A comparison of the efficacy of digital versus Hydra-Mat II cleaning methods

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Abstract
An in vitro comparison of the cleaning efficacy of the BARNESHIND® Hydra-Mat® II system with the traditional digital massage method was performed using fifty Fluoroperm 60 lenses coated with a simulated tear mixture. This artificial tear film consisted of human albumin, lactoferrin, and lysozyme, and other constituents determined using FDA guidelines and other research describing human tear composition. Twenty four lenses were cleaned with the Hydra-Mat II system; and 24 using digital massage. Cleaning efficacy was measured by having masked observers rate both the cleaned lenses and photos of the same lenses. The digitally cleaned lenses were judged to be significantly cleaner than the lenses cleaned by the Hydra-Mat II (p=0.0075), although there appeared to be qualitative differences in the types of deposits left behind by the two methods.

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Thesis

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A COMPARISON OF THE EFFICACY OF DIGITAL VERSUS HYDRA-MAT® II CLEANING METHODS

By

KELLY JOHN CORBRIDGE
HILARY LISA HAWTHORNE

A thesis submitted to the faculty of the
College of Optometry
Pacific University
Forest Grove, Oregon
for the degree of
Doctor of Optometry
May, 1992

Advisor:
Cristina Schnider, O.D., F.A.A.O.
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Hilary Lisa Hawthorne will be a degree candidate for a doctorate of Optometry from Pacific University College of Optometry in May 1992. During the course of study, her political activities included SOA President and AAO Liaison, as well as maintaining membership in various local organizations. Ms. Hawthorne was awarded by Who's Who Among Students in American Colleges and Universities in the 1990-1991 publication.

As a native Californian, she had attended California State University, Fullerton and received a Bachelor of Arts degree in Biological Sciences in 1986.

Future professional plans involve dedicating her skills toward primary care in optometry, contact lens specialization and research, and providing community health services. Upon graduation, she hopes to reside in California or the Northwest region.

Kelly John Corbridge was born and raised in Sparks, Nevada. He received his Bachelor of Science degree in Zoology from Brigham Young University, Provo, Utah in 1988. He is a candidate for Doctor of Optometry from Pacific University College of Optometry in May 1992. He plans to return to Nevada where he will practice primary care optometry.
ABSTRACT

An in vitro comparison of the cleaning efficacy of the BARNES-HIND® Hydra-Mat® II system with the traditional digital massage method was performed using fifty Fluoroperm 60 lenses coated with a simulated tear mixture. This artificial tear film consisted of human albumin, lactoferrin, and lysozyme, and other constituents determined using FDA guidelines and other research describing human tear composition. Twenty four lenses were cleaned with the Hydra-Mat II system; and 24 using digital massage. Cleaning efficacy was measured by having masked observers rate both the cleaned lenses and photos of the same lenses. The digitally cleaned lenses were judged to be significantly cleaner than the lenses cleaned by the Hydra-Mat II (p=0.0075), although there appeared to be qualitative differences in the types of deposits left behind by the two methods.

Key words: Contact lenses, cleaning efficacy, digital massage, Hydra-Mat II, in vitro comparison
INTRODUCTION

The use of contact lenses requires that the recommended lens care system contain a thorough cleaning step in order to minimize surface debris. When a rigid gas permeable (RGP) contact lens is removed from the eye, it will be covered with secretions from conjunctival epithelium, lacrimal and meibomian glands, as well as other pre-corneal tear film debris. Most notably, the lipids, denatured proteins, lysozyme, and calcium found in tear suspensions can adhere to contact lens surfaces and could lead to decreased wettability, visual acuity and comfort, thus a decreased wearing time. Deposits, especially proteins, may also cause red eye, hypersensitivity reactions, and provide a place for bacterial colonization.

Some organic deposits derived from the tear film may be removed by surfactant cleaners. Surfactants are surface-active agents which act like detergents to help rid the contact lens surface of foreign substance. The surfactants function primarily to solubilize tenacious contaminants and prevent them from depositing once again before they are rinsed away. Most are designed to work while the lens is being rubbed in the palm of the hand by the forefinger such that the surfactant cleaner's action is enhanced by friction created against the lens by skin. Some researchers advocate the use of daily, rigorous and thorough cleaning systems using strong surfactant cleaners often combined with a proteolytic enzyme stage. Other authors feel these
methods of cleaning can lead to lens warpage, irregularly cleaned areas, increased accidental breakage, and unnecessary scratches.⁹,¹⁰,¹¹

The BARNES-HIND® Hydra-Mat® II is a hydrodynamic cleaning device designed for use without friction; instead it involves the use of its cleaner in conjunction with kinetic energy to reduce the patient's handling of the lens. The Barnes-Hind Gas Permeable Daily Cleaner contains friction-enhancing potentiators in an aqueous concentrated solution to loosen and remove accumulations of film, deposits and debris from the lenses while they are immersed in the hydrodynamic device.¹² The Hydra-Mat's swirling action is cited by some authors as a way to avoid mechanical damage, warpage of the lens surface, and lens breakage, that have been attributed to excessive handling.¹³ Others warn that excessive agitation will cause the above mentioned problems.¹⁴,¹⁵ One author states that the Hydra-Mat system is superior to finger cleaning and that it can help remove deposits the fingertips can't reach.¹⁶ However, no research was cited to back up this conclusion. Another author cites several studies¹⁷-¹⁹ which point out how efficiently Hydra-Mat cleaned lenses,¹⁵ yet this research (which is now obsolete due to the redesign of the Hydra-Mat) only compared the Hydra-Mat to itself and provided no comparison data to support the statement, "The procedure [Hydra-Mat cleaning] proved superior to any other method of washing lenses." Most recently Backman²⁰ reported good results when using an electronic, ultrasonic, cleaning device in conjunction with
the Hydra-Mat. He also found good results with a comparison study of two peroxide-cleaning systems, one of which uses the Hydra-Mat.

The present study is an in vitro comparison of cleaning efficacy of the Hydra-Mat II system and the traditional digital massage method for cleaning RGP lenses.

**MATERIALS & METHODS**

The test contact lenses were newly manufactured Fluoroperm 60 fluoro-siloxane acrylate lenses of equal power, base curve and diameter. Upon receipt, the lenses were inspected to confirm that no chips or flaws were present. Prior to coating with an artificial solution, all lenses were individually cleaned in the palm of the hand with five drops MiraFlow® Extra Strength Daily Cleaner (CIBA Vision® Corporation, Duluth, GA) for 10 seconds, rinsed with tap water, rubbed with five drops Barnes-Hind Gas Permeable Daily Cleaner for 30 seconds, rinsed again, and allowed to air dry. One lens chosen randomly was photographed to demonstrate a clean, deposit free lens which would represent a grade of "0" in the later grading process (See Figure 1).

Insert Figure 1 about here
An artificial tear mixture was then prepared using FDA guidelines for contact lens research, and other research describing constituents found to deposit on lenses during wear.\textsuperscript{12,21-24} Table 1 contains the ingredients used in preparing the simulated tear solution. All 50 lenses were swirled in a beaker containing the artificial tear solution for 30 minutes at 35°C. The lenses were then removed from the solution with forceps and air dried at room temperature for 5-10 minutes. The coating and drying techniques were repeated three times. One coated lens was chosen at random and photographed to illustrate grade "4" on the scale for later rating (Figure 2).

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Insert Table 1 and Figure 2 about here

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Twenty-four lenses were randomly chosen to be cleaned by hand. The lenses were cleaned individually in the palm of the hand, with a finger from the other hand. Each lens was rubbed with five drops of Barnes-Hind Gas Permeable Daily Cleaner for 30 seconds, then rinsed thoroughly with tap water. Another twenty-four lenses were cleaned with daily cleaner in the Hydra-Mat II unit according to manufacturer's instructions.\textsuperscript{12} Using 9 drops of cleaner in the water-filled vial, the baskets were closed and the top was rotated back and forth vigorously for 20 to 30 seconds. Rinsing was done under running tap water with the lenses still loaded in the baskets. The two remaining control lenses underwent all cycles in artificial tear solution, but did not undergo cleaning steps. Photographs of all experimental lenses were taken in order
to facilitate magnified visual inspection for any lens surface depositing. The lenses were mounted in putty and photographed using an Olympus OM•4 macro camera body set up under dark field conditions with oblique illumination.

Four observers were solicited to judge the deposition on the study lenses following treatment. Observers were not aware of how any of the lenses were cleaned. Because of photography lighting and artifacts, a combination of the slides and the actual lenses was used in the judging exercise. The slides provided the judges a magnified view, while the actual lens gave some idea of what the lens would look like clinically. Each observer was shown the reference lenses, photographs demonstrating the endpoints of the grading scale, then asked to grade the amount of deposits on the test lenses. The endpoints of our scale (0 and 4) were established to represent a new, non-deposited lens (grade 0) or a heavily deposited lens that had not undergone the cleaning cycle (grade 4), and as such, were intended to be unattainable in this study.

The ratings by the four observers were entered into a Macintosh computer and analyzed using a Chi-square analysis in the StatView II statistical software program. An alpha level of 0.05 was used to determine statistical significance.
RESULTS

The results from the judging are summarized graphically in Figure 3. The lenses cleaned with digital massage were judged to be cleaner overall ($p = 0.0075$), as evidenced by the higher bar in the grade 1 (minimal deposits) category. The results of the statistical analysis are summarized in Table 2.

Insert Figure 3 and Table 2 about here

DISCUSSION

Although the results showed that finger cleaning appeared to be more effective in removing the majority of deposits, there was a noticeable difference in the type of deposit left behind following cleaning with the two methods. The photographic technique alone was not sufficient to differentiate these two types of residues. Although the slides showed the diffuse spotty deposits well, they did not always pick up the more generalized film that coated some of the lenses, unless the camera flash was reflected at just the right angle. The difference in the type of residue observed is illustrated in Figure 4 (finger cleaned method) and Figure 5 (Hydra-Mat cleaned method). Because of these differences, it may be that some combination of digital massage and Hydra-Mat cleaning would be optimal in removing all types of deposits and films. However, this
would defeat one of the prime purposes of the Hydra-Mat, i.e., less handling of the lens.

Insert Figure 4 and 5 about here

Due to the limited amount of cleaning involved in this study, no effort was made to address the issues surrounding lens scratches or damage. In this study, none of the experimental lenses were broken or damaged using either method.
ACKNOWLEDGEMENTS

The authors would like to thank Mr. Gene Ballweg of Ocular Contact Lenses in Seattle, WA for his generous donation of the finished lenses used in this study. We wish to thank Mr. Duane Tracy of Paragon Optical for donating the buttons, and SOLA/BARNES-HIND for their supply of care solutions and the Hydra-Mat devices. We also thank Dr. Bill Jordan for his advice, and use of the chemistry lab and equipment, and Dr. Cristina Schnider for overseeing the entire project.
REFERENCES


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<td>NaH₂PO₄•H₂O</td>
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pH = 7.2
Distribution of Deposit Ratings for Cleaned Lenses

Chi Square = 9.781, DF = 2, p = 0.0075
Table 2. Chi-Square analysis

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<td>2</td>
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Figure Legends

Figure 1. Photograph of a randomly chosen lens cleaned according to protocol, prior to lens coating sequence (Grade 0 deposits reference photo).

Figure 2. Photograph of a randomly chosen lens following coating protocol using artificial tear solution (Grade 4 deposits reference photo).

Figure 3. Graphical representation of results. The light bars indicate lenses cleaned digitally. The Hydra-Mat II cleaned lenses are represented by dark bars.

Figure 4. Photograph of a lens cleaned manually to illustrate characteristic spotty deposits left following cleaning.

Figure 5. Photograph of a lens cleaned with Hydra-Mat II to illustrate characteristic filmy deposits left following cleaning.