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Abstract

Since the Food and Drug Administration approved the use of hydrophilic lenses as ocular bandages in 1973, they have become the treatment of choice for many corneal problems, not the least being superficial corneal abrasions. Practitioners are opting for the more readily available disposable soft contact lenses because of the limited number of expensive therapeutically approved bandage soft contact lenses. In this study we set out to determine if there is a significant difference in the antibiotic reservoir and delivery effect of these two groups of soft contact lenses. The eyes in this study were divided into three groups: Protek® group, Acuvue® group and control group. Two drops of Tobramycin 0.3% solution were instilled into each eye followed by subsequent isolation of tear samples using diffusion disks. The relative amount of antibiotic in the tears at certain time intervals was inferred using kill zone ring width (KZRW) measures around the diffusion disks. The data were then analyzed using an ANOVA statistical test. From this analysis we found that while there was a significant difference in KZRW between both Protek® versus control and Acuvue® versus control, there was no significant difference between Protek® versus Acuvue®. This study shows that, when used as an antibiotic reservoir and delivery system, the Ciba Protek® therapeutic contact lens and One-day Acuvue® disposable contact lens behave very similarly.

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CIBA PROTEK® VS. VISTAKON ONE-DAY ACUVUE®: A COMPARISON OF ANTIBIOTIC RESERVOIR AND DELIVERY EFFECTS

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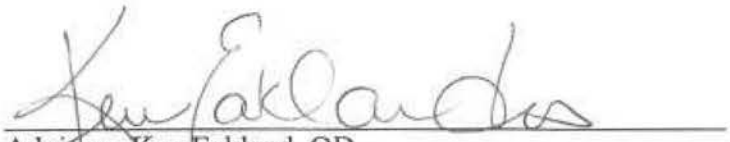

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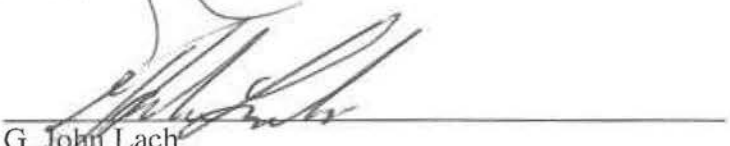

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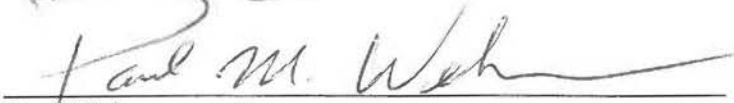

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G. John Lach obtained a Bachelor of Arts degree in Biology from St. John's University in Collegeville, MN. He has served as a member of the Student Optometric Association and the Pacific University Standards and Appeals Committee. He is currently a fourth year student at Pacific University College of Optometry.

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ABSTRACT:

Since the Food and Drug Administration approved the use of hydrophilic lenses as ocular bandages in 1973, they have become the treatment of choice for many corneal problems, not the least being superficial corneal abrasions. Practitioners are opting for the more readily available disposable soft contact lenses because of the limited number of expensive therapeutically approved bandage soft contact lenses. In this study we set out to determine if there is a significant difference in the antibiotic reservoir and delivery effect of these two groups of soft contact lenses.

The eyes in this study were divided into three groups: Protek® group, Acuvue® group and control group. Two drops of Tobramycin 0.3% solution were instilled into each eye followed by subsequent isolation of tear samples using diffusion disks. The relative amount of antibiotic in the tears at certain time intervals was inferred using kill zone ring width (KZRW) measures around the diffusion disks. The data were then analyzed using an ANOVA statistical test. From this analysis we found that while there was a significant difference in KZRW between both Protek® versus control and Acuvue® versus control, there was no significant difference between Protek® versus Acuvue®.

This study shows that, when used as an antibiotic reservoir and delivery system, the Ciba Protek® therapeutic contact lens and One-day Acuvue® disposable contact lens behave very similarly.

KEY WORDS: corneal abrasion; soft contacts lens; therapeutic contact lens; disposable contact lens.

INTRODUCTION:

Since the Food and Drug Administration approved the use of hydrophilic lenses as ocular bandages in 1973, they have become the treatment of choice for many corneal problems, not the least being superficial corneal abrasions. Practitioners are opting for the more readily available disposable soft contact lenses because of the limited number of expensive therapeutically approved bandage soft contact lenses. In addition to the cost effectiveness of disposable lenses, recent studies have shown that they are more effective in the treatment of corneal abrasions [1,2]. In this study we hope to determine if there is a significant difference in the antibiotic reservoir and delivery effect of these two groups of soft contact lenses. This ability is one variable which makes therapeutic soft contact lens treatment better for ultimate cover from corneal abrasion.

MATERIALS:

*Ciba Protek® Therapeutic soft contact lenses
*Vistakon One-day Acuvue® soft contact lenses
*Tobramycin 0.3%
*Polytrim® (Trimethoprim sulfate 1mg/mL, Polymyxin B sulfate 10,000 units)
*Refresh® Rewetting drops
*Forceps
*Mueller-Hinton agar plates
*Standardized Diffusion discs

METHODS:

This study consisted of 14 randomly selected subjects gender nonspecific, all optometry students. No requirements were set forth regarding previous contact lens wear. This was done specifically to represent the random population presenting clinically with corneal abrasions. Comprehensive initial evaluations were done to eliminate any anterior segment pathology.

Each subject was randomly assigned into one of three groups. Group A had a One-day Acuvue® disposable lens in the right eye and no lens in the other. Group B had an Acuvue® in the right eye and a Ciba Protek® therapeutic lens in the left. Group C had a Protek® in the right eye and no lens in the other. Patients were allowed to insert the contact lens themselves under supervision unless assistance was required. Several minutes for adaptation to the lenses were allowed for reflex tearing to subside before proceeding with antibiotic drop instillation.

Tobramycin 0.3% solution was used as our antibiotic since it is the clinically accepted standard for treatment of superficial corneal abrasions. Following accepted clinical procedures an initial drop of the antibiotic was administered accompanied by 30 seconds of punctal occlusion followed by another drop and occlusion. At the point of the second drop's instillation the timer was started for the first eye, this was designated time 0 minutes. The same procedure was followed for the fellow eye two minutes thereafter so as to allow the future procedures ample time to be completed.

Tear samples were then obtained from each eye, and introduced onto cultured agar plates. Previously calculated time intervals of 5, 10, 15, 20, and 30 minutes were used for tear sampling. Tear samples were isolated by inserting a standardized 6.5mm diameter untreated diffusion disc into the lower cul-de-sac. A standard of 5 seconds was used as the time the disc remains inserted, as this was found to provide the most sufficient tear absorption, with minimal patient discomfort. One set of alcohol sterilized forceps were used for insertion and removal of the discs for each subject.

Diffusion disks were plated on Mueller-Hinton agar streaked just prior to plating with a culture of *Staphylococcus aureus* . *S. aureus* was selectively used because of the known sensitivity to the antibiotic Tobramycin. Each plate was divided up into three equivalent sections to contain one diffusion disc each. This set up granted sufficient room for any large kill zones that might be expressed.

Upon completion of tear sampling, the contact lenses were removed, a drop of Polytrim® placed in each eye prophylactically and the patients were instructed to contact the experimenters should any complications occur.

Mueller-Hinton agar plates with the plated diffusion discs were incubated at 37^{o}C for 24 hours at which time the zones of inhibition were measured. Zones were measured by two separate experimenters with a millimeter rule. The assumption was made that the zone of inhibition created around the diffusion disc corresponds to the amount of antibiotic contained within the tear volume.

RESULTS:

Each subject's data of kill zone ring width (KZRW), which can be found in appendix 1-3, was averaged and standard errors calculated (table 1). Due to the nature of the measuring scale, and that measures were intra-subject an analysis of variance (ANOVA) statistical test was used to analyze the KZRW data. For statistical purposes on the ANOVA test, subjects were removed at random from each group: three from Acuvue® and one from the Ciba Protek® group. The asterisked rows in appendices 1-3 designates those data were removed.

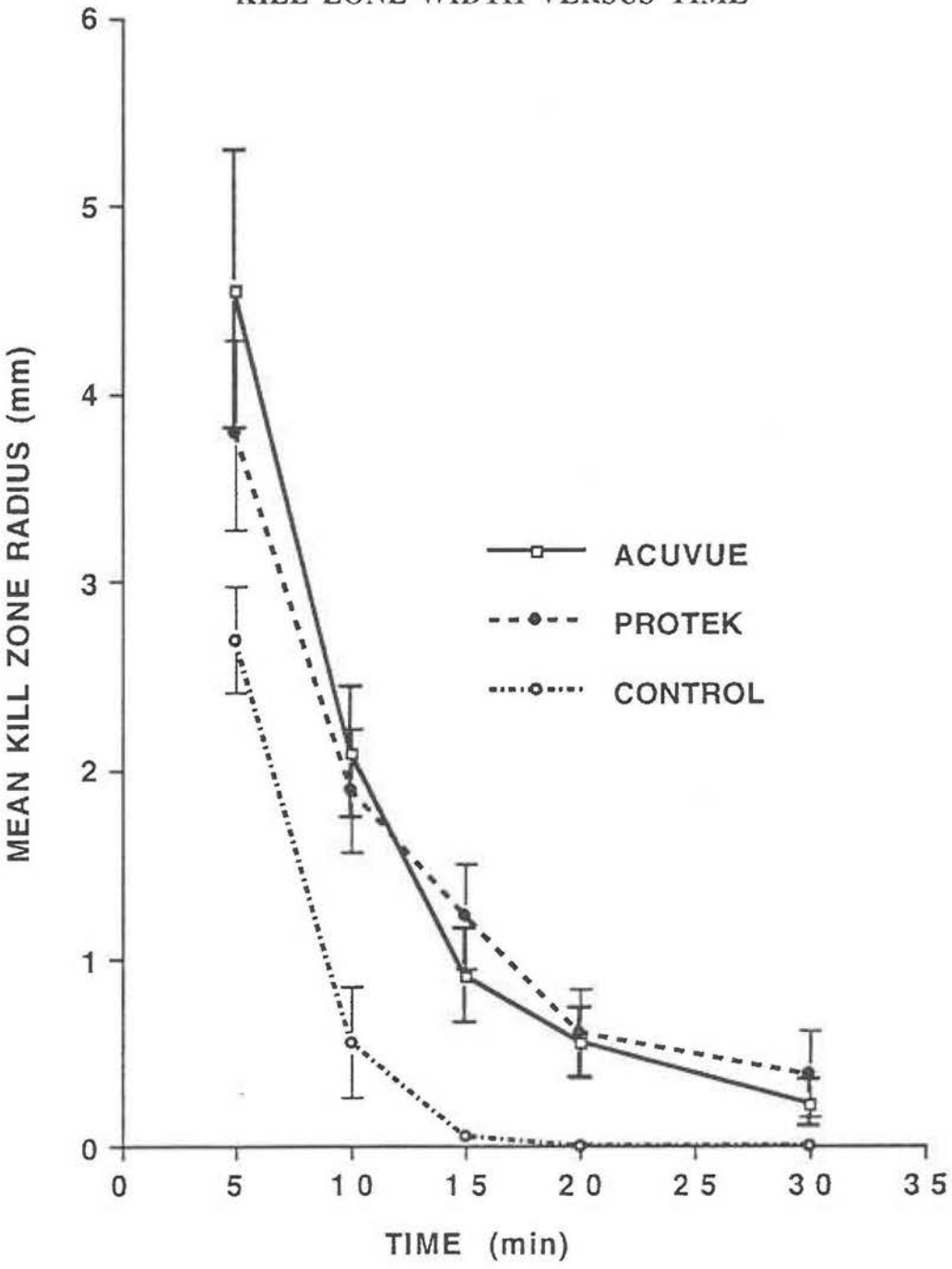
The means and standard errors of the KZRW tear sample data followed a general decreasing trend from time 5 minutes to time 30 minutes reflecting a decreasing concentration of antibiotic present in the tears over time. All calculated data is shown in table 1. The graph also expresses this by plotting the means and standard errors against time (graph 1).

Statistical analysis of the data revealed several interesting relationships: Acuvue® verses Protek® verses control $F(2,14)=4.78$; $p=0.02$, which implies that there is a significant difference ($p<0.05$) in KZRW between the three groups. Acuvue® verses Protek® verses control over time $F(4,28)=110.62$; $p=0$, which implies that the KZRW behaves differently over time between the three groups. Protek verses control $F(1,7)=12.55$; $p=0.01$, which implies that there is a significant difference in KZRW between Protek® and control. Acuvue verses control $F(1,7)=8.93$; $p=0.02$, which implies that there is a significant difference in KZRW between Acuvue® and control. Acuvue® verses Protek® $F(1,7)=0.01$; $p=0.89$, which implies that there is no significant difference in KZRW between Acuvue® and Protek®. Acuvue® verses Protek® over time $F(4,28)=0.45$; $p=0.77$, which implies that there is no significant difference in KZRW between Acuvue® and Protek® over time.

Table 1: Kill Zone Ring Width (KZRW)

Acuvue	Time (min)	5	10	15	20	30
(mm) total		50.00	23.00	10.00	6.00	2.50
mean		4.55	2.09	0.91	0.55	0.23
s.d.		2.44	1.14	0.83	0.61	0.41
s.e.		0.74	0.34	0.25	0.18	0.12
Protek	Time (min)	5	10	15	20	30
(mm) total		34	17	11	5.5	3.5
mean		3.78	1.89	1.22	0.61	0.39
s.d.		1.50	0.99	0.83	0.70	0.70
s.e.		0.50	0.33	0.28	0.23	0.23
Control	Time (min)	5	10	15	20	30
(mm) total		21.50	4.50	0.50	0.00	0.00
mean		2.69	0.56	0.06	0.00	0.00
s.d.		0.80	0.82	0.18	0.00	0.00
s.e.		0.28	0.29	0.06	0.00	0.00

KILL ZONE WIDTH VERSUS TIME



DISCUSSION:

The benefits of using soft contact lenses to decrease pain and healing time has been well documented [2]. With the increasing number of disposable contact lenses on the market, their use in treating superficial corneal abrasions is becoming more widespread than ever before. This study demonstrated that in terms of antibiotic reservoir and delivery effect, the Ciba Protek® therapeutic lens and Vistakon One-day Acuvue® disposable lens behave very similarly. While there was a significant difference between both experimental groups and the control, it was found that there was no significant difference between Protek® and Acuvue® in total KZRW, or in KZRW over time.

Several other questions were uncovered in the process of running the trials of this experiment. We found ourselves wondering how the results would differ if the lenses were actually soaked in antibiotic solution for five minutes prior to insertion, which is the clinical protocol for collagen shields. We made the decision to insert the lenses and then instill antibiotic drops based on current clinical practice. The other interesting question arose after seeing the results, and how quickly the ability to isolate the antibiotic from the tear value dropped off after instilling two drops of antibiotic. This reinforces the idea that, especially with deeper or more serious corneal abrasions, 1-2 drops every 4-6 hours may be inadequate to stave off potentially sight threatening opportunistic infections.

Appendix 1: Acuvue Lenses

Time (min)	5	10	15	20	30
subj #1	11 (mm)	4.00	2.50	1.50	0.50
#2	4.00	1.50	1.00	0.50	0.00
#3*	4.50	1.00	0.00	0.00	0.00
#4	2.50	2.50	1.50	0.00	0.00
#5*	3.00	2.50	1.00	1.00	0.00
#6	4.50	3.00	1.50	1.00	1.00
#7	6.00	1.00	0.00	0.00	0.00
#8*	5.00	3.00	1.00	1.50	1.00
#9	4.50	2.00	1.50	0.50	0.00
#10	2.00	0.00	0.00	0.00	0.00
#11	3.00	2.50	0.00	0.00	0.00
total	50.00	23.00	10.00	6.00	2.50
mean	4.55	2.09	0.91	0.55	0.23
s.d.	2.44	1.14	0.83	0.61	0.41
s.e.	0.74	0.34	0.25	0.18	0.12

Appendix 2: Protek Lenses

Time (min)	5	10	15	20	30
subj #1	2 (mm)	1.00	1.00	0.00	0.00
#2	5.00	4.00	2.50	1.00	0.50
#3	4.00	1.00	0.50	0.00	0.00
#4	5.00	2.00	1.00	0.00	2.00
#5	3.00	1.50	1.00	1.00	0.00
#6	5.50	2.50	2.50	2.00	1.00
#7	4.50	1.50	1.00	0.50	0.00
#8*	1.00	1.00	0.00	0.00	0.00
#9	4.00	2.50	1.50	1.00	0.00
total	34.00	17.00	11.00	5.50	3.50
mean	3.78	1.89	1.22	0.61	0.39
s.d.	1.50	0.99	0.83	0.70	0.70
s.e.	0.50	0.33	0.28	0.23	0.23

Appendix 3: Control

Time (min)	5	10	15	20	30
subj #1	4 (mm)	1.50	0.00	0.00	0.000
#2	2.00	0.00	0.00	0.00	0.00
#3	3.50	0.00	0.00	0.00	0.00
#4	2.00	0.00	0.00	0.00	0.00
#5	3.00	0.00	0.00	0.00	0.00
#6	2.00	2.00	0.00	0.00	0.00
#7	3.00	1.00	0.50	0.00	0.00
#8	2.00	0.00	0.00	0.00	0.00
total	21.50	4.50	0.50	0.00	0.00
mean	2.69	0.56	0.06	0.00	0.00
s.d.	0.80	0.82	0.18	0.00	0.00
s.e.	0.28	0.29	0.06	0.00	0.00

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