOR USE OF BARNES-HIND LENS CARE REGIMEN

1. Always wash, rinse and dry your hands (with a lint-free towel) before handling lenses.
2. Remove lenses and clean individually as follows:
   a. Apply several drops of *Barnes-Hind Soft Lens Daily Cleaning Solution* to all lens surfaces.
   b. Gently rub the lenses between the palm of your hand and index finger making sure to clean the entire lens surface with special emphasis on lens edges.
   c. After cleaning, rinse the lenses thoroughly with a flowing stream of preserved saline solution.
3. Place lenses in appropriate *Hydra-Mat®II* lens holding baskets.
4. Fill the *Hydra-Mat®II* chamber to the line with *Barnes-Hind Soft Lens Hydrogen Peroxide Disinfecting Solution.* Replace the top containing the lenses and store for 10 minutes. The *Hydra-Mat®II* should remain upright to prevent spilling contents.
5. After 10 minutes, open the *Hydra-Mat®II* and carefully discard the disinfecting solution. LENSES MUST NOT BE REPLACED ON THE EYE UNTIL THEY ARE SOAKED IN SALINE — See steps 6 through 8.
6. Fill the *Hydra-Mat®II* chamber to the line with *Barnes-Hind Soft Lens Preserved Saline Solution* and replace the cap. Rotate the top for 10 to 20 seconds while grasping the bottom chamber. Discard the solution.
7. Fill the *Hydra-Mat®II* chamber to the line with *Barnes-Hind Soft Lens Preserved Saline Solution* and store the lenses overnight (or for at least 4 hours).
8. After storing, rotate the top of the *Hydra-Mat®II* for 10 to 20 seconds while grasping the bottom chamber. Remove the lenses and rinse them thoroughly with preserved saline solution before reinserting on the eyes.

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The Inheritance of Keratoconus

B.M. Nobert*
G.Y. Mousa**

Abstract

Keratoconus has become a common problem in everyday optometric practice. More keratoconic patients are seeking optometric care, mainly for contact lens therapy. Optometrists have found that contact lenses improve the visual acuity of most keratoconic patients. More and more, they are faced with questions concerning the genetics of the disease and the probability that it may be passed to future generations. The best counselling an optometrist can provide in this situation is to discuss some of the current theories on the inheritance of keratoconus.

Abrégé

Le kératocône est une condition que l'optométriste voit de plus en plus fréquemment dans son cabinet. Les patients souffrant de cette maladie le consultent car l'expérience démontre que les lentilles cornéennes peuvent améliorer la vision de la plupart de ces personnes. De plus en plus, les parents et les patients questionnent sur la génétique et la transmission de la condition. Une franche discussion des théories courantes sur l'hérédité du kératocône est le meilleur service que l'optométriste puisse rendre à ces gens inquiets.

Keratoconus is an uncommon degenerative condition of the cornea in which the corneal apex thins gradually and usually bilaterally, so that the cornea eventually assumes a 'cone-shaped' appearance. This conical deformation of the cornea is generally manifest at about adolescence, more rarely at birth. Blurred vision and photophobia are the only symptoms. Besides a cone-shaped cornea, signs include indentation of the lower lid by the cornea when the patient looks down (Munson's sign), an irregular shadow on retinoscopy and a distorted corneal reflection visible with the keratometer, Placido's disk or the keratoscope. Pathologically, there is generalized thinning and anterior protrusion of the central cornea, folds or ruptures in Descemet's membrane and irregular, superficial linear scars in the posterior stroma at the apex of the cone that is formed. Contact lenses improve visual acuity in the early stages, but corneal transplantation is indicated when the corrected visual acuity is decreased to the point where it interferes with normal activities of the patient. Keratoconus is one of the most common indications for keratoplasty. If transplantation is done before extreme corneal thinning occurs, the prognosis is excellent.[1,2]

The exact etiology of keratoconus has long been disputed. For many years, endocrine disturbances were considered to be the most likely etiologic factors involved. Also, gonadal and pituitary disturbances and thyroid dysfunction seemed to be responsible, especially as keratoconus had been observed after thyroidectomy.[3]

However, incidences of hereditary transmission of keratoconus have been known since the last century,[3] and this familial incidence, already observed by V. Ammon in 1830, has been subsequently confirmed by numerous other authors. Besides the many geneological trees studied, the concordance of the affection in monozygotic twins also revealed the genetic character of keratoconus.[3,4,5]

Even so, the method of inheritance of keratoconus is not yet established with certainty. In those cases where parental consanguinity was noted, recessive inheritance had to be admitted. On the other hand, regular or irregular dominant transmission had to be considered in those cases manifest through two or three consecutive generations.[3,4]

The debate was further complicated by the recognition of abortive forms of keratoconus by Amsler and his school.[4] In addition to typical keratoconus, with obvious conical ectasia, there may be an attenuated form which is expressed only in a more or less high and irregular astigmatism.[5] Abortive forms may alternate in the same individual and in the same family with more complete forms. Thus, the interpretation of many pedigrees depends

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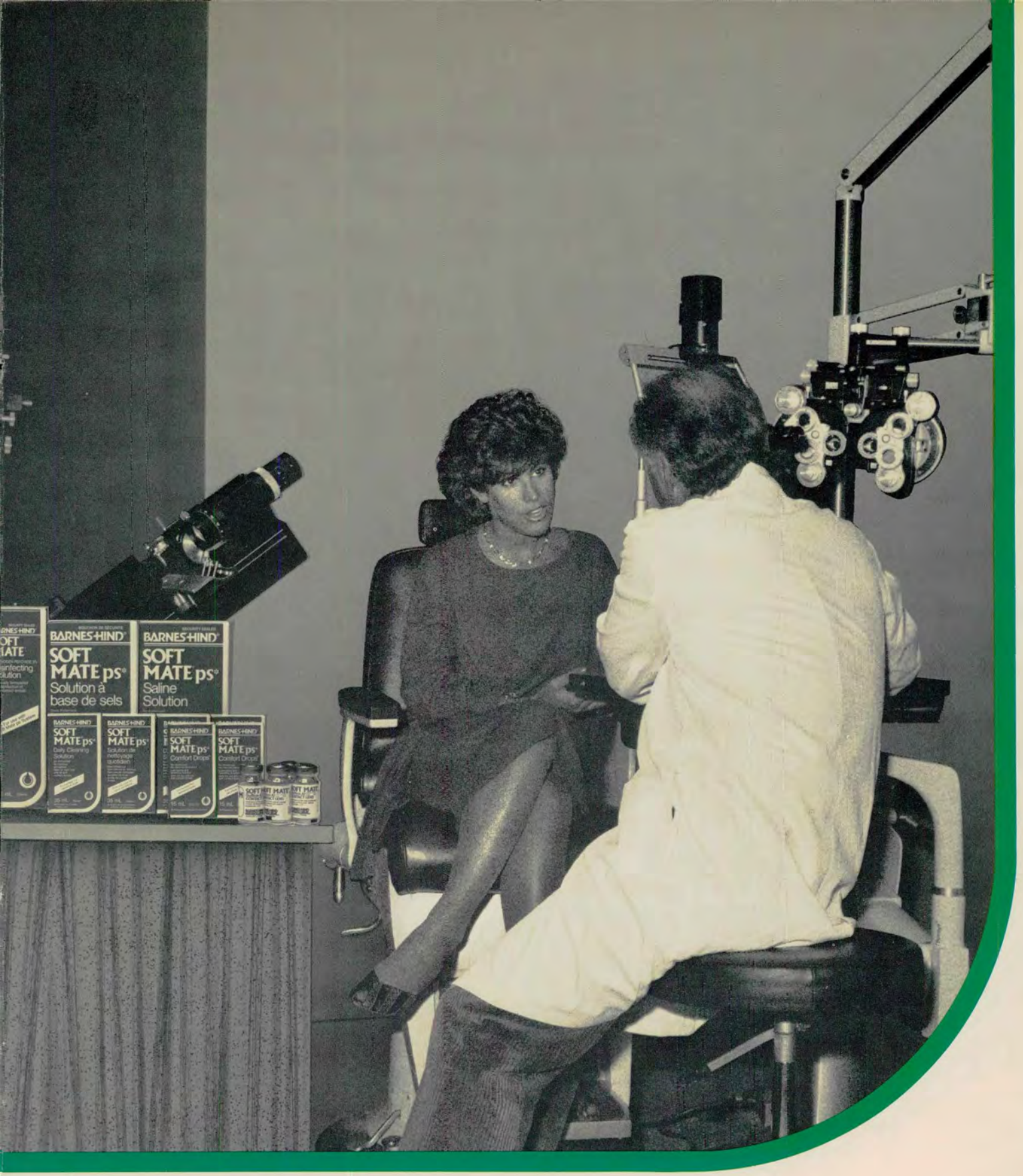

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Water Content	45%	38%	38,6%	38%	38,6%
Oxygen Transmissibility (DK/L x 10^{-9} à 22°C)	15.5*	12.4	U4 = 7.8	8.1	14.3
Diameter (mm)	14.8	13.5; 14.0	13.5; 14.5	14.0	13.5; 14.5
Base Curve (mm)	9.0	8.45; 8.7; 9.0	Variable	8.4; 8.7; 9.0	Variable
Centre Thickness (mm) à −3.00D)	0.05	0.06	0.07	0.06	0.035
Powers	Plano to −6.00D	+20.00D to −20.00D	+6.00D to −9.00D	Plano to −10.00D	−1.00D to −6.00D
Durability (Tensile & Shear Strength)	V. Good	V. Good	V. Good	V. Good	V. Good
Handling	V. Good	V. Good	V. Good	V. Good	Poor
Disinfection	Thermal & Chemical	Thermal & Chemical	Thermal & Chemical	Thermal & Chemical	Thermal & Chemical

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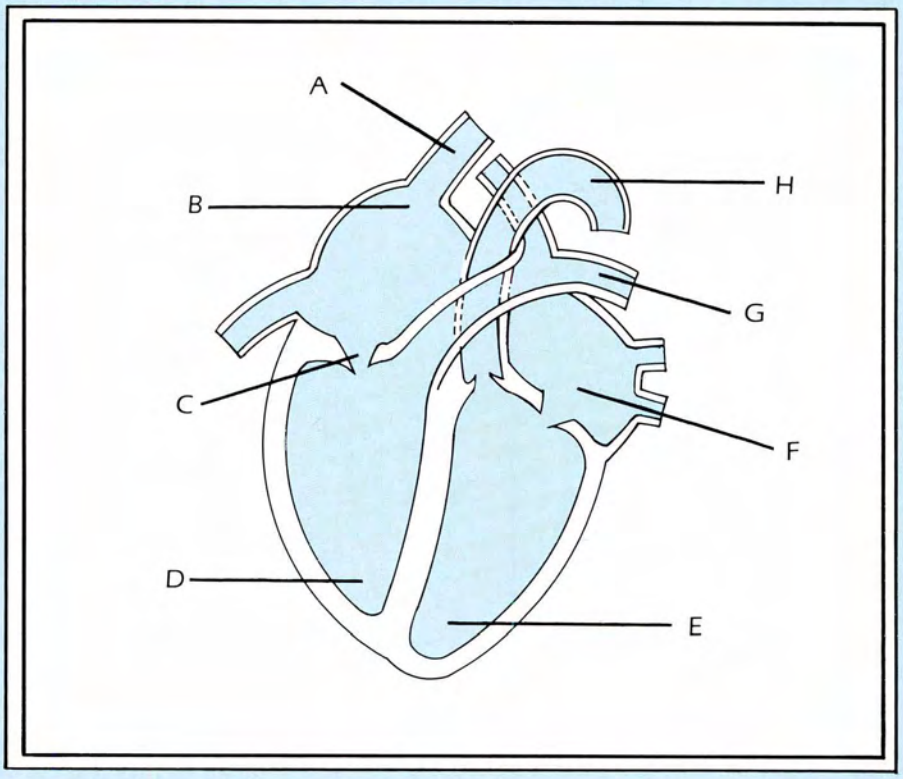

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largely upon the significance attached to astigmatism as an abortive form of keratoconus.[6]

The fact that the abortive forms were not recognized can be used to explain why geneological trees were not more often observed, and another reason may be that gene for keratoconus has a rather feeble penetrance and a greater variability of expression.[3] The latter also has importance in the theory of 'intermediate inheritance' for keratoconus. According to this theory, dominance and recessiveness do not indicate opposed methods of inheritance, but are only two extremes of a continuous chain of types of inheritance which are fundamentally similar. When penetrance (the frequency of phenotypic manifestation) and expressivity (the degree of this manifestion) are very low, the character will be recessive; if they are high it will be dominant; and if they are moderate it will be intermediate. Thus, the irregular and variable penetrance and expression of keratoconus could explain how the disease could be transmitted in ways that appeared to be different: ie. sometimes as a dominant and sometimes as a recessive.[5]

More recently the diverging views expressed in the literature on the inheritance of keratoconus have given several researchers cause to re-examine the genetic relationships of keratoconus. These studies have brought forth some new ideas on the mode of inheritance of the disease.

A German team, studying 304 cases of keratoconus in their own clinic found that "in the 22 cases (19 families) where two or more family members were affected, the genetic relationships generally indicated a multifactorial mode of inheritance, although isolated dominant or recessive variants could not be excluded".[7] In another study of 154 keratoconus patients which included 677 first degree relatives, Gasset et. al. also found that "the exact mode of transmission appears to fit the multifactorial (polygenic) mode of inheritance".[8] Thus, keratoconus appears to be inherited as a multifactorial or polygenic condition. (A multifactorial disorder is one which is "determined by a combination of genetic and environmental factors" without reference to the nature of the genetic component(s). The term polygenic is used to describe conditions "determined by a large number of genes, each with a small effect, acting additively".[9] However, in common practice, these terms have come to be used interchangeably to describe afflictions which may have both of these attributes.

If keratoconus does indeed follow the multifactorial mode of inheritance, then environmental as well as genetic risk factors must play an important role in the development of the disorder. Accordingly, eye rubbing[8,10,11] and hard contact lens wear[12] (which may be connected)[8] have been tentatively identified as possible environmental risks in keratoconus. It has been postulated that these factors may particularly affect those whose eyes have an unusually low scleral rigidity and thus may be at an increased risk of developing the disease.[12] Identification of such environmental risk factors which may particularly affect an individual at increased risk is one of the best ways to attempt prevention of such multifactorial disorders as keratoconus.[8]

The assumption of a multifactorial inheritance is further supported by the fact that keratoconus not only expresses itself in sharply defined stages, but also occurs in all possible degrees, from almost normal to the extreme, as previously stated.[7]

The hypothesis is even further strengthened by the frequent occurrence of keratoconus in connection with various other hereditary constitutional affections. Keratoconus has been associated with ocular abnormalities such as retinitis pigmentosa, infantile tapeto-retinal degeneration, blue sclerotics, aniridia, iridoschisis, micro-cornea, corneal dystrophy, cogenital cataract, ectopia lentis and anterior polar cataract. Keratoconus has also been associated with various endocrine disorders, Down's syndrome, Addison's disease, Marfan's syndrome, Ehler-Danlos' syndrome, Apert's syndrome, and many of the atopic diseases.[1,3,4,5]

While clinical experience indicates that many conditions may have been associated with keratoconus by chance, with no important pathological implications, in others, this association is much closer than could be expected by chance. The association between keratoconus and the atopic diseases is significant. Since this association was first reported in 1933, many other reports of a small number of keratoconus patients indicating the concomitant occurrence of atopic diseases have appeared in the literature.[8] Although Lowell and Carroll in 1969 challenged the association of atopic traits and keratoconus,[8,14] several recent studies have confirmed the earlier impression that keratoconus, for some unexplained reason, shows a strong tendency to co-exist with atopic disorders.[8,10,11,14] Two recent pieces of research have shown a greatly increased incidence of asthma and hay fever in keratoconus patients over the general population[8,10] and one of these even goes so far as to suggest that, as multifactorial disorders, keratoconus and asthma may share some of the genes necessary for the expression of the disorder.[8] One of these studies also found a high incidence of eczema,[10] although the other disagrees in this respect.[8] Neither study found much vernal catarrah apparent in keratoconus patients, however, incidences being much lower than previously reported. In another study, although no statistically significant increase of atopic disease in the keratoconus population was observed, such an increase was found among the relatives of the keratoconus group,

so that an association between atopy and keratoconus could still be hypothesized.[15]

Since it is well known that atopy is often associated with changes in various immunoglobulins and HLA antigens, some researchers have included determination of these two factors in their examination of the history of atopic disease in keratoconus. Although some studies have found no correlation between elevated immunoglobulin levels and keratoconus,[13] several others have shown that serum IgE was significantly raised in keratoconus patients.[11,14,15] One of these avoided clinical estimation of known systemic manifestations of atopic disease, thereby reaffirming the correlation between raised serum levels of IgE and keratoconus as objectively as possible.[15] This detection pattern may be useful in reviewing high risk groups and may aid in the earlier detection of the condition. Serum levels of IgG and IgM were also found to be raised by one group of observers,[14] who also found IgA levels to be normal, contrary to earlier findings which showed depression of IgA in keratoconus.[16]

With reference to investigations to determine whether keratoconus shows a preferential clustering around any particular histocompatibility antigen, the results have been many and varied. Although some studies have noted no association between keratoconus and any specific HLA antigen,[13] other results have shown that the frequency of HLA-AW19 and HLA-B40 were significantly higher in keratoconus patients;[11] a highly significant increase in frequency of HLA-B5 has been found;[17] and a genetic predisposition has been indicated by the discovery of HLA-B27 in affected patients.[18]

It is apparent that further research in this area is a necessity. Such study could help to identify individuals who are likely to develop keratoconus before they reach the age of onset of the disease. Moreover there is the possibility that further research in this area may provide clues to the basic histopathological processes involved in keratoconus.

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CONTACT LENS

The Effect of Contact Lens Wear on Contrast Sensitivity†

S.M. Goldberg*
D.J. Egan**

Abstract

Ever have the contact lens wearer who subjectively reports poor vision but objectively "checks out"? The qualitative visual response just doesn't seem to be supported by the quantitative findings. Is there more to seeing than the old standby — a Snellen acuity of 6/6? Perhaps these next few pages, describing an innovative and practical way to evaluate the quality of vision, will allow a better understanding of the plight of these patients with vague but very real complaints.

Abrégé

Vous est-il déjà arriver de recevoir un porteur de verres à contact qui se plaint d'une mauvaise vision malgré une acuité visuelle de 6/6? Il semble avoir conflit entre la qualité et la quantité de la vision. Y aurait-il un facteur à évaluer autre que le vieux critère de l'acuité Snellen de 6/6? Ce travail qui expose une nouvelle technique d'évaluer la qualité de la vision permettra au practicien de mieux comprendre l'état de ces patients sujets à des malaises vagues mais réels.

Introduction

Measures of Snellen acuity have been used as a metric of visual capability for many years. A patient with 6/6 Snellen acuity is generally considered to have excellent vision and vague complaints are often written off as inconsequential in lieu of the excellent resolution acuity. Recent research has shown that even with "6/6", patients' complaints of objects looking "washed out" may not only be real but can be verified clinically by evaluating contrast sensitivity. The evaluation of a patient's contrast sensitivity involves measuring the ability to distinguish light and dark bands from each other. The test paradigm involves discriminating sine-wave gratings, which are altered in contrast, from a uniform gray field. Varying the periodicity of the light and dark bands (number of bands per unit visual angle) produces varying spatial frequencies. In this manner, a patient's contrast discrimination can be determined for any number of spatial frequencies —from very low spatial frequencies (i.e., below 1 cycle* per degree of visual angle) to very high spatial frequencies (i.e., 45 cycles per degree of visual angle). The result is a contrast sensitivity function (CSF), a reproduceable entity which provides a much broader picture of the patient's visual status than does the Snellen acuity test, though the two tests are related.

Timpone and Sherman (1983) state that the best Snellen acuity is the limit of resolution at maximum contrast. To obtain the limit of resolution from a contrast sensitivity function locate the high frequency cut-off at 100 percent contrast. For example, a patient with 6/6 Snellen acuity can just resolve one minute of arc of visual angle; on the contrast sensitivity curve, this corresponds to a frequency of 30 cycles per degree. Similarly, a patient with 6/4.5 acuity should be able to detect up to 45 cycles per degree. A spatial frequency of 60 cycles per degree, corresponding to 6/3 Snellen acuity, is considered the limit of human resolution. Timpone and Sherman (1983) also note that although a patient's contrast sensitivity function may be used to predict his visual acuity, the reverse is not true. The clinician cannot extrapolate a patient's contrast sensitivity function from Snellen acuity alone because Snellen letters are all at nearly 100 percent contrast rather than at contrast threshold levels.

The analysis of contrast sensitivity has other important applications. For example, an altered CSF may be found in patients with cataracts, optic nerve disease, compressive lesions of the visual pathway, retinal disease, and amblyopia. Decreased contrast sensitivity may be present long before any other signs or symptoms appear, thus providing the practitioner with a practical diagnostic procedure for his armamentarium. It should be noted, however, that a CSF which appears to deviate from normal does not, necessarily, imply the presence of a

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* One cycle equals one light band — dark band pair.

pathological condition. As will be discussed later, many factors may affect contrast sensitivity.

The basic testing component of contrast sensitivity is the presentation of sine wave gratings to the patient. Unfortunately, the manner in which gratings are generated is not uniform and results can vary considerably. Comerford (1979) lists several different techniques which researchers have used to produce sine wave gratings:

1. Laser interference patterns
2. CRT displays
3. TV displays
4. Slide projection
5. Arden plates

Each of these methods has its shortcomings, but the most preferred techniques appear to be the use of cathode ray tube (CRT) displays and Arden plates. The CRT uses an oscilloscope and two wave form generators to produce the sine wave grating, while the Arden plates consist of six separate cards, each with its own characteristic pattern of light and dark bands representing a specific spatial frequency. These plates vary in contrast from the top of the card to the bottom, thus allowing contrast thresholds to be measured for each of six different spatial frequencies.

Even though these two methods of testing CSF have been used quite extensively, standardization of test conditions remains a problem. There are many types of CRT displays that produce sine wave gratings, each a little different from the others. For both CRT display and Arden plate testing, procedures vary from one researcher to another. These factors must be taken into account when comparing results of research studies.

Contact Lens Research Results

The scientific literature contains volumes of material on contrast sensitivity testing, many verifying its use as a diagnostic tool in the detection of ocular pathology. Few studies have been undertaken, however, to analyze the effects contact lens wear may have on contrast sensitivity, a potentially interesting area considering that millions of people rely on contact lenses for their primary source of visual correction. The studies that have been performed are summarized below.

Applegate and Massof (1975)

These researchers began with a premise that is fundamental to contrast sensitivity testing:

"There are two independent components to the contrast sensitivity function. One is an optical component which is affected by optical imperfections, diffraction, and scatter that degrade the retinal image. The second, a neural component, due to anatomical and physiological limitations and interactions, affect the processing of information within the retina and visual pathways."

Applegate and Massof were the first to conduct a study to determine how contact lens wear affects the optical component of the contrast sensitivity function. They measured the contrast sensitivity function of six spectacle-corrected ametropic subjects, followed by CSF testing of these subjects when corrected with contact lenses. For this portion of the test, three subjects were corrected with polymethylmethacrylate (PMMA) lenses and three with Bausch & Lomb Soflens® "soft" contact lenses.

The results indicated that "in relation to the functions generated by spectacle lens corrections, the use of contact lenses lowers the contrast sensitivity. Further, the differences between the two functions (spectacle lens versus contact lens) are consistently greater for the Soflens group." It was also suggested that uncorrected residual refractive error may decrease contrast sensitivity.

Woo and Hess (1979)

Contact lens patients, on occasion, complain of a reduction in the quality of vision despite exhibiting crisp visual acuity via the Snellen chart. Woo and Hess noted that "the symptoms manifested by these patients are more debilitating than the measurement of visual acuity would indicate," and investigated contrast sensitivity for a possible explanation.

Three "soft" lens wearers were examined, one complained of reduced vision while wearing contact lenses, the other two were asymptomatic. The results indicated that the two asymptomatic "soft" lens wearers showed no reduction in CSF while the subject who did complain of reduced vision showed a marked decrease in contrast sensitivity across the range of spatial frequencies, which was greater for the higher than for the lower frequencies.

The authors suggested that this patient's difficulties may stem from "an aberration effect not amenable to refractive correction." The general assumption is that successful "soft" lens wearers are likely to be the ones who exhibit little or no decrease in contrast sensitivity during lens wear.

Bernstein and Brodrick (1981)

Bernstein and Brodrick set out to test the findings of Applegate and Massof, discussed previously. Nine subjects were tested, each with at least 6/6 best corrected visual acuity and not more than 0.12D of astigmatism. All were fitted with Bausch & Lomb "soft" lenses, six with series B3, two with series B4, and one with series N.

The contrast sensitivity function for all patients was measured at 2-hour intervals, over an 18-hour period, for a total of 10 CFS plots each. One eye of each patient was fitted with a "soft" hydrogel lens, while the other eye wearing the appropriate spectacle correction served as the control.

From the data obtained in the 10 sessions for each of the nine subjects, Bernstein and Brodrick "neither found systematic differences between soft contact lenses and spectacles nor any systematic changes over the 18-hour period of testing." Thus, they concluded that no significant alteration in the contrast sensitivity function occurs with "soft" lens wear.

Mitra and Lamberts (1981)

These researchers tested twelve volunteers who were free from eye disease and who exhibited at least 6/6 best corrected visual acuity. Each subject's CSF was measured immediately before and immediately after "soft" lens fitting. The CSF was determined again after the Bausch & Lomb Series B3 and Series U3 lenses were worn daily for a two-week interval.

The results agree with the earlier data of Applegate and Massof and Woo and Hess. Mitra and Lamberts found a decreased contrast sensitivity over nearly all spatial frequencies with "soft" lens wear as compared to spectacle lens wear. This decrease in CSF was even more pronounced for the data collected after two weeks wear, perhaps being indicative of the buildup of lens deposits, as the authors indicate.

Mitra and Lamberts also checked whether this decrease in contrast sensitivity might be due to residual refractive error. Mitra and Lamberts found, however, that eleven of twelve patients with no residual astigmatism still exhibited significant decreases in contrast sensitivity with contact lens wear.

Interpretation

From the pioneering work of Applegate and Massof to current research studies, some problems still exist and many questions remain to be answered. Too few subjects have been examined and evaluation procedures are far from standardized. Nevertheless, some conclusions are possible from the investigations that have been completed.

It appears that some patients do experience decreased contrast sensitivity with "soft" lens wear and that this is the likely cause of their complaints of unsatisfactory vision. On the other hand, some other patients exhibit no significant change in CSF with "soft" lens wear. We know that residual refractive error can cause contrast sensitivity to decrease, but as Mitra and Lamberts demonstrated, even patients with no residual astigmatism can have reduced contrast sensitivity with contact lenses. Why some patients will show an altered CSF while others do not remains a mystery and warrants further investigation.

Additional Considerations

There are many variables that must be taken into account when evaluating contrast sensitivity. For research to be valid and comparable, these variables must be controlled and standardized. The more important considerations are:

1. Effects of corneal edema
2. Glare from lens surfaces
3. Binocular summation of contrast sensitivity
4. Reduction of light transmission through optical elements
5. Altered CSF of high myopes
6. Changes of CSF with age
7. Effects of varying levels of illumination

Effects of Corneal Edema

Hess and Garner (1977) have found that artificially induced corneal edema of six percent thickness change is sufficient to reduce the high spatial frequency portion of the contrast sensitivity function. Such edema can easily result during contact lens wear from hypoxic environments and/or noncompliance with wearing schedules. Mandell (1981) reports that levels of edema greater than six percent may also occur during the initial adaptation period to rigid lens wear, peaking as early as three hours after fitting.

Edema is present to some extent in many contact lens wearers and as demonstrated, appears to affect contrast discrimination. Hess and Garner also reported that the CSF edema-induced depression fully recovered 3½ hours after lens removal.

Glare From Lens Surfaces

Coupland and Kirkham (1981) examined the effect of glare on CSF in patients wearing spectacle lenses. They found that contrast sensitivity was reduced at all spatial frequencies by glare, with the greatest effect at the high spatial frequencies. If this observation can be extrapolated to contact lens wear, it might be postulated that scratches on contact lenses may produce glare and reflections, with a similar reduction in contrast sensitivity.

Binocular Summation of Contrast Sensitivity

Loshin, et al (1982) found that "the contrast sensitivity for the detection of sinusoidal gratings is increased by a factor of V2 when the stimulus is viewed binocularly rather than monocularly." Usually, CSF is measured monocularly but sometimes binocular evaluation may be done. The binocular summation effect is significant and its meaning needs to be investigated.

Reduction Of Light Transmission Through Optical Elements

If optical aberrations or scattering exist in the lens-eye system (e.g., cataracts, deposits on contact lenses, etc.), contrast sensitivity is adversely affected. Hess and Woo (1978) reported that initially the lower spatial frequencies are reduced the greatest, although "when scattering becomes isotropic, vision for all frequencies will be affected equally." It was also noted that "when low spatial frequencies are disproportionally affected more than high frequencies, vision is much more dramatically restricted." Obviously, such optical aberrations and scattering should be avoided in CSF evaluation procedures and if present need to be considered in the analysis and interpretation.

Altered CSF of High Myopes

Fiorentini and Maffei (1976) found that the CSF of high myopes (i.e., greater than 5D) was reduced relative to the CSF of emmetropes. In myopes with at least 6/6 best corrected visual acuity, a slight impairment of contrast sensitivity was detected at the higher spatial frequencies. In myopes not correctable to 6/6, the CSF was reduced at all spatial frequencies although the peak sensitivity was in the same spatial frequency range as the "normal" patient. This reduction in CSF, which exists even for myopes correctable to 6/6 visual acuity, needs to be considered when CSF research utilizes high myopes.

Changes in Normal CSF With Age

Extensive work has been done to quantify the effects of age on contrast sensitivity. Banks (1982/1983) states that contrast sensitivity is quite poor at birth, developing slowly, and not reaching adult levels until some time after 6 months of age. As to the effects of older age, many conflicting reports appear in the literature. Some researchers state that CSF is not affected by age at all, while others claim that contrast sensitivity is affected at all spatial frequencies by advanging age.

Sekuler and Owsley (1982), who sought to avoid many of the shortcomings of earlier studies, evaluated one hundred subjects, free of serious ocular disease, ranging in age from 20 to 80.

Sekuler and Owsley found that subjects of all ages had approximately equal sensitivity at 0.5 and 1 c/deg, but older observers had lower sensitivity beginning at about 4 c/deg, with greater losses at older ages. Additionally, beginning at about age 60, the peak of the CSF for older observers was at a lower frequency, 2 c/deg, as compared with younger adults, whose peak was at 4 c/deg. Thus with a large sample, it becomes apparent that older observers exhibit sensitivity losses predominately at intermediate and high frequencies.

Hence, age seems to play a significant role in contrast sensitivity. Does the clarity of optical media (e.g. lens yellowing) contribute to the losses observed with CSF?

Effects of Varying Levels of Illumination

Van Meeteren and Vos (1972) demonstrated that decreasing luminance levels drastically affects contrast sensitivity. All spatial frequencies are affected and peak sensitivity changes to lower spatial frequencies. This indicates the importance of standardized luminance levels for CSF testing as well as questions regarding CSF during different ambient levels (day, night, twilight). Will tints also affect the CSF?

Conclusions

From the work that has been completed in the area of contrast sensitivity, particularly in relation to "soft" contact lens wear, it appears that a decreased CSF does result from "soft" lens wear for some patients. From the preceding discussion we may enumerate several factors that might account for this decrease:

1. Uncorrected refractive error (i.e., uncorrected astigmatism with contact lenses).
2. Optical aberrations from the contact lenses (i.e., scratches, discolouration, deposits, changes in hydration).
3. Corneal edema induced by contact lens wear.

In the final analysis, it is not presently possible to determine or predict which patients will exhibit decreased contrast sensitivity with contact lenses. Nevertheless, we should be aware that some patients will not be good candidates for "soft" contact lenses due to a deleterious effect on their CSF and quality of vision. Whether this is primarily an optical problem with the contact lenses themselves or a physiological problem with the patient cannot always be determined. What is certain is that further research is necessary to answer these questions and provide answers as to how we may prevent such decreases in contrast sensitivity or screen out patients from contact lens wear.

For now, when the contrast sensitivity function is to be evaluated for a patient, a practitioner needs to consider standardizing the evaluation procedures and be familiar with the reported observations and sources of error. In this way, the contrast sensitivity function will represent a repeatable, reliable phenomenon identifying a weakness in the quality of vision. Once identified, perhaps we can then direct research to quick, inexpensive screening procedures that can be followed up with corrective devices or guidance.

Considerations for Future Research

To better understand the relationship between contact lens wear and contrast sensitivity, it would be helpful to identify some directions for future work. A few suggestions follow.

1) A shortcoming of prior research has been that few subjects have been examined. Thus, it is recommended that a suitably large subject population (symptomatic and asymptomatic) be chosen, representative of the patient population as a whole with regard to age, sex, race, and refractive error.

2) It is important to have a standardized method of evaluating contrast sensitivity. As mentioned earlier, CSF has been measured via a CRT display or Arden plates, among other techniques. Luminance of the gratings varies from one method to another, as do instructions to patients. If research results are to be reliably compared and interpreted correctly, standardization is a necessity.

3) It has been hypothesized that the type of contact lens used may largely determine whether the patient's CSF will be altered. It is, therefore, suggested that a wide variety of lenses be utilized in research studies, whether in a single study or cumulatively through a series of studies. Among the comparisons that might be made are the following:

— low water content vs. high water content lenses
— low power vs. high power lenses
— spun-cast vs. lathe-cut vs. molded lenses
— toric vs. spherical lenses
— rigid vs. "soft" lenses
— PMMA vs. CAB vs. PMMA-hybrid vs. silicone lenses
— bifocal vs. monovision vs. modified monovision lens correction
— non-tinted vs. various tinted lenses ("soft" and rigid)
— effect of X-chrom correction on binocular summation

4) Mitra and Lamberts (1981) conjectured that the build-up of lens deposits may decrease contrast sensitivity. Since such deposits and/or discolouration will affect light transmission and, more importantly, light scattering, it might be expected that CSF will decrease under such conditions. It would be useful, however, to quantify the level of CSF loss with lens deposits or discolouration. Since many patients do not adequately clean their lenses, thus permitting the build-up of lens deposits, it would be interesting to compare severity of CSF loss with severity of lens deposits and discolouration.

5) An edematous corneal response to contact lens wear would also affect light transmission and create light scatter. Ideally, an edema-free state should exist so that results are not contaminated.

Obviously, much remains to be investigated concerning contrast discrimination and contact lens wear. Many studies are in progress and hopefully their results will enable us to better understand the vision of a contact lens wearer as well as offer effective ways to diagnose and manage any irregularities.

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Addendum

Subsequent to the submission of this paper, Alan Tomlinson, Ph.D. reported at the December, 1983 meeting of the American Academy of Optometry on: "An analysis of visual performance with "soft" contact lens and spectacle correction."

CSF was measured with "soft" lenses and spectacle correction for ten nonastigmatic ametropic subjects. Statistically superior performance was found with contact lenses but the average difference in CSF with spectacles and contact lenses was felt to be clinically insignificant. Tomlinson also noted that most results reported in the literature are for "soft" spun-cast lenses. His study utilized lathe-cut lenses and there may be a performance difference relative to the method of lens fabrication. Also, the higher spatial frequencies of the CSF were reported as being more critical in that patients were usually more sensitive to this region for any loss in optical clarity.

BOOK REVIEWS

Ocular Anatomy, Embryology and Teratology, edited by F.A. Jakobiec, 1982, Harper and Row, Philadelphia.

The twentieth century can be characterized by the explosive development of new knowledge in all scientific disciplines. New journals with narrower and narrower terms of reference are constantly appearing as a consequence of the exponential increase in the number of scientific articles. Scientific textbooks written by a single author are a thing of the past; the majority being written by a collection of experts in narrow subspecialties.

Ocular anatomy is no exception. The simultaneous development of new technology and methods such as electron microscopy (scanning and transmission), freeze fracture and radioactive labelling techniques, along with the rapid growth of the fields of cellular and molecular biology has made standbys such as Duke-Elder's *The Anatomy of the Visual System* and Wolff's *Anatomy of the Eye and Orbit* (revised by Warwick) badly outdated. The volume entitled Ocular Anatomy Embryology and Teratology edited by F.A. Jakobiec (Harper and Row, 1982) is an appropriate replacement.

The book consists of 33 chapters dealing with every major ocular tissue, including the ocular adnexa and sensory and motor neural pathways, as well as normal and abnormal embryological development. The list of 38 contributors includes well respected names such as Balazs, Tripathi and Witkovsky. Chapter titles such as Cell Action and Cell Interaction During Ocular Morphogenesis and Functional Anatomy of the Anterior Chamber Angle are indications of the emphasis on cellular biology and on relating form and function. Most chapters include developmental anomalies. For example, descriptions of various congenital cataracts are included with the normal anatomy of the lens.

The existence of gaps or superficially treated sections is the major pitfall of multiple authored textbooks. The quality of the contributions and the skillful way in which they have been arranged minimizes the problem and comes close to creating the impression that this book is written by a single individual.

The book is large (1122 pages) but well indexed. All chapters include an abundance of photographs and diagrams of superior quality, with a great deal of attention to recent work in the area of transmission and scanning electron microscopy. The book is recommended for students and practitioners alike.

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Continued on p. 195

Ocular Toxicity of Common Household Agents*

P.K. Hrynchak**

Abstract

Alive with a natural curiosity to experience all aspects of the environment around him, the young child is at risk also to experience many of the hazards in that environment. Household chemicals come disguised in bright packages and boxes, fun spray cans and with a variety of interesting textures and odors. To the child, these are merely new play things but to the parent each represents a true danger to the child's well-being. This paper will investigate some of these chemicals and specifically the implications of ocular exposure to them.

Abrégé

La curiosité naturelle de l'enfant le porte à enquêter tous les aspects de son environnement familiale ce qui inclus tant les objets inoffensifs que dangereux. Les produits chimiques pour emploi à domicile viennent souvent dans un emballage coloré et attrayant, les cannettes aérosol dont l'apparence et les odeurs attirent. Ces produits deviennent des jouets pour l'enfant mais pour les parents ils sont des sujets d'inquiétude, un danger pour le bien-être de leur enfant. Ce travail porte sur la nature de ces produits chimiques et le risque potentiel aux yeux et la vision de l'enfant.

Accidental poisoning is the single most common medical emergency involving children. In Ontario alone, in 1982 25,000 children under the age of five swallowed a household poison. The 1981-82 report of the Poison Control Center at the Kitchener-Waterloo Hospital shows that in 1981, 14% of the admissions and 38% of the outpatients treated for poisoning were children. It also states that 19.2% of *all* calls, admissions and EOR treatments involved insecticides, cleaners, chemicals or household products. Most of this abuse is by children. Approximately 305 children per year in this one Ontario hospital's records have accidents involving household agents which are severe enough to require medical attention.[1]

There are many agents which are potentially dangerous. The average household has as many as 250 of these "poisons". They can be divided into categories such as household cleaners, insecticides and other chemicals, cosmetic preparations, drugs, medicines and household plants. Since 50% of all poisonings occur in the kitchen and only 20% in the bathroom and 10% in the bedroom[2] it is the "chemicals" commonly found in the kitchen which are of most concern. This paper will investigate some of the potential ocular hazards associated with topical contact and ingestion of these products.

Knowledge of the ocular implications of such exposure is important to the optometrist so that he/she will know what to expect should the history reveal such an accident. It is also important so that the optometrist may provide adequate counselling to the parents on the hazards and consequences of ocular trauma.

Listening to radio and television advertising and glancing through newspapers and magazines, one becomes quickly aware of the vast numbers of new products on the market and the continual "improvements" that are being made to the old products. As a method of determining which products an average Waterloo household might have today, a survey of the products currently being sold at a large, local plaza's grocery store was done. The survey involved recording the name, use, listed ingredients and suggested treatment in case of ocular contact or ingestion of all products included in the "household cleaners" aisle. Of the 186 products surveyed, only 66 listed the active ingredients they contain.

As a method of determining some of the unknown ingredients, the Poisondex microfiche file at the K-W Hospital's Center for Poison Control was utilized. This file is updated every three months and therefore contains the most recent information available.[3] The

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system is American and some differences between products produced by American and Canadian manufacturers is to be expected. It was also evident from using the file that differences in composition of the products occur among products produced in different areas of the United States. As a "best estimate" the national formula was used when this occurred. Those products for which no information was available were not included, resulting in a total of 125 products studied.

Ocular toxicity information was also available from the Poisondex files. However, more detailed information could be obtained from Grant's Toxicology of the Eye[4] and Smith's Handbook of Ocular Toxicity.[5] Most of the information deals with topical exposure but, where applicable, the ocular side-effects of systemic absorption were included. Recommended treatment was general at best but, in a few instances, specific treatment was indicated and this is included.

The information gathered has been presented in table form. The products studied are broadly divided into laundry products, household cleaners and insecticides with subgroups under each heading. The ingredients which have been asterisked were listed on the label. Since many of the ingredients are common to more than one product the ocular toxicity is listed only once and cross-referral back to previous products is necessary. This, however, avoids excessive length of the table.

The damaging effect of topical exposure to a chemical will depend on the concentration, the time of exposure and the nature of the chemical substance. Proper first aid treatment is *essential* to minimize any possible damage.

Chemical compounds which may be irritating but do not produce severe or permanent effects include: borates, sodium chloride, petroleum distillates, hydrocarbons, quaternary ammonium chlorides, phosphates, magnesium chloride, chlorinol, pine oil, insect repellents and piperonyl butoxide.

Compounds which produce slight but transient injury include: anionic and nonionic detergents, tetrachlorethylene, sodium hypochlorite, (the longer the solution stays on the eye the greater the potential for damage), perchloroethylene, isopropanol (must be in concentrations over 70% to be damaging), cyanourates, enzymes, phenols and related compounds, glycols and pyrethrins.

The effects of certain products are potentially much more serious and deserve greater attention. Laundry products may contain corrosives, anionic surfactants, sodium carbonate, sodium silicate and potassium hydroxide. Corrosives can cause burns and inflammation with the loss of the cornea. In concentrations over .5% anionic surfactants can be potentially damaging. Sodium carbonate can produce sufficient alkalinity to damage the corneal epithelium. Sodium silicate may produce damage even when flushed with water. Potassium hydroxide, the active component of bleaches, can produce severe alkali burns of the eye.

Household cleaners may contain ethanol, ammonium hydroxide, naphthalene, formic acid, sulfuric acid or oxalic acid. Ethanol splashed in the eye causes stinging, burning, reflex lid closure and lacrimation. The injury of the epithelium that results is usually completely healed in one or two days. If, however, ethanol is ingested in large quantities it can produce nystagmus, diplopia, mydriasis, and increased IOP. Ammonium hydroxide produces a severe reaction with a delayed onset. It has excellent penetration through the cornea and, thus, has the potential to destroy the vitreous humor and the retina with severe burns. It has also been shown to cause cataracts, increased IOP, corneal ulceration and permanently decreased visual acuity. Naphthalene which is found in mothballs causes only minor irritation topically but taken internally can produce chorioretinitis, optic neuritis and cataract. Formic acid splashes cause opacities in the cornea which clear, cataracts, endothelial disturbance, neovascularization and iris infiltration with hyperemia. Sulphuric acid burns are highly corrosive and cause blepharospasm and lacrimation. Oxalic acid causes irritation, burns with epithelial injury, possible opacification of the cornea and contact dermatitis.[6]

Insecticides contain cholinesterase inhibitors which cause miosis, blurred vision and lacrimation. The antidote for such exposure is atropine topically. Organophosphates also found in insecticides produce miosis and blurred vision.

With such potentially serious consequences of ocular exposure to these products it is important that parents take every measure to try and prevent accidents from occurring. With very young children it is sufficient to store all potentially dangerous items in a safe place out of their reach. It is *not* advisable to draw attention to these items as it will only serve to provoke the child's curiosity.

With the older child it may be adequate to designate the hazardous area or cupboards as "off-limits". A sticker reminding the child and every other member of the household of the danger may be useful.

Another measure which has been introduced is to put some of the most potentially harmful products in child-proof containers. Specially designed caps make access to these substances much more difficult for the child.

Should an accident occur, it is important that the child's eyes be promptly irrigated with copious amounts of water. The proper method is to tip the child's head back and run water on the forehead such that it will run into the eyes. The lids should be lifted periodically. It may be necessary to hold the lids open if the child is uncooperative or, if the eyes

are in blepharospasm, a drop of anesthetic will help to open the lids. If the substance is a known weak acid irrigate for five minutes. A base should be irrigated for 20 minutes. When the nature of the substance is unknown irrigate for 20 minutes. If irritation persists ophthalmological attention should be sought immediately.

Conclusion

Household "chemicals" or products, while effective when used for their intended purpose, represent a real danger to the unaware young child. Ocular exposure to these substances may produce only mild irritation or may be as serious as to result in a permanent reduction in visual acuity. It is necessary that parents be aware of the potential hazards so as to implement adequate preventative measures to protect their children. The role of the optometrist is to be informed so that adequate counselling and care can be provided in the event that an accident should occur.

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Ocular Toxicity of Common Household Agents

***Ingredients listed on label**
. . . Refer to previous products

Product and Use	Ingredients	Ocular Toxicity	Treatment
I LAUNDRY PRODUCTS			
Detergents:			
All	sodium sulfate 35-45%, sodium carbonate 30-40%, sodium silicate 5-15%, ionic detergent	DETERGENTS AND SOAPS - ANIONIC AND NONIONIC: usually momentary irritation without permanent damage. Low phosphate detergents may produce eye injury. CORROSIVES: burns with inflammation and in severe cases loss of cornea.	irrigate with water for 15 min. if irritation persists seek ophthalmologic attention
Bold	sodium sulfate 10-24%, sodium phosphate 10-24%, sodium silicate 10-24%	ANIONIC SURFACTANTS: may be irritating and potentially damaging to the eye in concentrations as low as .5%. SODIUM CARBONATE: may produce alkalinity sufficiently strong to damage corneal epithelium. SODIUM SILICATE: may produce damage even when flushed with water.	prompt washing avoids damage to the stroma
Breeze	sodium sulfate 20-40%, anionic detergent, sodium polyphosphate 20-40%	IONIC SURFACTANTS: may be irritating and potentially damaging. CORROSIVES . . .	irrigate with water for 15 min. if irritation persists seek ophthalmological attention
Cheer	sodium phosphate 25-49%, sodium sulfate 25-49%, sodium alkyl benzene sulforate 10-24% sodium silicate	IONIC SURFACTANTS . . . CORROSIVES . . . SODIUM SILICATE . . .	irrigate with water for 15 min. if irritation persists seek ophthalmological attention
Dreft	anionic surfactants, sodium carbonate, sodium perborate, sodium silicate, sodium sulfate	ANIONIC SURFACTANTS . . . SODIUM CARBONATE . . . SODIUM SILICATE . . .	irrigate for 15 min. with water, if irritation persists seek ophthalmological attention
Fab	alkyl aryl sulfonate 35%, potassium triphosphate 40%, sodium sulfate	DETERGENTS AND SOAPS: ANIONIC AND CATIONIC . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention

Ivory Snow	Sodium soap 75-99%, potassium soap 10-24%	DETERGENTS AND SOAPS: ANIONIC AND CATIONIC . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Oxydol	sodium sulfate 25-29%, sodium phosphate 10-24%, sodium carbonate 10-24%, sodium aluminosilicates 10-24%, sodium ethoxylate sulfate 5-9%, sodium alkyl sulfate 5-9%, sodium alkyl benzene sulfate	ANIONIC SURFACTANTS . . . SODIUM CARBONATE . . . SODIUM SILICATE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Tide	sodium phosphate 10-24%, sodium sulfate 10-24%, sodium aluminosilicate 10-24%, sodium carbonate 10-24%	ANIONIC SURFACTANTS . . . SODIUM CARBONATE . . . SODIUM SILICATE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Wisk	*potassium hydroxide, anionic detergent 10-20%, sodium silicate 1-5%, potassium soap 1-5%, fatty alkarolamides 1-5%	ANIONIC SURFACTANTS . . . SODIUM SILICATES . . . POTASSIUM HYDROXIDE: severe alkali burns of the eye can occur	burns should be copiously flooded by water or a sodium phosphate buffer solution, lavage should be continued with water or sodium chloride solution
Detergent Aids:			
Arm and Hammer Super Washing Soda	sodium carbonates, borax	SODIUM CARBONATE . . . BORATES: in solution do not cause local injury but if in crystaline form they may be irritating to the eye.	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Borateem Fabric whitener	*borax decahydrate 98.44%, sodium carboxymethylcellulose 1.0%, sodium N-alkyl benzene sulfonate .4%	BORATES . . .	irrigate with cool water, if ingested see physician
Borax 20 mule team	*Borax 99%	BORATES . . .	irrigate with cool water for 15 min, if irritation persists seek ophthalmological attention
Calgon water softener	sodium hexametaphosphate > 50%, sodium chloride > 35%, sodium bicarbonate > 15% sodium carbonate > 10%, sodium tripolyphosphate > 5%	SODIUM CARBONATE . . . SODIUM CHLORIDE: is not considered to be toxic to the eye, however at hypertonic concentrations stinging is felt.	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Mrs. Stewart's liquid blueing	unknown	considered non-toxic	no treatment required
Shout soil and stain remover	*petroleum distillate 80-90%, detergent, tetrachloroethelyene	PETROLEUM DISTILLATES: are usually not damaging or irritating to the eyes. TETRACHLOROETHEYLENE: may be irritating but serious injury is unlikely. HYDROCARBONS: if very volatile can cause slight transient injury	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Spray 'N Wash soil and stain remover	*petroleum distillates, synthetic detergents, perchloroethylene 26-27%	HYDROCARBONS . . . DETERGENTS AND SOAPS - ANIONIC AND NONIONIC . . . PERCHLOROETHYLENE: may cause pain and blepharospasm, loss of corneal epithelium may occur with recovery in 48 hours.	irrigate with water for 15 min, if irritation persists seek ophthalmological attention if ingested do not induce vomiting
Sunlight laundry soap bar	sodium soap 80-90%	DETERGENTS AND SOAPS - ANIONIC AND NONIONIC . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Bleaches:			
Chlorox 2	sodium carbonates, sodium perborate	SODIUM CARBONATE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention if ingested call physician
Javex	*sodium hypochlorite	SODIUM HYPOCHLORITE: solutions of 5% cause pain, edema and blurred vision, recovery in 24 hours if rapidly irrigated. The longer the solution remains in contact with the eye the greater the potential for eye damage.	irrigate with water for 15 min, if irritation persists seek ophthalmological attention

Javex bleach for the unbleachables	unknown	UNKNOWN	if in doubt irrigate
No Name Bleach	*sodium hypochlorite 5.25%	SODIUM HYPOCHLORITE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Old Dutch	*sodium hypochlorite 6%	SODIUM HYPOCHLORITE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Zehrs	*sodium hypochlorite	SODIUM HYPOCHLORITE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Fabric Softeners:			
Bounce	polyhydric ester 70-95%, dialkyldimethyl ammonium salt 10-25%	QUATERNARY AMMONIUM CHLORIDE: similar to benzalkonium chloride, must be 1:1,000 to be on the border line to damage the eye	irrigate with water for 15 min, if irritation persists seek ophthalmological attention if ingested do not induce vomiting call physician and drink large quantities of milk or water
Downy	dialkylethylammonium chloride, catonic surfactants, isopropanol	DIALKYLETHYLAMMONIUM CHLORIDE: similar to benzalkonium chloride, must be 1:1,000 to be on the border line to damage the eye. ISOPROPANOL: IOW concentrations may be slightly irritating to the eye, but damage is not likely if it is washed out immediately. In concentrations over 70% isopropanol is likely to be very irritating and damaging, up to 70% heals without permanent damage.	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Fleecy	dialkylethylammonium chloride, cationic surfactants, isopropanol	DIALKYLETHYLAMMONIUM CHLORIDE . . . ISOPROPANOL . . . DETERGENTS AND SOAPS - ANIONIC AND NON-IONIC	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Free 'N Soft	*quaternary ammonium salt with stearic acid and hydrogenated tallow chains, complex amide with coconut oil	QUATERNARY AMMONIUM CHLORIDE . . . DETERGENTS AND SOAP - ANIONIC AND NON-IONIC	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Starches:			
Easy-on sizing	starch, silicone, brightener	SODIUM SILICATE . . . NON TOXIC: generally does not produce any adverse effects	
Easy-on speed starch	starch	NON TOXIC . . .	
Glide	starch	NON TOXIC . . .	
Ivory	starch	NON TOXIC . . .	
Static Guard	SD alcohol 40%, dimethyl ditallow ammonium chloride, isobotane	QUATERNARY AMMONIUM CHLORIDE . . . ETHANOL: causes stinging and burning reflex lid closure and lacrimation. Injury of epithelium can result. Spontaneous complete healing in 1-2 days. Ingestion can result in nystagmus diplopia, mydriasis and decreased IOP.	irrigate with water for 15 min, if irritation persists seek ophthalmological attention

Dish Washing Fluids:

Calgonite	sodium phosphate 40%, sodium chloride 10%, chlorinated isocyanurates, polyethylene, sodium sulfate, sodium carbonate	PHOSPHATES: topically irritating but systemically has no poisonous action. ANIONIC DETERGENTS: can cause topical irritation. CYANOURATES: slight irritating effect of high concentrations over a long period of time. SODIUM CARBONATE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Cascade	sodium tripolyphosphate 10-24%, chlorinated trisodium phosphate 5-9%, sodium silicate 10-24%	CORROSIVES . . . SODIUM SILICATE . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Electra Sol	*sodium tripolyphosphate, *metasilicate, *sodium carbonate	CORROSIVES . . . SODIUM SILICATE . . . SODIUM CARBONATE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Ivory Liquid	ammonium alkyl ethoxylate sulfate 10-24%, ethanol 5-9%, ammonium alkyl sulfate 5-9%, alkylamine oxide 5-9%, potassium chloride 1-4%	DETERGENTS AND SOAPS - ANIONIC AND NON-IONIC . . . ALCOHOLS . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Joy	ammonium alkyl ethoxylate sulfate 10-24%, ammonium alkyl sulfate 10-24%, ethanol 5-9%, alkyl oxide 1-4%	DETERGENTS AND SOAPS - ANIONIC AND NON-IONIC . . . ALCOHOLS . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Lux	anionic detergents 30-40%, fatty alkyloids 5-10%	ANIONIC DETERGENTS . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Palmolive	ammonium ethoxylated alcohol sulfate 20%, sodium alkyl-benzene sulfonate 15%, ethanol 7%	ETHANOL . . . ANIONIC SURFACTANTS . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Sunlight	anionic detergent 30-40%, hydrotrope 5-15%, magnesium chloride 1-5%	ANIONIC SURFACTANTS . . . MAGNESIUM CHLORIDE: is considered harmless on topical application to the eye, however if solids precipitate they may produce irritation.	irrigate with water for 15 min, if irritation persists seek ophthalmological attention

II HOUSEHOLD CLEANERS

Product and Use	Ingredients	Ocular Toxicity	Treatment
General:			
Ajax cleanser disinfectant	*sodium bromide .42%, trichloro-s-triazinetrione .41%, sodium alkylbenzene sulfonate 3.7%, inorganic phosphates 5%	ANIONIC SURFACTANTS . . .	if swallowed drink citrus juice, in case of eye contact flush with water, call physician.
Ajax household cleaner	potassium carbonate $< 5\%$, ethoxylated alcohol 5%, sodium cumene sulfonate 5%, ammonia, sodium sulfate	AMMONIUM HYDROXIDE: produces lacrimation and a severe reaction with a delayed onset. Can destroy vitreous humor and retina with severe burns. Also can cause cataracts, increased IOP, corneal ulceration and permanent decreased visual acuity.	irrigate with water then liquid paraffin, drain anterior chamber with severe burns call physician
Comet cleanser	*chlorinol, *sodium hypochlorite .45%, silica	ANIONIC SURFACTANTS . . . CHLORINOL: produces slight irritation SODIUM HYPOCHLORITE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Fantastic household cleaner	*sodium hydroxide	SODIUM HYDROXIDE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention

Lestoil household cleaner	*pine oil 10%, *mineral spirits, petroleum distillates	PETROLEUM DISTILLATES . . . PINE OIL: is irritating but non injurious to the eye.	if ingested do not induce vomiting, irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Lysol cleaning and disinfecting	*N-Alkyl (50% C14, 40% C12, 10% C16), N-N-Dimethyl N-Benzyl Ammonium chlorides 2.7%, Tetro-acetate 1%, ethyl alcohol .34%	ETHANOL . . . DETERGENTS AND SOAPS - ANIONIC AND NON-IONIC ALKYLDIMETYL BENZYL AMMONIUM CHLORIDE: in low concentrations causes no damage, however 1:1000 solutions may be very irritating and potentially damaging to the eye.	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Mr. Clean household cleaner	tetrasodium pyrophosphate 10-24%, potassium tolvene sulfonate 5-9%, sodium carbonate 1-4%	DETERGENTS AND SOAPS - ANIONIC AND NONIONIC . . . CORROSIVES . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
No Name household cleaner	*chlorine bleach, *trichloro-isocyanuric acid	CYANURIC ACID . . . CHLORINOL . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Pine Sol	*pine oil 20%, isopropanol 10.9%, soap 10%	PINE OIL . . . ISOPROPANOL . . . DETERGENTS AND SOAPS - ANIONIC AND NON-IONIC . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
SOS scrubber pads	tallowed based soap 57.8% steel wool 42.2%	DETERGENTS AND SOAPS - ANIONIC AND NON-IONIC . . . STEEL WOOL: as an intraocular foreign body may cause ciderosis	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Spic and Span cleaner	sodium sesquicarbonate 50-74%, sodium tripolyphosphate 10-24%, trisodium phosphate 10-24%	SODIUM CARBONATE . . . ANIONIC SURFACTANTS . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Bathroom Cleaners:			
Dow bathroom cleaner	*sodium salt of o-phenyl phenol .2%, *tetrasodium ethylene - diamine tetraacetate 2.75%, ethelyne glycol	DETERGENTS AND SOAPS - ANIONIC AND CATIONIC . . . PHENOL AND RELATED COMPOUNDS: produce photophobia with fluid or vapor exposure. GLYCOLS: may result in immediate discomfort with mild temporary conjunctival inflammation but no corneal damage.	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Drano drain opener	*sodium hydroxide, sodium hypochlorite 6%, sodium silicate 1.23%, ammonium hydroxide	CORROSIVES . . . SODIUM HYDROXIDE . . . AMMONIUM HYDROXIDE . . . SODIUM HYPOCHLORITE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Easy-Off mildew and stain remover	*sodium hydroxide, sodium hypochlorite	SODIUM HYDROXIDE . . . SODIUM HYPOCHLORITE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Fantastic bathroom cleaner	*sodium hydroxide, *sodium dodecylbenzenesulfonate .6%, *sodium o-benzyl-p-chlorophenate .5%, sodium silicate	SODIUM HYDROXIDE . . . SODIUM SILICATE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Gillett's lye	*100% sodium hydroxide	SODIUM HYDROXIDE . . .	irrigate for 15 min with water, call physician
Liquid Plumber drain opener	*sodium hydroxide, sodium hypochlorite, sodium chloride	SODIUM HYDROXIDE . . . SODIUM HYPOCHLORITE . . . SODIUM CHLORIDE . . .	irrigate for 15 min with water, if irritation persists seek ophthalmological attention

Lysol bathroom cleaner	*N-alkyl (C12 67%, C14 25%, C16 7%, C8,10,18 1%), Dimethyl benzyl ammonium chloride .08%, N-alkyl (C14 50%, C12 40%, C16 10%), sodium metasilicate penta hydrate .10%	SODIUM SILICATE . . . GLYCOLS . . . DETERGENTS AND SOAPS - ANIONIC AND CATIONIC . . .	irrigate with water for 15 min, if irritation persists, seek ophthalmological attention
Misto-Van toilet cleaner	*pine oil	PINE OIL	irrigate with water for 15 min, if irritation persists seek ophthalmological attention. If ingested call physician
Sani-flush toilet cleaner	sodium bisulfate 62%, inert ingredients 38%	CORROSIVES . . . ACIDS: may lead to pain swelling corneal erosion and blindness	irrigate with water for 15 min, get immediate ophthalmological attention
Sani-flush 4-mo cleaner	*calcium hypochlorite, calcium carbonate	SODIUM HYPOCHLORITE . . . SODIUM CARBONATE . . .	irrigate with water for 15 min, get immediate ophthalmological attention
Sani-flush powder bowl cleaner	*sodium bisulphate 70%, sodium binoxalate 1.75%	ACIDS . . .	irrigate with water for 15 min, get immediate ophthalmological attention
Sani-foam bathroom cleaner	*trisodium phosphate 1.8% methyldodecylbenzl trimethyl ammonium chloride .2%, trimethyl ammonium chloride .05%	ANIONIC SURFACTANTS . . .	irrigate with water for 15 min, get immediate ophthalmological attention
Septo-Bac septic tank activator	*enzyme active biological compounds	ENZYMES: can cause transient conjunctivitus	irrigate with water for 15 min.
Septo-Solve septic tank activator	*sodium hydroxide	SODIUM HYDROXIDE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Tilex mildew and stain remover	*sodium hypochlorite sodium hydroxide	SODIUM HYDROXIDE . . . SODIUM HYPOCHLORITE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Vanish toilet cleaner	non-ionic surfactants anionic surfactants, 1 ye	DETERGENTS AND SOAP - ANIONIC AND NON-IONIC . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Vanish powdered toilet cleaner	*sodium bisulphate 60.5%, potassium monopersulphate .04%	ACIDS . . . ANIONIC DETERGENTS . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Glass Cleaners:			
Bon-Ami	isopropanol, glycol ethers, isobutane	ISOPROPANOL . . . GLYCOLS . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Easy-Off	isopropanol, ethyl glycol ether, ammonia trace	ISOPROPANOL . . . GLYCOLS . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Glass Plus	isopropanol, glycol ether, ammonia NH13	ISOPROPANOL . . . GLYCOLS . . . AMMONIA . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Windex	*Ammonia-D, isopropanol, glycol ether	ISOPROPANOL . . . GLYCOLS . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Oven Cleaners:			
Easy-Off oven cleaner	*sodium hydroxide, glycol ether, amine	SODIUM HYDROXIDE . . . GLYCOLS . . . CORROSIVES . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Mr. Muscle oven cleaner	*sodium hydroxide, monoethanol-amine 5%, butylcarbitol 13%	SODIUM HYDROXIDE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention

Air Fresheners:			
Airwick	gelling agents, essential oils, pigment preservative	UNKNOWN	consult ophthalmologist
Glade flo-thru	polysaccharide 2-7%, preservatives .5%, color .1%	UNKNOWN	consult ophthalmologist
Glade Rolair	polysaccharide 2-7%, preservatives .5%	NON-TOXIC	
Stick Ups	essential oils 1.5 gms	UNKNOWN	consult ophthalmologist
Twice as Fresh	cellulose pad impregnated with octyl phenoxy polyethoxyethanol fixative 50-60%	UNKNOWN	consult ophthalmologist
Furniture Products:			
Complete polish	emulsifiers 1-3%, silicone fluid, petroleum distillates 1%	PETROLEUM DISTILLATES . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Endust	mineral oil, petroleum hydrocarbon solvent, trichlorethane, hydrocarbon propellent	PETROLEUM DISTILLATES . . . TRICHLORETHANE: causes chemosis and hyperemia	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Klean 'N Shine	*petroleum distillates 5-15%, silicone fluid	PETROLEUM DISTILLATES . . . this product was shown to cause no eye irritation in rabbits	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Hawes' Lemon Oil Polish	*petroleum distillates	PETROLEUM DISTILLATES . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Lemon Favor	*petroleum distillates	PETROLEUM DISTILLATES . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Liquid Gold polish	*petroleum distillates	PETROLEUM DISTILLATES . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Pledge polish	*petroleum distillates, silicone fluid, waxes	PETROLEUM DISTILLATES . . .	irrigate with water for 15 min, if irritation persists, seek ophthalmological attention
The Tannery vinyl cleaner	mineral spirits	HYDROCARBONS . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Floor Products:			
Aerowax floor wax	solids, emulsifiers, plasticizers, resins, ammonia 1%, polysterate acrylic copolymer	AMMONIA . . . DETERGENTS AND SOAP - ANIONIC AND NON-IONIC . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Beautiflor floor wax	*Naphtha	NAPHTHALENE: topically irritation may occur; systemically cataract, chorioretinitis, and optic neuritis have been reported	topically irrigate, if swallowed do not induce vomiting and contact physician
Carpet Fresh rug deodorizer	sodium sulfate, sodium bicarbonate, starch, aluminium monohydride	UNKNOWN	contact ophthalmologist
Future floor polish	modified acrylic polymers, surfactants, ammonia $<1\%$	NON TOXIC	
Glamorene Shine Guard	acrylics, solvents, preservatives	UNKNOWN	contact ophthalmologist
Glory 2 carpet cleaner	hydrocarbon propellant, detergent, acrylic polymer, phosphate	ANIONIC SURFACTANTS . . . this product was found to produce corneal opacities and irritation in rabbits	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Lysol, Love my carpet	sodium sulfate anhydrous major, alumia minor	UNKNOWN	consult an ophthalmologist

Perk floor cleaner	perchloroethylene	PERCHLOROETHYLENE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Plush carpet cleaner	borax, aluminus salt, glycol ether, surfactant	BORATES . . . GLYCOL . . . ANIONIC SURFACTANTS . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Super Bravo floor cleaner	modified acrylic polymer 10-20%, diethylene glycol monoethylether 5-7%, surfactants, ammonia < 1%	ANIONIC SURFACTANTS . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Wizard rug deodorizer	sodium sulfate 10%, sodium bicarbonate 25%, starch 15%	IONIC SURFACTANTS . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Metal Cleaners:			
Brasso metal polish	*petroleum distillates 60-70%	PETROLEUM DISTILLATES . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Cameo stainless steel and aluminium cleaner	Silicous abrasive, sulfonic acid 10%, sodium silicone, anionic surfactant	SODIUM SILICONE . . . ANIONIC SURFACTANT . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Kettle Scale Remover	*formic acid	FORMIC ACID: splashes are rapidly penetrating and cause opacities on the cornea which clear, cataracts, endothelium disturbance, neovascularization and iris infiltration and hyperemia	splashes should be diluted with lots of water if ingested do not induce vomiting but dilute with water or milk and call physician
Quick Dip silver cleaner	*sulfuric acid	SULFURIC ACID: burns are highly corrosive and cause blepharospasm and lacrimation	use anesthetic to open lids, irrigate well, get ophthalmological attention
Twinkle metal cleaner	clay, soap flakes, propylene glycol	ANIONIC SURFACTANTS . . . PROPYLENE GLYCOL: is considered non injurious to the eye but may cause stinging and blepharospasm	wash with copious amounts of water
Zud rust and stain remover	*oxalic acid 10%	OXALIC ACID: irritation of the eyes, burns with epithelial injury, possible opacification of the cornea; contact dermatitis of the lids may also occur.	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Miscellaneous:			
G.H. Wood Moth Balls	Naphthalene 99.9%	NAPHTHALENE . . .	give water by mouth and induce vomiting call physician
K 2r spot lifter	perchloroethylene	PERCHLOROETHYLENE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Kiwi wet silicone	waxes, stearates, biocides preservatives	HYDROCARBONS . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Nugget shoe polish	unknown	NON TOXIC	

III INSECTICIDES:

Product and Use	**Ingredients**	**Ocular Toxicity**	**Treatment**
Ant Trap	decatchloroctahydro-1,3,4 - methano - 2H cyclosuta (CD) phenalen - 2 - one (kepone) (chlorinated hydrocarbon) .125%	CHLORINATED HYDROCARBON INSECTICIDES: no topical effect on the eye	irrigate for 15 min with water, if irritation persists seek ophthalmological attention
OFF insect repellent	*Deet 14.25% and related toluamines .75%	INSECT REPELLENTS: may cause smarting to mucous membranes, temporary stinging occurs if it gets into the eye on topical application to the face.	avoid contact with eyes

OFF deep woods	*Deet 19%, related toluamines 1%, di N-propyl isoanchomeronate .5%, 2,3,4,5 bis 12-butylene), tetrahydro-forfural 1%, N-octul bicyclo heptene dicarboximide 4.0%	INSECT REPELLENTS . . .	avoid contact with eyes
Raid ant and roach	*petroleum distillate	PETROLEUM DISTILLATE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Raid crack and crevice	*choline esterase inhibiter, petroleum distillates .75%	PETROLEUM DISTILLATES . . . CHOLINES TERASE INHIBITER: results in miosis, blurred vision and lacrimation	atropine topically
Raid insecticide	*pyrethrins .176%, *tetra methrin .09%, *technical piperonyl butoxide 1.25%	PYRETHRINS: Topically may irritate the eyes, conjunctival hyperemia, edema and allergic contact dermatitis have been reported with no permanent damage. PIPERONYL BUTOXIDE: topically is irritating but produces no damage ORGANO PHOSPHATES: produce miosis and blurred vision	irrigate with water for 15 min, if irritation still persists seek ophthalmological attention
Raid rose and flower	*pyrethrins .02%, rotenone .10% N-octyl Dicycloheptene dicarboximiae .12%, Di Nocap .125%, Di chlone .125%, methoxychlor .30%	PYRETHRINS . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Raid vegetable garden fogger	pyrethrins .2%	PYRETHRINS . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Raid wasp and hornet	propoxur .475%, tetramethrin .25%	ANTICHOLINESTERAS . . .	atropine antidote
Raid yard fogger	pyrethrins .2%, technical piperonyl butoxide 1%, technical methoxychlor 1%, 2 hydroxy ethy N-octyl sulfide .95%	PYRETHRINS . . . PIPERONYL BUTOXIDE . . .	irrigate with water for 15 min, if irritation persists seek ophthalmological attention
Vaporette insecticide	DDVD .465%, pyrethrins .03%, piperonyl butoxide .06%, N-octyl bicycloheptene decarboxamide .102%, petroleum distillates	DDVD: an anticholinesterase inhibiter which may blur vision, produce lacrimation and miosis	irrigate with water for 15 min, if irritation still persists seek ophthalmological attention
		PYRETHRINS . . .	atropine
		PIPERONYL BUTOXIDE . . .	

Continued from p. 184

Dictionary of Eye Terminology, by Barbara Cassen and Sheila Solomon; Edited by M.L. Rubin. Triad Publishing Company, Gainesville, Florida, 1984. Softcover, $14.95 (U.S.)

As knowledge expands, so does vocabulary and the need to provide tools to understanding the ever-increasing division of that knowledge into specialty groups and sub-groups.

Compacting all terminology for all branches of health care into a single dictionary is an expensive undertaking and would result in a very unwieldy volume. Such a project is unlikely to receive the widespread distribution a smaller, specialized dictionary, particularly a desk reference, can achieve.

The authors have responded to a very real need. Non-professional ophthalmic personnel, students, office aides and general physicians & nurses will find in this compact volume the answers to their many questions on eye terminology.

The book contains 3,000 terms in alphabetical order. Definitions are presented in simple language readily understood by non-professionals. A further bonus is that most terms are catalogued under specific classes by an underlined notation such as *anatomy, pathologic condition, drug, optical instrument, optics, optical device, surgical instrument, functional defect, congenital anomaly* and many others. Where necessary, there are cross references which are printed in capital letters. There are few illustrations, pen and ink sketches, and most relate to eye movements and positions.

Practitioners who already possess a good dictionary may not be interested in acquiring this new publication for themselves, but they should consider it for their office staff. The cost-conscious student will find this a bargain and a life-long friend.

G.M. Bélanger

Schools of Optometry, University of Waterloo, University of Montreal, 1984 Graduating Classes and Award Winners

Recently, the CJO received a flood of information from both Schools of Optometry in Canada listing their 1984 graduates and, from Waterloo, their Scholarship, bursary and award winners from its Graduation Awards Ceremony (May 24), Convocation Ceremony (May 25) and its Awards Assembly (November 9).

We are pleased to present the following information and, with it, our congratulations to all graduates and award winners from both the faculty and student populations of both Canadian Schools of Optometry.

École d'Optométrie, Université de Montréal — 1984

Arseneau, Marc
Bernard, Sandra
Blais, Marielle
Bolduc, Michel
Bouchard, France
Charron, Dominique
Cote, Alain
Doiron, Conrad
Drouin, Carole
Dubois, Kimberley
Duchemin, Mario
Dupont, Marie
Dupuis, Emery
Duquette, Sylvain
Fournier, Marc
Grenier, Dominique
Guerin, Edith
Huppe, Pierre
Labelle, Linda
Lafontaine, Marie-Claude
Laplante, Lucie
Laplante, Martin
Lapointe, Richard
Laroche, Lucie
Laroche, Michèle
Laurin, Marie-Hélène
Lauzon, Ghislaine
Leblanc, Yves
Leduc, Michel
Maisonneuve, Hélène
Marchand, Brigitte
Martin, Michèle
Mastrogiuseppe, Joseph
Mayrand, François
Mercier, Diane
Ouellet, Yvan
Rathel, Guylaine
Rivest, Gaston
Rousseau, Lise
Thibault, Diane
Tondreau, Nathalie
Turgeon, Hélène

School of Optometry, University of Waterloo — 1984

Ph.D. (Physiological Optics/Biology): Craig W. Hawryshyn
M.Sc. (Physiological Optics): J. Graham Strong
Diploma in Residency: Anthony C. Chan

O.D.'s

Acs, Mira M.
Anderson, Cindy J.
Bacher, Steven. M.
Bruhjell, Michael C.
Butts, Bruce L.
Carey, Jay A.
Champagne, Denis R.
Chim, May C.
Clipp, Deborah H.
Cox, David A.R.
Derrah, June E.
Dueck, David A.
Eves, Edward V.
Feinstein, Brian R.
Fraser, Grant A.
Gagliardi, Mimmo
Gentles, John E.
Gladstone, Gila D.
Granda, John C.
Hickey, Joseph E.
Hicks, David A.
Hoh, Samuel S.K.
Hudson, Patricia L.
Kiddie, Timothy W.T.
Kostiuk, Gary A.
Kruezer, Ronald O.
Kuhn, Linda D.
Kumar, Rasha
Lan, Shim F.
Landry, Ronald
Lee, Richard E.
Linton, Lillian C.
Lu, Doris
Lukenchuk, Darcy J.
Mittleholzer, Perry A.
Moores, James R.
Mulhall, Tom G.
Nardone, Jerry S.
Ozimok, Darlene A.
Pawa, Amrit S.
Pineau, David R.
Pozza, Mariano L.
Quinlan, Diane
Sewell, J. George
Shamenski, Robbin
Shaul, Brenda
Smart, Eric G.
Snow, Howard P.
Szymkiw, Mary A.
Thatcher, D. William
Tittley, Violaine M.
Trenholm, Carol R.
Twidale, Joan D.
U, Connie Y.H.
Warren, Gordon S.
Wilson, Alex G.

Awards and Prizes — May, 1984

College of Optometrists of Ontario General Proficiency Medal
— R.O. Kruezer

A.W. Cole Award for Clinical Excellence
— D.R. Champagne

CIBA Vision Care Award for Clinical Excellence
— J.R. Moores

Essilor Award for Academic and Clinical Excellence in Optics
— J.D. Twidale

Bausch and Lomb Optical Soflens Division Outstanding Achievement Awards
— 1st Prize: J.R. Moores
— 2nd Prize: M.A. Szymkiw, H.P. Snow

Bernell Clinical Optometry Award for Excellence in Orthoptics and Visual Training
— D.R. Pineau

T.T. Beattie Award for Orthoptics and Visual Training
— D.R. Pineau

E.F. Attridge Prize for Highest Achievement in Pathology
— D.R. Pineau

Canadian Contact Lens Society Prize
— M.M. Acs

Percy Hermant General Proficiency Prizes
— 1st Prize: R.O. Kruezer
— 2nd Prize: D.R. Pineau

Ontario Association of Optometrists Leopold Lacourciere Award for General Proficiency
— M.L. Pozza

J.C. Thompson Prize for Optometry
— R.O. Kruezer

William Feinbloom Low Vision Award
— D.R. Champagne

Prize for Academic Excellence in Ocular Pharmacology
— T.G. Mulhall

K-W Optical Company Limited Awards
— 1st Prize: M.A. Szymkiw
— 2nd Prize: J.R. Moores

Central Optical Awards for Excellence in Special Studies
— 1st Prize: M.A. Szymkiw
— 2nd Prize: M. Gagliardi, M.L. Pozza
G.A. Fraser, G.S. Warren

Dean of Science Honours List
— R.O. Kruezer, D.R. Pineau,
J.D. Twidale, D.R. Champagne

November 9, 1984

Certificates of Honour
— Drs. W.R. Andrews, R.R. Bock, E.L. Buchner

Certificates of Honour are presented by the School of Optometry, University of Waterloo, in recognition of special achievement and merit. In the case of Drs. Andrews, Bock and Buchner, the awards were presented "in recognition of their dedicated teaching as part-time clinical supervisors and adjunct faculty."

Dr. Jacob Sivak (l.), Director of the Waterloo School of Optometry, presents Certificate of Honour to Dr. E.L. Buchner.

All three Doctors joined the School in 1967 as part-time clinical supervisors, with Dr. Buchner becoming an adjunct faculty member in 1970.

Alberta Optometric Association Scholarships
— Louise Myshak, Len Ferguson

British Columbia Optometric Association Scholarship
— Lindsay Kamachi

AOCO Canada Ltd. Douglas T. McPherson Scholarship
— Catherine Chiarelli

Barnes-Hind Canada Bursary
— Patrick Brodie

Bausch and Lomb Soflens Division OD Awards
— Judy Schnarr, Linda Bathe

Bernell Freshman Scholarship (Optometric equipment)
— Charline Gauthier

Canadian Ophthalmic Suppliers Prizes for General Proficiency
— Year 2: Charline Gauthier, Andrew Palmer
— Year 3: Colette Lebert, Susan Jany
— Year 4: Linda Bathe, John Newman

Centennial Optical Company Scholarships
— Gregory Cook, Dagmar Otto

K-W Optical Company Awards
— Year 3: H. Kerby Kelly, Craig Menzies
— Year 4: Allan Bernardi, Joseph Giddens

Percy Hermant Centennial Bursaries
— 1st Professional Year: Kevin Hagerman, Marianne Reid, Robert Cole, Lorne Ryall, Alan Nicholson, Derek Shaw
— 2nd Professional Year: Mary Lou Barry, Caroline Wong, Lori Lukey, Fern Fujimoto, Raymond Limber
— 3rd Professional Year: Michael Cormier, Kathleen Breen, Jody Toyanaga, Wayne Diakow, Linde Tse, Brian Joslin
— 4th Professional Year: M. Lyn DesRoches, Daniel Cote, David Hazlett, Greg Boguski, Brenda Horner, Richard Nielsen

Saskatchewan Optometric Association Scholarships
— Nancy Hopfner, Beverly Orr

Science Faculty Awards
— Year 1: Karen Hyyrylainen, Christine Shalhoub
— Year 2: Beverly Dodge, Linda McIlveen
— Year 3: Brian Ing, Blanche Nobert
— Year 4: Michael Hall, Angela Kothe

Reginald Williams Memorial Scholarship
— Gary Butterworth

Beta Sigma Kappa Silver Medal Award
— Linda Bathe

School of Optometry Distinguished Teaching Award from the Optometry Students
— K.M. Robertson, O.D., M.Sc., Supervisor of Clinics

Summer Research Assistantships
— (1) Howard A. Backman Scholarship: Murray McLeod
— (2) H.A. Stein Scholarship: Michael Hall
— (3) Beta Sigma Kappa Student Research Grant: Michael Hall

Alberta Heritage Scholarship
— Charline Gauthier

NSERC Summer Assistantships
— Linda Bathe, Theresa Hildebrand, Brian Ing, Susan Jany, Colette Lebert, Alison McMechan

Newfoundland Association of Optometrists' Presentation to CAO President

CAO President Dr. Ralph Rosere (r.) was recently presented with an Atlantic landscape photograph by NAO past-President Dr. Wayne Wheeler, on the occasion of Dr. Rosere's appearance at the provincial Association's 1984 Annual General Meeting. Also at the meeting, the NAO elected its new provincial Executive for the coming term. Pictured are (front row, l-r) Drs. Garry Best (V-Pres), Richard Howlett (Pres), Richard Buchanan (Sec-Treas) and (back row, l-r) Drs. David Anderson (Cnclr), Douglas Cote (PRO), Wayne Wheeler (past-Pres) and James Patriquin (CAO rep).

In This Season of Giving, Consider Third World Countries

The Canadian Foundation for World Development is collecting equipment and supplies from doctors, pharmaceutical manufacturers and suppliers to assist in the establishment and operation of non-profit clinics in Jamaica, Mexico and Haiti.

Presently, they are specifically seeking to collect 100,000 pairs of glasses in support of these programs, as well as any volunteer participation that health professionals are willing to provide. Further information about CFWD and its programs is available from:

Kenneth G. Davis, President
Canadian Foundation for World Development
2441 Bayview Avenue
Willowdale, Ontario
M2L 1A5
(416) 445-4740

Combination Eyeglass/Contact Lens Case

An eyeglass case designed exclusively for the contact lens wearer is now available from a company called Kelley and Hueber, a unit of BMC Industries, Inc.

The spectacle case is "velvette" lined, open-ended, with contact lens case attached and is available in two colour choices — beige or pastel blue. Cases are packaged 20 to a box.

Further information:

Kelley and Hueber
PO Box 98
Triboro Industrial Park
North Attleboro, Massachusetts
02761, U.S.A.

Contact Lens Wearer Mascara Launched

Revlon has launched a new mascara in Canada, being touted as "the first of its kind developed for contact lens wearers" and "exclusively endorsed by Barnes-Hind Hydrocurve vision care experts."

Advanced Formula Mascara's claims include "Free of Irritants", "Flakeproof", "Waterproof" and "Easily removed". Available at Ultima II Cosmetic counters, AFM is presently offered in three shades — black, brown and blue.

Further information is available from:

Eustace Fotiu, Executive Vice President
Research and Development
Revlon Research Centre, Inc.
2121 Route 27
Edison, New Jersey
08818, U.S.A.

Continued from p. 169

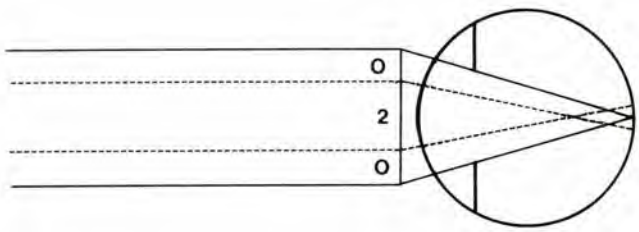

Fig. 2 Schematic representation of the light rays passing through the centre and periphery of the lens used in this investigation.

overlapping obviously contributes to a slight loss of contrast of the focused image and consequently results in the loss of standard acuity. The blurred image, on the other hand, is easily suppressed.

This phenomenon is somewhat similar to the irregular refraction which is sometimes encountered in clinical practice following a cataract or a corneal ulcer (Hodd, 1938; Coates, 1951). However, in irregular refraction there may be more than two refractions within the pupil and of dioptric powers which are unpredictable and sometimes causing rivalry and diplopia. In the present study, diplopia was not noticed as there were no prismatic effects in the path of light which would separate the two images on the retina. Moreover, one of the two images is easily suppressed because the dioptric power of the out-of-focus image is large (2D).

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Brown, V., Asymmetry of interocular transfer in amblyopic subjects. (In preparation).

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Ginsburg, A.P., Evans, D.W., Cannon, M.W., Large - sample norms for contrast sensitivity, *American Journal of Optometry and Physiological Optics* 61: 80-84, 1984.

Hodd, F.A.B., Analysis of coincidence optometer readings in clinical practice, *The Refractionist* Sept: 7-17, 1938.

Molinari, J.F., Soft bifocal contact lenses in the USA *The Contact Lens Journal* 11(5): 2-5, 1983.

À NE PAS MANQUER: "LE PANORAMA DES PRAIRIES", 19e CONGRÈS BIENNAL DE L'ACO

— Points saillants du congrès —

Conjoints: La randonnée touristique de la vallée de la Qu'Appelle; les pièces d'artisanat de la Saskatchewan; un restaurant campagnard français; il y aura également du golf, des "aquacices", du jogging et des randonnées pédestres.

Jeunes délégués (6-12 ans): Trois journées entières au camp de jour du YWCA: natation, artisanat, films, gymnase, tour de ville, coucher pour une nuit et bien d'autres choses.

Jeunes délégués (13-15 ans): Camp Ta-Was-See, trois jours d'aventure dans un camp du YMCA dans la vallée de la Qu'Appelle: canotage, voile, artisanat, water-polo, natation, soccer, feux de camp, coucher dans une cabine, et bien d'autres choses encore. Départ de Regina le 3 juillet et retour le samedi 6 juillet.

DATE LIMITE: Le nombre d'inscriptions de jeunes délégués à *l'un ou l'autre* de ces programmes sera limité; la date limite de confirmation est fixée au 15 mai. Le prix sera d'environ 100$ par enfant. On trouvera TOUS LES DÉTAILS ET UNE FORMULE D'INSCRIPTION dans la livraison de mars de *La Revue canadienne d'optométrie.*

Retrouvailles: Jeudi 4 juillet: La soirée est réservée pour les retrouvailles de confrères de classe. On a déjà commencé à désigner, pour chaque promotion, des hôtes qui se chargeront de coordonner les festivités de la soirée. Les délégués trouveront au comptoir d'inscription du Congrès la liste des autres délégués, par promotion. Pour renseignements: D r Fred McWilliams, président — Retrouvailles, 303 Scott Bldg., 12 High St. E., Moose Jaw (Saskatchewan) S6H 0B9. Tel. (306) 692-7227.

L'après-congrès

Excursion de pêche dans le Nord de la Saskatchewan

Pourvoyeurs de canots du fleuve Churchill, Camp Missinipi. Du samedi 6 juillet au mercredi 10 juillet. Tous repas compris; une embarcation avec moteur par groupe de trois pêcheurs; un guide par embarcation; essence; hébergement au camp; literie; transport aller-retour par autocar. Ne comprend PAS l'équipement de pêche ni les articles personnels. Prix par personne — 425$ (minimum de 20 personnes). Si vous organisez votre propre transport, le séjour au camp coûte 100$ par jour, pour un groupe minimum de trois personnes. LA DATE LIMITE POUR L'INSCRIPTION à cette excursion est fixée au 1er MARS 1985.

Réservations et renseignements:

Sportsmen Adventure Inc.
94 Empress Drive
Regina (Saskatchewan)
S4T 6M6
Attention: M. Russ Green
Tél.: (306) 522-8867

Excursion en canot en pleine nature

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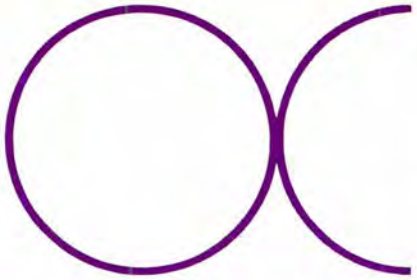

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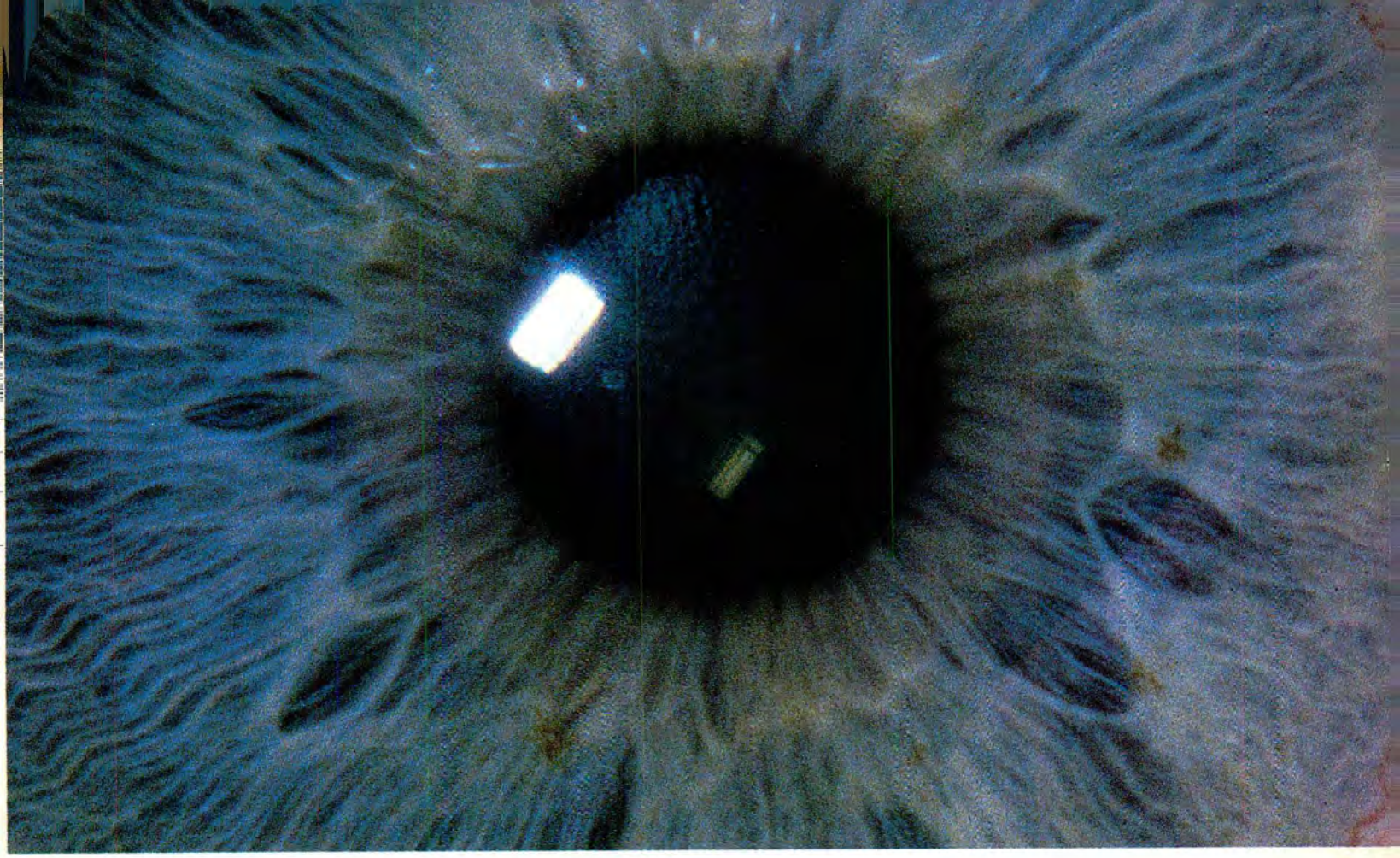

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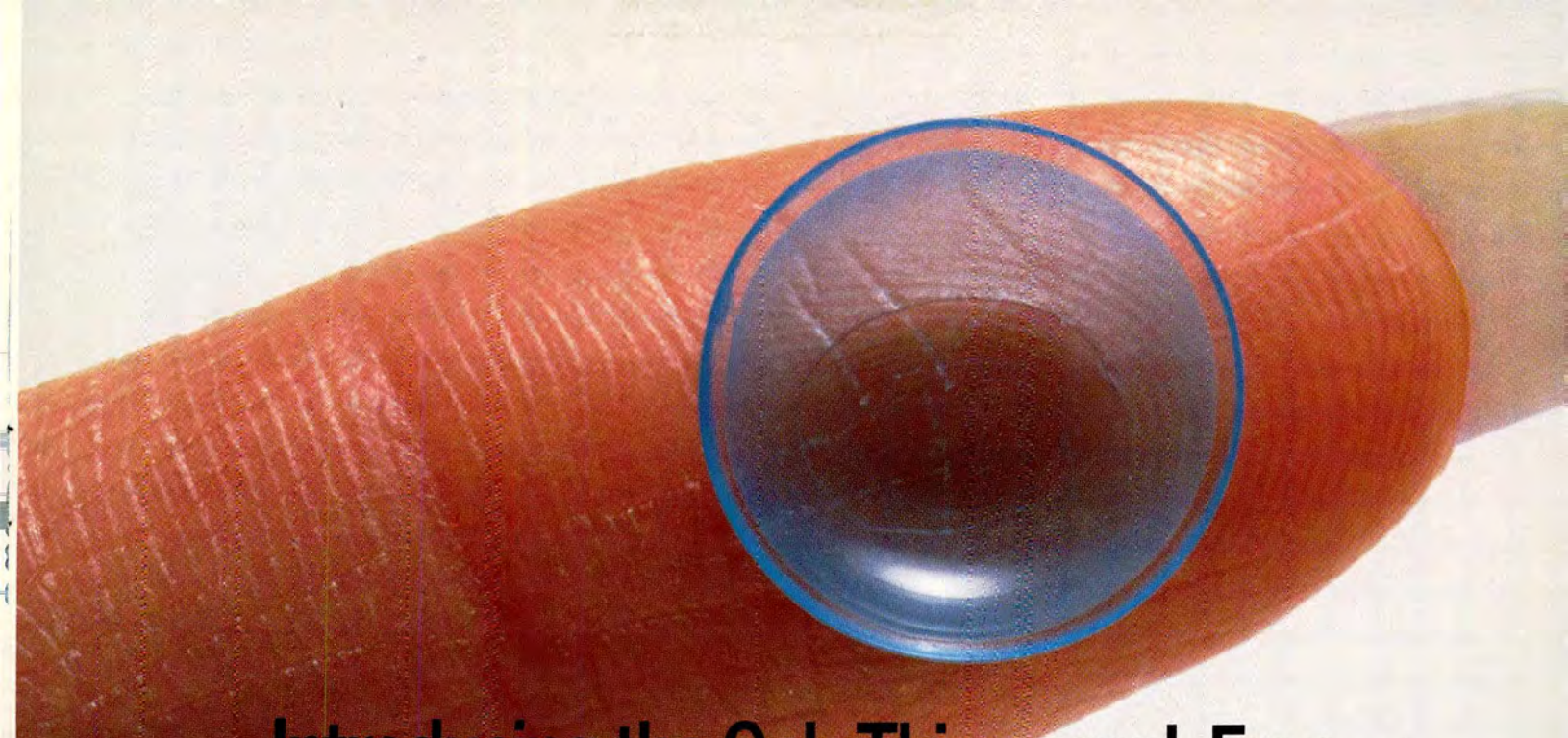
1. Stein, J.M.: Clinical evaluation of Alcon's Enzyme Cleaner with daily wear soft, hydrophilic contact lenses. June, 1982.
2. Randeri, K.J. et al: A new broad spectrum enzymatic cleaner for contact lenses, Alcon Report Series: 107, Alcon Laboratories, Inc. Fort Worth, Texas 76101, July, 1982.



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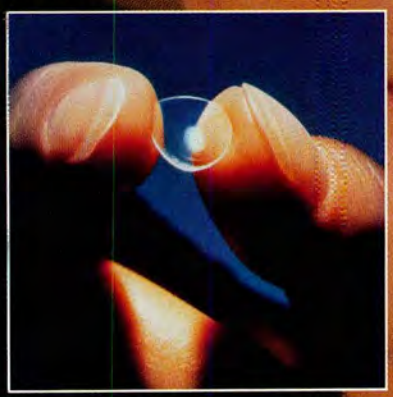

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