PERIPHERAL CORNEAL INFILTRATES ASSOCIATED WITH CONTACT LENS WEAR*

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ABSTRACT

Purpose: A retrospective study was performed to review the clinical characteristics of peripheral corneal infiltrates in contact lens wearers.

Methods: The charts of all contact lens patients with peripheral corneal infiltrates 1.5 mm or less in size who presented to the office from 1987 to 1994 were reviewed.

Results: The epidemiological and clinical characteristics of peripheral corneal infiltrates associated with contact lens wear were reviewed in 52 patients (64 infiltrates). Forty-four patients presented with a single infiltrate, while the remaining 8 patients had multiple infiltrates. While there was no predilection for a specific quadrant of the cornea, when a subgroup of patients who wore extended wear lenses was analyzed, 19 of the 40 infiltrates were located in the superior quadrant. Forty percent of the patients were wearing disposable extended wear contact lenses, 21% were wearing conventional extended wear lenses, 33% were wearing conventional or frequent replacement/disposable daily wear contact lenses and 6% were wearing rigid gas permeable lenses. The majority of patients had minimal conjunctival inflammation, an anterior stromal cellular reaction and minimal anterior chamber activity. A subgroup of 16 patients had corneal cultures of their infiltrates. In this group, 8 of the 16 had positive cultures. All patients had a resolution of the infiltrates without complications and the majority were refitted to daily wear soft or rigid contact lenses.

Conclusion: Peripheral corneal infiltrates in contact lens wearers appears to be more common in patients wearing extended wear soft contact lenses. While often considered "sterile" in the literature, a significant number have been shown to be culture-positive. The organisms that have been associated with peripheral infiltrates appear to be less "pathogenic" than those that have been reported to be associated with central corneal ulcer. However, it is probably advisable that patients with peripheral corneal ulcers secondary to contact lens wear should be initially treated with topical antibiobics.

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INTRODUCTION

Corneal infiltrates are a serious complication associated with contact lens wear. They can range from a small infiltrate with or without an associated epithelial defect to a large corneal ulcer with active microbial involvement. Distinguishing noninfectious sterile infiltrates from infected microbial keratitis is often difficult.[1-4] Stein and coworkers[4] found that small ulcers, usually less than 1 mm, associated with minimal pain, minimal anterior chamber reaction, absent discharge, and epithelial staining limited to superficial punctate keratopathy (SPK) were usually associated with sterile infiltrates. Bates and coworkers[1] defined "sterile" keratitis as small lesions with limited or no epithelial involvement associated with mild or no anterior chamber reaction without significant pain. Using this criteria, he found 92% were located in the peripheral cornea. Gordon and Kracher[5] also found that "sterile" infiltrates most often cluster in the peripheral cornea. The pathophysiology of corneal infiltrates is not completely understood. The infiltrates are presumed to be a cellular response to chemotactic factor resulting from tissue insult and inflammation.[6] There is a migration of inflammatory cells including polymorphonuclear leukocytes and mononuclear cells into the cornea, forming the infiltrate. The limbal arcade and the precorneal tear film are the likely origin of these inflammatory cells.[7] The etiologies attributed to this infiltrative response include sterile etiologies, contact lens hypersensitivity, preservative toxicity, hypoxia, retrolental debris, and staphylococcal immune complexes, as well as infectious causes.[8-10]

METHODS

A retrospective study of patients with peripheral corneal infiltrates associated with contact lenses who presented to the office between 1987 and 1994 was conducted. The focal corneal infiltrate was defined as being 1.5 mm or less in diameter, occurring in the peripheral cornea within 4 mm of the limbus and located in the subepithelial and/or anterior stroma. The purpose of the study was to describe the epidemiologic characteristics, the clinical characteristics, and the response to therapeutic modalities associated with contact lens–related peripheral corneal infiltrates. Patients were excluded if they had undergone ocular surgery, had central infiltrates, or were wearing a therapeutic contact lens.

The following information was collected from the charts of the subjects: age and sex, lens type, brand and parameters, contact lens wearing schedule, age of the lens, and cleaning and disinfecting methods. The following clinical characteristics of the lesions were analyzed: size, number, location, status of the overlying epithelium, the presence or absence of a surrounding corneal stromal cellular reaction, the degree of conjunctival inflammation, and the degree of anterior chamber activity. An inflammatory index was

TABLE I: CRITERIA FOR INFLAMMATORY INDEX

	GRADE	LEVEL
Conjunctival inflammation (0-3)	Absent	0
	Minimal	1
	Mild	2
	Moderate	3
Cellular infiltrate (0-1)	Absent	0
	Present	1
Anterior chamber activity (0-3)	Absent	0
	Trace	1
	Minimal	2
	Mild	3

**The sum of conjunctival inflammation, cellular infiltrate, and anterior activity; maximum inflammatory index = 7.*

derived in the following manner (Table I): the amount of conjunctival inflammation (0-3), anterior chamber activity (0-3), and presence or absence of corneal cellular reaction. The inflammatory index could vary from 0 to a maximum of 7 for each patient. Bacterial cultures were performed in a subgroup of 16 patients. Cultures were taken from the corneal infiltrate (a swab of the corneal infiltrate) and then sent directly to the laboratory in transport media for gram stain, culture, and sensitivity.

Treatment modality and time to resolution of the infiltrates were analyzed. Following resolution of the infiltrate, the type of contact lens the patient was refitted to was documented.

Statistical analysis was undertaken by using a two-tailed Student's *t* test and chi-squared analysis. A 95% confidence interval was utilized for all analyses.

RESULTS

DEMOGRAPHICS

The population consisted of 52 patients, 33 females (63%) and 19 males (37%), who ranged in age from 13 to 68 years (average age, 34). Twenty-seven patients (52%) presented with corneal infiltrates involving the right eye, and 25 (48%) with infiltrates involving the left eye (Table II).

TABLE II: AGE, SEX, AND AFFECTED EYE IN 52 PATIENTS WITH CORNEAL INFILTRATES

	NO.	(%)
Age		
Average, 34 yr		
Range, 13 to 68 yr		
Sex		
Male	19	(37%)
Female	33	(63%)
Eye		
Right	27	(52%)
Left	25	(48%)

PATIENT PROFILES

Thirty-two patients (61.5%) were wearing extended-wear hydrogel lenses, 17 patients (32.7%) were wearing daily-wear hydrogel lenses, and 3 patients (5.8%) were wearing rigid gas permeable lenses. Of the 32 patients who were wearing extended-wear soft contact lenses, 21 wore disposable extended-wear lenses and 11 wore conventional extended-wear lenses (Table III).

The patients wearing disposable extended-wear lenses wore their lenses an average of 7.7 days prior to presenting with corneal infiltrates and reported that they replaced their lenses with new lenses an average of once a week. Patients wearing conventional extended-wear lenses wore them continuously for an average of 8 days before removing, cleaning, and disinfecting their lenses. They replaced their lenses on a yearly basis. Patients who wore conventional daily soft contact lenses wore their lenses an average of 16 hours a day and replaced their lenses an average of once every 340 days. Patients who wore disposable daily wear lenses replaced their lenses at weekly intervals and wore their lenses an average of 14 hours a day. Patients who wore their lenses on a frequent replacement schedule replaced their lenses an average of once every 44 days and wore their lenses for 19 hours a day. Patients who were wearing rigid gas permeable lenses replaced their lenses an average of 240 days and wore their lenses an average of 14 hours a day.

Forty-two patients (80%) required a myopic correction with an average power of -3.60 diopters. Five patients (10%) wore hyperopic correction with an average power of +5.10 diopters. The water content and lens polymer data are summarized in Table IV.

TABLE III: LENS TYPE AND INDICATION FOR LENS WEAR VERSUS LENS AGE AND WEARING TIME

	NO. (%)	AV LENS AGE (DAYS)	AV WEAR TIME (HRS)	AV INFLAMMATORY INDEX
Lens type				
CDW	10 (19%)	340	16	2.25
CEW	11 (21%)	361	210	2.80
DDW	1 (2%)	7	14	2.00
DEW	21 (40%)	7	185	2.09
FRP	6 (12%)	44	19	1.88
RGP	3 (6%)	240	14	1.67
Indication for lens wear				
Myopia	42 (80%)			
Hyperopia	5 (10%)			
Unknown Refr	5 (10%)			

CDW, conventional daily wear; CEW, conventional extended-wear; DDW, disposable daily-wear; DEW, disposable extended-wear; FRP, frequent replacement daily-wear; RGP, rigid gas permeable.

LENS CARE

Eighteen patients (35%) were wearing disposable lenses and thus did not use any cleaning or disinfecting solutions. Twenty patients (38%) used a chemical disinfectant regimen, and 10 patients (19%) used a hydrogen peroxide system. For 4 patients the disinfecting system was unknown.

CLINICAL CHARACTERSTICS OF INFILTRATES

Forty-four patients (85%) presented with a single infiltrate, while the remaining 8 patients had multiple infiltrates (4 patients presented with 2 infiltrates and 4 patients presented with 3 infiltrates). Forty-four infiltrates (34 patients) were less than 1 mm, while 20 infiltrates (18 patients) were between 1 and 1.5 mm (Table V). Figure 1 shows the location of the infiltrates. There was no predilection for a specific quadrant of the cornea when the infiltrates in all patients were analyzed. However, if the location of the infiltrates in only those patients who wore extended-wear soft contact lenses were analyzed, then 19 infiltrates (47.5%) were located between the 11- and 1-o'clock positions. This predilection for the superior cornea approached statistical significance with a P value of .062.

Twenty-seven of the infiltrates presented with intact epithelium. Mild punctate staining was noted over 18 infiltrates, and 19 had a frank epithelial

TABLE IV: WATER CONTENT AND LENS POLYMER DATA FOR HYDROGEL LENSES

	NO. LENSES	(%)	INFLAMMATORY INDEX
Ionization			
Ionized	21	(42%)	2.28
Nonionized	28	(58%)	2.17
Water Content			
38%	17	(35%)	2.17
55%	9	(18%)	2.22
58%	14	(29%)	2
71%	2	(4%)	4.5
74%	1	(2%)	2
Unknown	6	(12%)	

TABLE V: CHARACTERISTICS OF INFILTRATES

	NO. OF INFILTRATES	NO. OF PATIENTS	(%) OF PATIENTS	INFLAMMATORY INDEX
Number				
Single	44	44	(85%)	2.25
Multiple	20	8	(15%)	1.87
Size				
< 1 mm	44	34	(65%)	1.94
1 to 1.5 mm	20	18	(35%)	2.67
Epithelial defect				
Absent	27	17	(33%)	1.55
SPK	18	16	(31%)	2.27
Frank defect	19	19	(36%)	2.74

SPK, superficial punctate keratopathy.

defect. Thus, a total of 37 infiltrates in 35 patients (67%) had epithelial involvement overlying the corneal infiltrate.

BACTERIAL CULTURES

Bacterial cultures of the corneal infiltrates were performed on 16 of the 52 patients (31%). These 6 patients were not using topical antibiotics at the

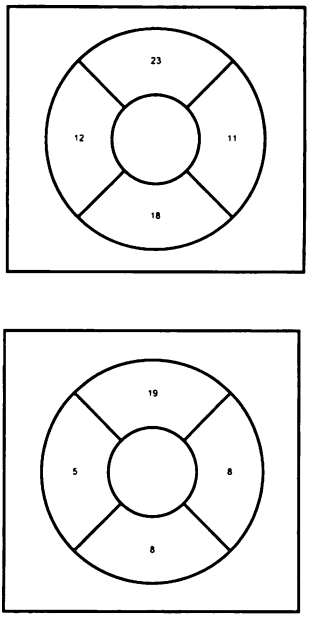

FIGURE 1
Location of infiltrates in all patients (top) and in extended-wear contact lens wearers (bottom).

time of the culture. Eight patients had a positive culture. The cornea in 7 of the 8 patients with positive cultures had a frank epithelial defect, while the remaining case had overlying punctate staining. Of the corneas with negative cultures, 3 had an epithelial defect, 4 had SPK, and in 1 the epithelium was intact. The organisms isolated from the cultures included Staphylococcus non-aureus (4), gram-positive cocci in clusters (2), Staphylococcus aureus (1), Acinetobacter lwoffi (1). In addition, Enterococcus and Escherichia coli were isolated in combination with the staphylococcal organisms. There was no relationship between positive or negative cultures and the number of infiltrates, the size of the infiltrates, and the inflammatory index. In addition, the time to resolution was not statistically different when patients with positive cultures were compared with those with negative cultures. The only significant statistical relationship was that all patients with positive cultures were wearing extended-wear contact lenses ($P = .007$)(Table VI).

OCULAR INFLAMMATION

The inflammatory reaction involving the conjunctiva, anterior chamber, and cornea is presented in Table VII. The majority of patients had minimal to

TABLE VI: LENS TYPE VERSUS CULTURE RESULTS IN 16 PATIENTS

CULTURE RESULTS	EXTENDED WEAR (%)	DAILY WEAR (%)
Positive	8 (100%)	0 (0%)
Negative	2 (25%)	6 (75%)

TABLE VII: OCULAR INFLAMMATION IN 52 PATIENTS

	NO.	(%)
Conjunctival inflammation		
Absent	3	(6%)
Minimal	41	(79%)
Mild	7	(14%)
Moderate	1	(1%)
Cellular infiltrate		
Absent	13	(25%)
Present	39	(75%)
Anterior chamber activity		
Absent	42	(82%)
Trace	4	(8%)
Minimal	3	(6%)
Mild	2	(4%)

mild conjunctival inflammation. An anterior stromal cellular reaction surrounding the infiltrate was found in 39 patients (75%). Anterior chamber activity (trace to mild) was present in only 9 patients (18%).

Using the inflammatory index scale (Table I), patients who had infiltrates less than 1 mm showed a significantly lower inflammatory index than those with larger infiltrates ($P = .03$) (Table V). The presence of an epithelial defect correlated with a higher inflammatory index. For SPK, it was significant at the $P = .003$ level, while for a frank defect it was significant at $P = .002$ level. There was no difference in the inflammatory index when lenses of 38%, 55%, and 58% water content were compared. There was also no statistical difference in the inflammatory index when lenses of ionized and nonionized polymers were compared (Table IV). There was a positive cor-

relation with patients wearing conventional extended-wear lenses in that they had the highest inflammatory index, while frequent replacement and rigid gas permeable lenses were associated with the lowest inflammatory index (Table III). This difference approached significance with a *P* value of .12 when conventional extended-wear lenses were compared with frequent replacement lenses.

RESOLUTION

The mean time to resolution for all infiltrates was 1.74 weeks. Resolution time was 1.58 weeks for patients with single infiltrates, and 2.7 weeks for patients with two infiltrates. This difference was statistically significant ($P = .008$). There was no statistical difference with regard to resolution when one compared the differences in lens wearing modality, inflammatory index, and presence of positive or negative cultures. In all patients, the infiltrates resolved without any effect on vision.

REFITTING WITH CONTACT LENSES

Twenty-six patients (50%) were refitted to daily wear soft contact lenses. Five patients (9.6%) were refitted to frequent replacement soft contact lenses, and 3 patients (5.8%) were refitted to gas permeable contact lenses. Only 3 patients (5.8%) continued to wear extended-wear lenses, using disposable contact lenses and decreasing their wearing time. Fifteen patients were returned to the referring physician for refitting of their contact lenses with the recommendation to be refitted in a daily wear modality.

TREATMENT

The initial treatment consisted of (1) single topical antibiotics, (2) a combination of topical antibiotics, (3) fortified topical antibiotics, (4) topical antibiotic steroid combination, and (5) topical steroids alone. Thirty-nine patients (75%) were treated with antibiotics, 12 patients (23%) with antibiotics/steroids, and 1 patient (2%) with steroids alone. Patients who were treated with antibiotics and steroids had a mean resolution time of 1.27 weeks, while those that were treated with antibiotics alone had a mean resolution time of 2.02 weeks. This is statistically significant with a *P* value of .01.

DISCUSSION

Peripheral corneal infiltrates (within 4 mm of the limbus) associated with contact lenses have a range of clinical characteristics. They are nonprogressive and respond to therapy without serious sequelae. The majority of patients with focal peripheral infiltrates secondary to contact lenses present with minimal conjunctival injection and minimal anterior chamber reaction. However, they do have substantial associated cellular reaction in the cornea surrounding the infiltrate. In the majority of cases, the epithe-

lium overlying the infiltrate was disturbed, with over a third having a frank epithelial defect.

In the present study, there are many similarities to that presented by Bates and coworkers.[1] Peripheral corneal infiltrates appear to be more common in patients wearing extended-wear contact lenses than in those using daily wear lenses. The question of whether disposable extended-wear lenses are more commonly associated with peripheral focal corneal infiltrates than are conventional extended-wear lenses cannot be answered with any degree of certainty from this study. The higher number of patients wearing disposable extended-wear contact lenses presented in this study would suggest this possibility. Nilsson and Montana[11] found that microbial keratitis was significantly more common than sterile keratitis among conventional soft extended-wear contact lens wearers, whereas sterile keratitis was more common than microbial keratitis in disposable extended-wear contact lens wearers. A study by Poggio and Abelson[12] comparing the complications of disposable and conventional extended-wear contact lenses found that while the incidence of ulcerative keratitis was similar between disposable extended wear and conventional extended-wear, peripheral ulcers-infiltrates were more common in disposable extended-wear users and central infiltrates were more common in the conventional extended-wear group.

Boswall and associates[13] reported the occurrence of more peripheral infiltrates in patients wearing disposable extended-wear contact lenses compared with patients wearing conventional extended-wear lenses, but this difference was not statistically significant. Mertz and coworkers[14] reported 9 cases of paracentral corneal infiltrates associated with disposable extended-wear. In their series, the infiltrates ranged from 1 to 3.5 mm. They performed cultures in 6 of 9 patients, and all were reported as negative. They felt that corneal hypoxia might be an important factor in the etiology of these infiltrates.

In the Bates study,[1] 43% had multiple infiltrates, whereas in our study, 15% had multiple infiltrates. Bates[1] found the epithelium was disturbed in 49% of the patients; the defect was limited to a SPK or a small defect. In our study, 36% presented with a frank epithelial defect, and 31% had punctate staining over the infiltrate. In both studies, there appeared to be no specific predilection for any quadrant of the cornea; however, in our study, patients wearing extended-wear lenses were found to have slightly more involvement of the superior cornea, similar to that reported by Gordon and Kracher.[5] In both the Bates and present studies, there was minimal anterior chamber activity associated with the infiltrates. In the present study, lens water content and ionized or nonionized polymers did not appear to have any effect on the associated ocular inflammation.

Bates and coworkers[1] cultured contact lens cases in patients with and without corneal infiltrates. He found that 66.7% of the contact lens cases of patients with corneal infiltrates were contaminated by bacteria, compared

with 37.2% of patients without corneal infiltrates ($P = .048$). In the present study, positive cultures were obtained directly from the corneal infiltrates in 50% of the patients' cultures (8/16). In addition, Stein and coworkers[4] reported that in 35% of infiltrates less than 1 mm, bacteria were present. Thus, there is evidence that these focal corneal infiltrates may not be "sterile." However, the range of organisms appears to be different from those clinically found in central infections where the predominant organism is reported to be Pseudomonas.[15,16] The organisms associated with peripheral corneal infiltrates appear to be less virulent and thus have a more benign course with resolution that does not affect the visual potential of the eye. In both Bates' study and the present study, there were no serious sequelae. The average time to resolution was 1.74 weeks. When treatment was considered, the average time to resolution in our study was 1.27 weeks if antibiotics and steroids were used, whereas the mean time to resolution with antibiotics alone was 2.02 weeks. In the study by Bates, when patients were treated with antibiotics alone, 65% resolved within 1 week, whereas when treated with antibiotics and steroids, 61% resolved within 1 week.

Bates and coworkers[1] reported that peripheral corneal infiltrates counted for 12.5% of all the contact lens–related problems presenting to a casualty department. Thus, these are fairly common complications associated with contact lens wear. The question of whether these focal peripheral infiltrates are truly sterile or not remains to be determined. Both the study reported by Bates[1] and the present study have shown an association between focal peripheral infiltrates, which are clinically considered sterile, and the presence of bacterial organisms. Whether these represent true "infections" or a hypersensitivity response to the bacteria [16] or to bacterial toxins [17] or hypoxia[14] with associated bacterial contamination has yet to be determined. The possibility of preservative toxicity seems unlikely, since the majority of patients were wearing disposable extended-wear lenses and thus were not utilizing a cleaning disinfecting system.

CONCLUSION

It is our conclusion that focal peripheral infiltrates with or without epithelial disturbance represent a distinct clinical complication associated with contact lens wear. Infiltrates less than 1.5 mm with intact epithelium do not require cultures and can be safely treated with antibiotics. Patients who present with corneal infiltrates and a frank epithelial defect associated with extended-wear contact lenses in a moderately inflamed eye may require culture, since these have the highest association with positive cultures. Patients can initially be treated with topical antibiotics, and steroids may be considered in the face of persistent ocular inflammation when the epithelial disturbance has resolved. Patients who develop peripheral infiltrates should probably not continue with extended-wear lenses, but can continue successfully with either soft or rigid daily wear contact lenses.

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DISCUSSION

DR JULES BAUM. Dr Donshik has, in fine fashion, presented the second-largest series to date of patients with soft contact lens–related peripheral corneal infiltrates in this, his first presentation before the Society. I would like to review those findings Dr Donshik and his coworkers have confirmed, highlight new findings stemming from their study, discuss the evidence he presented suggesting a possible infectious etiology and, lastly, offer a modified pathogenesis for this entity.

Dr Donshik and his colleges have confirmed that:

1. The infiltrates in this condition are characteristically small, solitary, midperipheral, and located in the superficial stroma.

2. Soft contact lenses pose a greater risk factor than rigid gas perme-

able lenses, and disposable extended-wear lenses have a greater association with peripheral corneal infiltrates than any other lens type.

3. Extended-wear soft contact lenses are more frequently associated with positive bacterial cultures, especially gram - positive organisms, than other lens types.

4. The infiltrates respond rapidly to topical antibiotics or antibiotic/corticosteroid therapy.

New data stemming from the study suggest that neither the ionization nor the water content of the soft contact lens is of significance in the production of the infiltrates. There is, in addition, an almost statistically significant predilection for the appearance of the infiltrates in the superior quadrant, a finding that, I believe, may relate to the pathogenesis and that will be discussed shortly.

The authors further document bacterial growth in 50% of eyes from a small subgroup in which corneal tissue overlying an infiltrate was swabbed, placed in a transport medium, and sent to the laboratory for plating. The criteria used for selection of the subgroup are undefined, and those criteria selected for the determination of culture positivity are less than rigid. There is also no control group for this subsection of the study. It is not surprising, however, that bacteria adhere disproportionately to the epithelium overlying and compromised by even sterile inflammation. The authors might have considered using eyes diagnosed as having peripheral ulcerative keratitis as a control group.

Consideration of the pathogenesis of this entity is intriguing. I believe, as do others, that the infiltrates develop secondary to corneal epithelial hypoxia and that they are inflammatory rather than infectious. Clinically, their appearance and rapid resolution suggest other than a microbial process. I have not infrequently treated patients with this condition by simply removing the soft contact lens and having them return in 12 to 24 hours, providing the clinical condition strongly suggests a nonmicrobial process and the patient is one who I feel certain will return for prompt reevaluation. The strong association of these infiltrates with soft rather than hard contact lenses offers another clue. Tears, containing atmospheric oxygen, pass more easity under a hard lens than a soft lens.[1,2] Interestingly, as already stated, the present study documents an almost statistically significant predilection for the appearance of the infiltrates in the superior quadrant, the quadrant covered by both the soft contact lens and the upper eyelid, two barriers to the delivery of atmospheric oxygen to the superior corneal epithelium. Another putative risk factor relates to the supposition that all corneas do not "breathe" the same. There is a large individual variation in oxygen uptake rates.[3] I have been further intrigued by the characteristic midperipheral location of the infiltrates. Thirty years ago, in a histochemical study of corneal respiratory enzymes, I found more intense staining relating to those enzymes associated with glycolysis in the central corneal epithelium, com-

pared with the peripheral cornea, and greater staining in the periphery for those enzymes associated with the Krebs cycle and the pentose shunt.[4] This study is certainly no measure of enzymatic activity, but it does offer a clue that the central and peripheral corneal epithelium differ in their respiratory metabolism. If the central epithelium is less dependent on oxygen than the peripheral epithelium, it is less at risk for oxygen deprivation secondary to the application of a soft contact lens. Likewise, this risk is less for the corneal epithelium adjacent to the limbal blood vessels. The area putatively at most risk is the midperipheral zone, in which the infiltrates characteristically appear.

Treatment of the condition deserves comment. Dr Donshik and his coworkers suggest the use of topical antiobiotics, complemented, at times, by a topical corticosteroid. Perhaps the safest therapeutic regimen when there is more than punctate staining over a 1-mm infiltrate and when a bacterial infection is a possibility, but is not strongly considered, is to instill tobrmycin as an eye drop or ointment, avoid patching the eye, and see the patient daily until the possibility of an infection has been excluded. For such an infiltrate seen following soft contact lens wear, Dr Donshik institutes tobramycin ointment with the admonition never to patch the eye. Another approach is to scrape, culture, and treat as though all such infiltrates were the result of infection. I believe this is unwarranted, since many "sterile" lesions would be overtreated. The third, more risky, approach is the one I suggested earlier—lens removal and re evaluation in 24 hours or less with the prerogative of instilling a coricosteroid to achieve a more rapid resolution of the infiltrate, but only after the ongoing clinical condition suggests a noninfectious process. If, after removing the lens, the patient returns and both symptoms and signs are more severe, a microbial workup may be performed and therapy instituted for a microbial keratitis.

In conclusion, I would like to thank the Committee and the program chairman for affording me the opportunity to discuss this excellent paper by Dr Donshik and his colleagues.

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DISCUSSION

DR R. LINSY FARRIS. It's a pleasure to have this opportunity to comment on the work of Dr. Donshik and colleagues and to consider with this audience the difficulties which do arise in patients presenting with contact lenses. Many of our patients are wearing contact lenses and when they do develop problems, Ophthalmologists are best equipped to deal with those problems. I have visited Dr Donshik's practice and can testify that he serves as a good example of how contact lenses can be incorporated into a group ophthalmic practice. He has many good assistants, two of whom are co-authors. The paper brings to our attention some of the problems with contact lenses and suggests how to deal with them.

One of the most dramatic problems which can literally become a calamity in a previously problem free contact lens wearer, is the red eye developing during contact lens wear. Prior to the occurrence, patients are often doing so well with contact lenses that they are practically ignored as their repeated visits show no pathology. Then suddenly without warning, the patient develops a red eye which may or may not be accompanied by a small corneal infiltrate in the periphery. Such a red eye becomes "the big event" because a decision must be made concerning its cause, treatment, follow-up and contact lens wear.

Dr Donshik has suggested that such patients cease to wear extended wear contact lenses. Many Ophthalmologists agree and have decided that extended wear of contact lenses is forbidden. I am still trying to make up my mind. The epidemiologic studies are very convincing that extended wear of contact lenses carries greater risk. The problem in these studies is the variety of compliance in patients adhering to wearing schedules, cleaning and handling of the contact lenses, daily and extended-wear. I have a small contact lens practice where I come to know the patients very well. I have spoken to them very specifically about the risks of contact lens wear whether they are rigid or soft, daily wear or extended-wear. Decreased oxygenation as pointed out by Dr. Baum, particularly the upper portion of the cornea which remains under the upper lid like the closed eye condition of extended-wear, produces a chronic shortage of oxygen to the cornea. We now advise extended-wear contact lens patients to remove their contact lenses every seventh night in order to increase the supply of corneal oxygen and allow recovery from the chronic oxygen deprivation.

The extended wear of contact lenses does eliminate the risk of bacterial contamination and exposure to chemicals in cleaning solutions that occurs with daily-wear contact lenses. Patients do not always wash hands, change cases and solutions every three months, or insert contact lenses cleanly to the corneal surface without wiping materials from the lids onto the lens. I am convinced that many patients do better and are safer to leave the contact lens in place for several days, especially the new disposable contact lenses.

The number of nights of extended wear that individual patients can tolerate varies a great deal from one patient to the next which means that follow up twenty-four hours after initiating extended-wear and being available for emergencies is an important component of safe extended wear of contact lenses. Most important, the patient must be well schooled in following the rule: "when in doubt, take it out". That means having a current spectacle prescription which prevents one from becoming "trapped" in their contact lenses.

My major point is that a great deal of variation occurs in contact lens wearers that may produce different outcomes when one considers the conclusions of combined patient data from a large practice and compares it with the experience from an individual's practice comprised of a smaller group of patients. I do have a significant number of patients who are able to wear extended-wear contact lenses very successfully and who I feel are much safer wearing the lenses six nights continuously, removing the lenses for one night, and then putting in a new disposable lens the next day for another six nights of extended wear.

DR PETER DONSHIK. Thank you, Dr. Baum and Dr. Farris, for your comments. With regard to the question of culturing the infiltrate, a swab of the infiltrate was obtained by means of a Q-tip and was then placed into transport media. This was then sent to the laboratory, where the material was plated on various culture plates.

Of the 8 positive cultures, 2 were reported as a "rare colony". I do not know the magic number of colonies that indicates a substantial infection, but the other 6 were reported in the same way as if we had an infectious corneal ulcer. Thus, I have to believe that there was significant bacteria obtained on multiple media from the corneal infiltrates. Our positive culture rate of 50% is similar to that reported in other studies (40% to 50%) of positive culture results from infectious corneal ulcers.

With regard to the question of extended-wear, I am not opposed to extended-wear providing there are no medical contraindications, and providing the patient has an understanding of the inherent slightly greater risk compared with daily-wear. We have many patients who are in extended-wear contact lenses. We have shown that if you use disposable lenses, both the problems associated with extended-wear lenses and the number of patients who discontinue contact lens wear is decreased.

If you believe, and I do, that hyopoxia is a major cause of these peripheral infiltrates, then when a patient develops a corneal infiltrate, it is a warning sign. It is an indication that the cornea is not tolerating the contact lens that is being worn on an extended wear basis. If the patient wants to continue wearing contact lenses, he/she should be refitted with a daily-wear lens. One-day disposable lenses have recently been introduced. They now offer all of the advantages of daily-wear lenses without the need to clean and disinfect, which can create many of the problems to which Dr. Farris referred. In addition, the patient is wearing a new, clean lens each day.

Thank you again for your comments.