VIDEOTAPING OF CONJUNCTIVAL VASCULAR RESPONSE TO CONTACT LENS WEAR

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ABSTRACT

Patients without previous contact lens experience were filmed with a video camera mounted on a slit lamp before initial contact lens insertion and again a minimum of one hour after initial wear. The entire 360 degrees of the corneal-scleral limbus was filmed for patients in the first section of the study. The limbal vascular arcades were seen to engorge in width and increase an average of .05mm in length. No vessels were found that extended over 0.50mm from the limbus.

In addition to recording changes at the corneal-scleral limbus the superior palpebral conjunctiva was filmed in the second section of the study. With one exception, no vascular changes were seen after at least one hour of wear after initial insertion of both hard and soft contact lenses.

Several advantages and disadvantages of the method of videotaping in ocular research are listed in the discussion. Results of videotaping in this study were similar to results in other studies utilizing still photography.

RESEARCH GOALS

Recent research documenting vascular response to contact lens wear has been completed utilizing still photography[1]. This study was done to explore the advantages and disadvantages of videotaping vascular changes and recording these on video cassette tape.

The first section of the study included the filming of corneal-scleral limbal vessel changes following the initial fitting of contact lenses. The goal of this section was to quantitate and visually document the filling of these vessels and to evaluate the utility of recording on video cassette tape.

E. Faber and J. Alles in a recent presentation[2] to a contact lens conferance gave evidence that lens calculi result in part from micro-bleedings of the conjunctiva due to mechanical damage from the contact lens. A second goal of this study was to search for and document any vascular changes of the superior palpebral conjunctiva apparent using clinical methods, and to evaluate the unique problems of videotape recording of this region of the eye.

METHODS

Filming of the conjunctival blood vessels was done using a Nikon photoslitlamp and a 35mm Pollux black and white CCCD television camera mounted on the slit lamp. All filming was done using a red-free filter and direct illumination.

Recording was done on a Hitachi videocassette recorder with a RCA videocassette tape. A black and white television connected to the camera was used to moniter the recording. All filming was monitered during the recording to optimize the quality of the recording.

To determine the linear magnification of the vessels to be measured a contact lens graticule was filmed at both 25x and 35x. All vessels were filmed at both magnifications, the lower magnification to locate specific vessels and the higher magnification to measure fine vessel changes.

Acetate transparencies were placed over the television screen and a tracing of the filmed graticule at both 25x and 35x was made. The use of acetate transparencies made it possible to measure vessels with consistant accuracy on any size television used for videocassette playback of the recorded results.

EXPERIMENTAL SUBJECTS

All subjects filmed for evidence of conjunctival vascular changes had no previous contact lens wearing experience, had normal limbal vasculature, and were between the ages of 19 and 29 years old. For filming the limbal vasculature the subjects were fitted with soft contact lenses of appropriate power. An optimum fit with good centration, sag, lag, and at least 1mm of movement on blink for each subject was obtained after initial pre-insertion filming of the limbal vasculature.

FILMING METHOD

Before fitting the subjects with their contact lenses, 360 degrees of the corneal-scleral limbus was filmed in both eyes at both 25x and 35x. Extra time was spent filming unique limbal conjunctival vessel configurations that could be used as landmarks for filming after contact lens wear. The subjects wore the soft contact lenses for a minimum of one hour and returned for the filming of any vascular changes that may have occured. When the subject returned, 360 degrees of the corneal-scleral limbus was filmed at both 25x and 35x with special attention to maintaining the same red-free illumination and with extra filming time of landmark vessels. The initial before-fit recording was reviewed prior to the after-fit filming to help insure similar illumination and landmark vessel inclusion for the measurement of vascular changes. Five patients were filmed using these techniques.

For the second section of the study four additional patients were fit with hard contact lenses to increase the possibility of mechanical damage to the superior palpebral conjunctiva (SPC) from the hard contact lens edge. One patient was filmed before and after irritating the SPC with a cotton swab. Two additional patients were fit with soft contact lenses and filmed at least one hour after wear.

The initial filming of these patients was done with the same video recording apparatus as detailed above. To film the SPC the upper lids were everted and filmed at 25x and 35x. The vessels used as landmarks in the SPC filming were the underlying ascending and descending branches of the superior conjunctival vein[10], while focusing on the surface of the SPC. Red-free illumination was again used to enhance the contrast of the filmed vessels. Special attention was paid to filming the inferior one-third of the SPC in patients fit with hard contact lenses where the lid would meet the edge of the lenses, and filming the middle to superior one-third of the SPC in patients fit with soft contact lenses at the apposition of the soft contact lens edge.

After initial filming, patients were fit with standard clinic hard gas permeable trial lenses of appropriate diameter, base-curve radii and power for an optimum fit. The hard contact lens edges were not evaluated. The soft contact lenses were fit as mentioned in section one of the study above.

The method for measuring vessel changes in section two was to search for any change in vasodilation, capillary flush, vessel extension, and to note any micro-bleedings.

MEASUREMENTS AND RESULTS

To measure the changes in limbal vasculature, the video tape sections recording the eye before contact lens wear were searched for landmark conjunctival vessel configurations. The positions of these vessels were noted by the meter number on the videocassette recorder at the first appearence of the vessel on the tape. The configuration of the vessel and location on the limbus was sketched and a search was begun to locate the same vessel on the section of the videotape recorded after contact lens wear. Of the 45 vessels filmed on the five patients, 32 were filmed with adequate quality to make good measurements both before and after contact lens wear.

The vessels were measured at the limit of the visible iris in the same manner of McMonnies et al[1]. Measurements were taken to the nearest 0.05mm with error to ±0.025mm. It was found to be impossible to measure below this limit with confidence due to the size of the graticule initially used and the eye movements of the subjects during filming.

It was hoped that the pause control of the VCR could be used during measurement-taking but this resulted in very poor resolution, therefore all measurements were taken with the film advancing during moments of stationary filming.

There were three observations of changes in transparency of the limbus affecting the baseline of the visible iris limit. None of these vessels were included in the data.

Table 1 lists the data taken from the five patients in the first section of the study. All measurements listed are in millimeters. MEAN represents the arithmetic mean of all the measurements, MAX and MIN represent the maximum or minimum increase in the linear extent of vessels measured from the visible iris edge to the point of greatest penetration into the cornea in the direction of the visual axis. % represents the percentage change in length of the average values after contact lens wear in each patient.

TABLE 1 : LIMBUS STATISTICS

		BEFORE	AFTER	
PATIENT #1	RANGE	0.25-0.45mm	0.25-0.50mm	
	MEAN	0.34mm	0.36mm	MAX 0.10mm
	MEDIAN	0.35mm	0.35mm	MIN 0.00mm
	N	15	19	6%
PATIENT #2	RANGE	0.00-0.35mm	0.05-0.35mm	
	MEAN	0.17mm	0.20mm	MAX 0.05mm
	MEDIAN	0.15mm	0.20mm	MIN 0.00mm
	N	14	18	17%
PATIENT #3	RANGE	0.00-0.30mm	0.05-0.30mm	
	MEAN	0.08mm	0.11mm	MAX 0.05mm
	MEDIAN	0.05mm	0.10mm	MIN 0.00mm
	N	14	13	37%
PATIENT #4	RANGE	0.05-0.15mm	0.05-0.25mm	
	MEAN	0.10mm	0.15mm	MAX 0.10mm
	MEDIAN	0.10mm	0.15mm	MIN 0.00mm
	N	18	13	50%
PATIENT #5	RANGE	0.00-0.10mm	0.00-0.15mm	
	MEAN	0.02mm	0.06mm	MAX 0.05mm
	MEDIAN	0.00mm	0.05mm	MIN 0.00mm
	N	12	12	200%
TOTAL	MEAN	0.15mm	0.20mm	

For all data the increase in the mean is significant at $p<0.001$, z-test.

The limbal vascular plexus was seen to engorge on all of the patients filmed and this engorgement was mainly an expansion in width of the vessels filmed. The linear extent of the vessels increased in twenty of the thirty-two vessels measured. Although with only a few exceptions this increase was limited to 0.05mm. The expansion of vessal width was apparent on viewing the video tape, but unfortunately the dimension of the increase was too small to measure with the experimental technique used.

In the five patients measured, the length of vessels extending past the visible iris limit into the cornea ranged from 0.00mm to 0.45mm before contact lens wear and 0.00mm to 0.50mm after contact lens wear. All of the increases measured were in the tertiary limbal arcades. No vessel spikes were noted in any of the five patients. As noted in Table 1 the total of the mean increases in vessel length from 0.15mm to 0.20mm was a significant increase at the $p<0.001$ level utilizing the z-test. A consideration of the limit for measuring vessel lengths with a possible error of + 0.025mm must be made in evaluation of the data.

In the second section of the study the method for measuring results for SPC changes was similar to that of the limbal vessels. Due to no apparent changes in vessel lengths no linear measurements were taken.

Of the six patients filmed there were twenty-four landmark vessels with overlying conjunctiva that were possible to evaluate both before and after the mechanical stimuli of hard contact lenses, soft contact lenses and cotton swab.

Only one vascular change was noted from the hard contact lens patients. This change was a band of capillary flush along the inferior third of the SPC. No micro-hemmorhages were seen.

No vascular changes were seen in the two subjects wearing soft contact lenses and on the SPC of the patient that agreed to an unpleasant scrubbing with the cotton swab.

DISCUSSION

A. LIMBAL VESSELS

In the effort to prevent vascularization of the cornea Optometrists need to moniter the vessels of the corneal-scleral limbus. Engorgement of the limbal vessels occurs due to soft contact lens wear.[3,4,11] Corneal neovascularization is thought to result from an initial engorgement of the perilimbal plexus in the presence of peripheral corneal edema followed by invasion into the cornea of new vessels.[5]

Obviously the practioner needs to know the difference between limbal vessel engorgement and the first stages of neovascularization. Allansmith defines neovascularization as an extension of vessels over 1mm from the limbus into the cornea.[6] Larke agrees with this definition but extends his definition to catagorize early neovascularization as follows:

1. NORMAL - 9 of 10 limbal arcades unfilled, no spikes.
2. LIMBAL CONGESTION - Greater than 1/2 of the arcades filled with blood and no spikes.
3. APPARENT EARLY NEOVASCULARIZATION - one or more spikes present off from the arcades.
4. APPARENT NEOVASCULARIZATION - vessels extending greater than 1mm into the cornea.

McMonnies et al measured limbal vessel engorgement in habitual soft contact lens wearers and found the average vessel extent to be 0.47mm; this was not statistically significantly different from the 0.42mm measure of limbal vessel engorgement due to a vaso-stimulent.[1]

Tomlinson and Haas found that corneal edema and limbal engorgement occured within one hour of contact lens wear, but did not quantitate the extent of vascular change.[8]

One aim of the first section of this study was to quantitate the immediate engorgement to provide a baseline for measuring expected vessel changes in contact patients. This study has shown that the filling of tertiary limbal arcades and increases in the linear extent of limbal vessels can occur soon after contact lens initial wear. This study and the study of McMonnies et al found normal limbal vessel extent into the cornea of less than 0.50mm. Limbal vessels extending up to 0.50mm from the limit of the visible iris seen on patients presenting for contact lens followup examinations could represent an engorged limbal vascular plexus rather than neovascularization. Vessels extending greater than 0.50mm may represent actual new vessels which would fall into Larkes´ stage 3 of apparent early neovascularization.

B. SUPERIOR PALPEBRAL CONJUNCTIVAL VESSELS

Mechanical irritation of the SPC vessels is one of the stimuli thought to induce giant papillary conjunctivitis.[9] Faber and Alles found that mechanical irritation of the SPC from soft contact lenses caused micro-bleedings that induced formation of lens calculi or "jelly bumps".[2] The second section of this study was to determine if any micro-bleedings could be found and recorded on videotape with clinical methods. No micro-bleedings were located on the six patients studied. One possible explanation for the lack of vascular changes is the wear time of only one hour in these patients. One patient with stage 2 giant papillary conjunctivitis was filmed, though the results were not included in the data above. This patient exhibited the injected SPC and slightly raised papillae characteristic of stage 2 and although this patient was a long-term wearer of contact lenses again no micro-bleedings were found.

C. EVALUATION OF VIDEOTAPING METHOD

A few comments on the method of videotaping used in this study might be helpful to future investigators as little discussion in this regard is reported in the literature. The following is a discussion of the advantages and disadvantages of videotaping.

One of the major disadvantages of this method is the need to create a tape chronology with meter numbers for the data being recorded, such as landmark vessels in this study. The meter numbers for each data point on the film will change if the tape is played on different videocassette recorders. This necessitates a complete review and notation of the results taped which can consume hours of time. All taping and tape review should be done on the same recorder. Unlike measuring still photographs or slides videotaped data is not stationary. The pause control was not found to be useful on several videocassette recorder makes used in reviewing data in this study. Therefore when filming objects to be measured filming must focus at one point for a sufficient time to take measurements (approximately eight seconds in this study). A third disadvantage is the movement of the subject though this presented no problem in this study even at high magnifications. A final disadvantage is the diffulty in comparing before and after shots, due to the time it takes to view the appropriate taped segments. One method which could enhance the ability to make good comparisons would be to make a copy of the videotaped results. The two tapes could be viewed with the observer seeing the before-segment on one television screen and the after-segment on another television screen simultaneously.

There are several advantages of videotaping over that of still photography in ocular research. The first major advantage is the quick results obtainable by avoiding the time necessary for the development of 35mm slides and photographs. Also several photographs or slides must be taken with still photography to insure the proper focus and illumination of the object for measurement. With videotaping the object can be viewed on a moniter and focused and illuminated as needed before and during recording. Other advantages of videotaping include the lower cost of the purchase of one videotape as compared to the purchase of film and developing as well as the ability to record motion. Some of the vessels filmed in this study did not appear patent untill an aggregation of erythrocytes moved through the vessel. Videotaping may also prove useful in recording other movements such as pupillary reactions, convergence-divergence, ocular motility, cover test results, and initial stage deposit formation on new contact lenses.

CONCLUSION

This study supports research quantitating limbal vasculature engorgement at a range up to 0.50mm from the limbus and suggests that greater than 0.50mm may be a sign of apparent early neovascularization.

No evidence of micro-bleeding was found in the SPC resulting from mechanical effects of soft or hard contact lenses after a minimum wear time of one hour.

Some advantages and disadvantages of videotaping in ocular research were detailed above. The only major problem of videotaping in this study was the inability to maintain a consistent tape chronology when switching different videocassette recorders during data analysis. Major advantages of videotaping were the ability to record motion and to simultaneously moniter data recording.

The following are suggestions for studies that may be appropriate for videotaping research.

a.) Contact lens compression of limbal vessels.
b.) Long term studies of SPC vascular changes in contact lens wear.
c.) Long term limbal vessel engorgement and corneal vascularization studies.
d.) Rebound phenomena of conjunctival vessels subject to vasoconstrictors.
e.) Filming of allergic response to topical agents.
f.) Filming of pupillary response such as Marcus-Gunn pupil.
g.) Filming anomalies of ocular motility such as nystagmoid movements.
h.) Immediate deposit formation on new contact lenses.

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