Original Article

Do UV-blocking Soft Contact Lenses Meet ANSI Z80.20 Criteria for UV Transmittance?

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Abstract

Purpose: To compare ultraviolet (UV) ray transmission in four UV-blocking soft contact lenses with Z80.20 standards set by the American National Standards Institute (ANSI).

Methods: Four soft contact lenses including Acuvue Oasys (Johnson & Johnson, Ireland), Acuvue 2 (Johnson & Johnson, Ireland), Zeiss CONTACT Day 30 (Zeiss, Germany), and Sauflon 55 UV (Sauflon, UK) were evaluated for UV transmission. One-way ANOVA testing was performed to compare mean values of UVA and UVB transmission for the contact lenses.

Results: Acuvue Oasys, Acuvue 2, Zeiss CONTACT Day 30 and Sauflon 55 UV showed UV-B transmittance values of 0.24%, 1.46%, 10.37%, and 2.52%, respectively. Corresponding values for UV-A transmittance were 20.81%, 33.49%, 44.03% and 42.53%, respectively. One-way ANOVA showed a statistically significant difference among the tested contact lenses in terms of UV-B ($P < 0.001$) and UV-A ($P < 0.001$) transmission.

Conclusion: Acuvue Oasys met the ANSI criteria for UV transmission and may thus be a good choice for eye and vision care specialists and contact lens wearers seeking UV protection.

Keywords: UV-blocking Contact Lens; Spectral Transmittance; ANSI Z80.20 Standard

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INTRODUCTION

Protection against solar ultraviolet (UV) radiation is an important health concern.[1] UV radiation is part of sunlight spectrum and covers a range of wavelengths from 100 to about 400 nm which is broken down into three regions: UV-C (200-290 nm), UV-B (290-315 nm), and UV-A (315-400 nm). UV-C rays are completely absorbed by the ozone layer in the upper atmosphere and do not reach the surface of the earth.[2]

Exposure to UV radiation may lead to a spectrum of eye diseases.[3-6] The term Ophthalmoheliosis is used to describe any eye disorder caused by, or related to, sunlight exposure.[7] Several studies have demonstrated abnormalities in the eyelids, cornea, conjunctiva and iris after UV-B exposure[8] and suggested a correlation between UV-B exposure, and cataracts and age-related macular degeneration.[6,9-12]

Ozone depletion due to recent environmental changes may increase exposure to UV radiation.[13] There are several ways to reduce the risk of potential UV radiation damage to the eyes, such as avoidance of direct sunlight exposure, use of UV-blocking eyewear (sunglasses) and

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UV-blocking contact lenses. UV-blocking contact lenses which cover the limbus provide protection from all sources of incident UVR[14] and also help block peripheral light which sunglasses cannot block.[15,16]

Standards provide information on requirements, specifications, guidelines or characteristics regarding a given subject.[17] One of the common standards used for UV transmission of contact lenses is the ANSI Z80.20 provided by the American National Standards Institute (ANSI). According to this standard, there are two different classifications of UV-blocking lenses. Class 1 contact lenses block 90% of UV-A rays and 99% of UV-B rays, while class 2 contact lenses, block 70% of UV-A and 95% of UV-B radiation. As class 2 blockers transmit UV rays, they are recommended for general environments.[18]

The present study was designed to evaluate whether available UV-blocking soft contact lenses can meet the ANSI Z80.20 criteria for UV (A and B) transmittance and protect the eyes against solar UV rays.

METHODS

This cross sectional study included four types of soft contact lenses including Acuvue Oasys (Johnson & Johnson, Ireland), Acuvue 2 (Johnson & Johnson, Ireland), Zeiss CONTACT Day 30 (Zeiss, Germany), and Sauflon 55 UV (Sauflon, UK). All lenses were selected randomly, and their optical power was -3.00 diopters (D). The characteristics of the lenses are detailed in Table 1. The study was conducted in a laboratory, the Ophthalmic Lens Verification Center (OLVCR), at Shahid Baheshti University of Medical Sciences, a collaborating laboratory for the Iranian National Standard Organization (ISNO).

Measurement of UV transmittance spectra was performed using a spectrophotometer (Cecil instruments, UK). A contact lens holder and cell were designed to ensure that the soft contact lens remained in saline in a stable and hydrated state throughout the measurement process. Before each test, the baseline transmittance of the reference cell was measured and recorded. The cell was a cube-shaped glass with opaque sides except for two clear sides with dimensions of 12.5 × 12 × 45 mm^3. The cell was placed and fixed in the holder, and then both were inserted in the dark space of the instrument. The mentioned space was closed with a shield to prevent interference with external light. Baseline recording was the reference and taken without the contact lens. After recording the baseline, each contact lens was removed from the blister pack or vial using tweezers, inserted into the measurement cell of the holder and the test was repeated.

The scan was performed at 0.5 nm intervals at a speed of 10 nm/seconds (s) for the waveband 290–400 nm and with an optical bandwidth of 4nm. Spectral transmittance (UVA, UVB) was measured three times for each of the three lenses evaluated from the four different brands and compared to values set by the ANSI Z80.20 standards for class 2 UV blocking contact lenses.

Data was analyzed using SPSS Statistics software (Version 17.00, IBM Co. USA). One-way ANOVA was used to compare mean UVB and UVA transmissions for UV-blocking soft contact lenses versus the standard values. $P < 0.05$ were considered as statistically significant. Multiple comparisons were employed to make pairwise comparisons for each waveband among the different contact lenses.

RESULTS

UVA and UVB transmittance of four UV- blocking soft contact lenses (Acuvue Oasys, Acuvue 2, Sauflon 55 UV and Zeiss CONTACT Day 30) were evaluated. The results of UVA and UVB transmission from contact lenses are summarized in Table 2. Each entry at this table is the average of nine values (three lenses from each brand and three experiments on each lens).

Acuvue Oasys showed the lowest transmittance of UV-B (0.24%) while Zeiss CONTACT had the highest transmittance (10.37%). Acuvue 2 and Sauflon 55 UV had UV-B transmittance of 1.46% and 2.52%, respectively [Figures 1 and 2]. UV-A transmittance values for Acuvue Oasys and Acuvue 2 were 20.81% and 33.49%, respectively. Sauflon 55 UV and Zeiss CONTACT Day 30 had higher UV-A transmittance values of 42.53% and 44.03%, respectively [Figures 1 and 3].

One-way ANOVA statistical analysis showed a statistically significant difference among the tested contact lenses in terms of UVB ($P < 0.001$) and UVA ($P < 0.001$) transmission.

Multiple comparisons using the Tukey HSD test showed that the difference between the two sets of

Table 1. Characteristics of the four contact lenses

Brand	Manufacturer	UV marking	Material	Power (D)	BC (mm)	CT (mm)	WC (%)
Acuvue Oasys	Johnson & Johnson, Ireland	UV blocking	Senofilcon A	–3.00	8.4	0.07	38
Acuvue 2	Johnson & Johnson, Ireland	UV blocking	Etafilcon A	–3.00	8.7	0.08	58
Sauflon 55 UV	Sauflon, UK	UV blocking	Methafilcon A	–3.00	8.6	0.07	55
Contact Day 30	Zeiss, Germany	UV blocking	Ocufilcon F	–3.00	8.6	0.10	55

BC, base curve; WC, water content; CT, central thickness; UV, ultraviolet; mm, millimetre; D, diopter

Table 2. Ultraviolet-A and ultraviolet-B transmission in four contact lenses

Brand	UV-B (%)	UV-A (%)
Acuvue 2	1.46±0.26	33.49±37.92
Acuvue Oasys	0.24±0.33	20.81±33.54
Sauflon 55 UV	2.52±0.86	42.53±35.90
Zeiss Contact Day 30	10.37±1.12	44.03±35.08

UV, ultraviolet

data was statistically significant at a 95% significance level ($\alpha = 0.05$). The differences among UVB spectra were significant for all pairwise comparisons between tested contact lenses ($P < 0.001$). The differences between the UVA spectra were statistically significant for the Acuvue Oasys compared to Acuvue 2 ($P < 0.006$). This was also true for the Acuvue Oasys versus the Zeiss CONTACT Day 30 and Sauflon 55 UV ($P < 0.001$ for both comparisons). There was no significant difference in other pairwise comparisons.

DISCUSSION

In the present study, UVB and UVA transmittance values of four different UV-blocking soft contact lenses were compared to ANSI standards for UV transmittance of Class 2 UV-blocking contact lenses. UVC transmittance was ignored because it is not considered in the standard.[18] We included two brands of contact lenses which have not previously been studied, i.e. Zeiss CONTACT Day 30 and Sauflon 55 UV.

Our results showed that different amounts of UV were transmitted by various contact lenses, although some values were comparable [Figure 1]. The main reason for different transmission of UV through contact lenses is different UV absorber materials used for their manufacture [Table 1].

UVB transmittance values for Acuvue Oasys and Acuvue 2 contact lenses were in good agreement with the manufacturer;[19] however, our results showed that UVA transmittance values for Acuvue Oasys and Acuvue 2 were higher than the company's claim at 10% and 21%, respectively. We have no information regarding instrumentation and experimental procedure employed by the company, thus the different findings may be due differences in the instrument and methods.

UVA transmittance values for the Acuvue Oasys and Acuvue 2 contact lenses corresponded well with values published in a recent study by Osuagwu et al[20] before and after wearing the mentioned lenses; however for UVB, agreement was present only for the Acuvue Oasys. The small observed difference is probably due to the formation of biofilms on the contact lens surface following wearing.[20] The main reason for similarity of the results is due to comparable protocols used in the two studies. Other tested brands in the two studies were different.

There was considerable similarity between our results and those reported by Mohammadinia et al regarding Acuvue 2 and Acuvue Oasys contact lenses.[21] The small difference between the studies may be due to different thickness and power of tested contact lenses, and different instruments. Mohammadinia et al used a transmittance meter and contact lenses with -1.50D power, while in the current study, we employed a spectrophotometer and contact lenses with -3.00D power resulting in more accurate and acceptable findings. In the study by Mohammadinia et al, only the Acuvue Oasys contact lens met the UVB ANSI criteria; however in our study, both the Acuvue 2 and Acuvue Oasys lenses

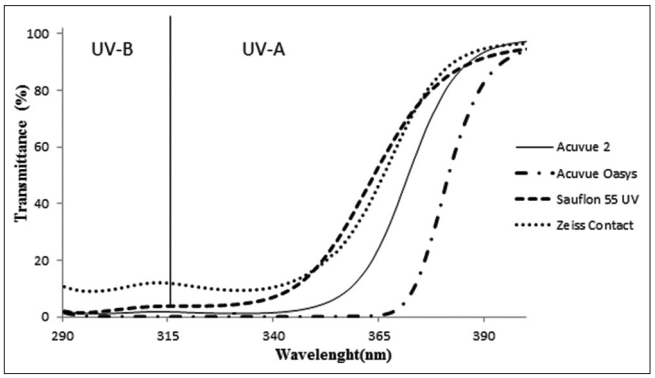

Figure 1. UV transmittance in tested contact lenses.

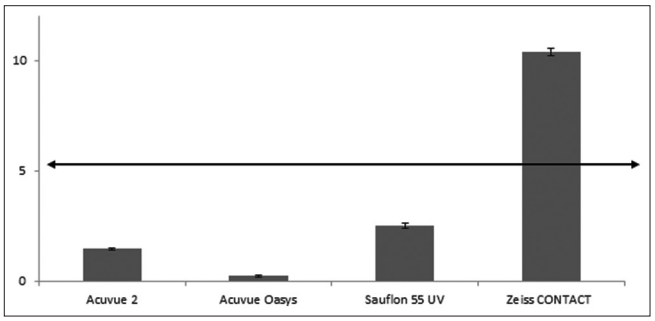

Figure 2. UVB transmittance (%) of tested UV-blocking soft contact lenses.

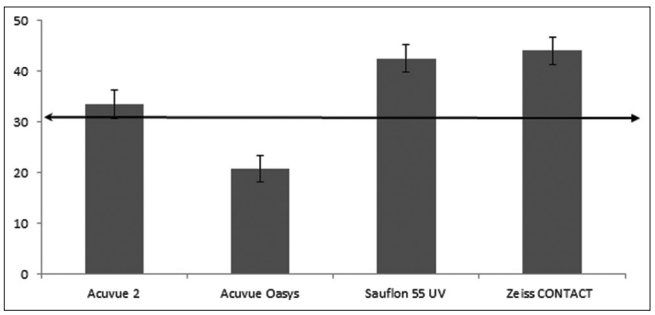

Figure 3. UVA transmittance (%) of tested UV-blocking soft contact lenses.

fulfilled the UVB ANSI criteria. Moreover, both UVB and UVA ANSI criteria were met by Acuvue Oasys.

The results of previous studies on transmittance properties of Acuvue 2 UV blocking soft contact lenses are comparable to ours.[22-24] Although the nature of those studies are basically different from our method, there is an agreement on effectiveness of UV blocking soft contact lenses to eliminate harmful UV rays.

Considering UV transmission of the Acuvue Oasys, Moore and Ferreira reported findings consistent with ours.[25] The instrumentation and experimental procedure used in the studies such as the use of a wet cell and similar powers of tested lenses, are considered as the main reasons for the agreement.

Since we could not find any article reporting the UV transmittance of Sauflon 55 UV and Zeiss CONTACT Day 3 in the literature, we only report our results for these contact lenses. The spectra for evaluated contact lenses show that Acuvue 2 and Zeiss CONTACT Day 30 have a window of transmittance at about 313 nm, while Sauflon 55 UV has a window of transmittance at about 318 nm region. We did not find any definite window of transmittance for the Acuvue Oasys.

For UVB radiation, the Acuvue 2, Acuvue Oasys and Sauflon 55 UV contact lenses met the ANSI standard criteria because all of them transmitted less than 5% of the spectrum [Figure 2]; however, for UVA transmittance, only the Acuvue Oasys contact lens showed the required blocking value and the Acuvue 2 had the closest value to Acuvue Oasys [Figure 3].

In summary, we observed that among other tested contact lenses, the Acuvue Oasys contact lens meets the ANSI criteria for class 2 UV transmittance. Further studies on other UV blocking soft contact lenses is recommended to distinguish brands which are able to meet the ANSI Z80.20 criteria and thus effectively protect the eyes against harmful UV rays.

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Nil.

Conflicts of Interest

There are no conflicts of interest.

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