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Cristina Schneider

Keywords

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Subject Categories

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**THE EFFICACY OF QUICK CARE CLEANING REGIMEN ON
MENICON SF-P RIGID GAS PERMEABLE LENSES:
AN IN-VITRO STUDY**

By

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TERI K. GEIST

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BIOGRAPHICAL SKETCH

Jill A. Anderson, a native of Waupaca, Wisconsin, attended the University of Wisconsin- Madison. She completed a B.S. in History of Science, graduating with distinction. During her course of study, Ms. Anderson was a member of the Beta Sigma Kappa International Honor Society, Phi Theta Upsilon, and Amigos member. Upon graduation in May of 1996, she plans to practice in Madison, Wisconsin.

Teri K. Geist, a native of Lakeside, Nebraska, graduated from the University of Nebraska-Lincoln with a B.A. degree in Psychology. During her course of study, Ms. Geist was an officer for the Student Optometric Association, on the Contact Lens Faculty Search Committee, and was awarded the Bausch and Lomb Student Leadership Award. Upon graduation, she plans on becoming an associate in a private optometric practice.

ABSTRACT

The goal of this study was to determine the efficacy of Ciba's QuickCARE System on Menicon SF-P rigid gas permeable lenses. An in-vitro study was designed to examine any parameter changes on Menicon SF-P lenses while using QuickCARE. Twenty-five lenses with identical parameters were cleaned for a simulated time of six months. Twenty lenses were cleaned with Ciba's QuickCARE System, two with Allergan's Wet 'n Soak Plus Care System, two with QuickCARE Finishing Solution only, and one lens was stored in QuickCARE Finishing Solution with no mechanical cleaning. Half of the lenses were scooped out of the storage cases and half were poured out of the cases. The lenses were assessed at 1 week, 1 month, 3 months and 6 month intervals for any changes in base curve, power, center thickness, diameter and surface integrity. No significant parameter changes occurred for diameter, power, center thickness, and base curve. However, surface integrity changes were statistically significant with pouring the lens from the case being better than scooping the lens from the case.

Key Words: Rigid Gas Permeable contact lens, cleaning regimen, Menicon SF-P Lens, QuickCARE System

INTRODUCTION

The ocular health of the eye has always been an important issue with contact lens patients. Clinicians are faced with the decision of fitting hydrogels versus rigid gas permeable lenses. Hydrogels are often the first choice because of initial comfort to the patient. However, it is well documented in the literature that RGP's provide increased oxygen to the cornea, equivalent or improved vision, are more durable, and deposit less than do soft lenses.¹

Although, there are many advantages to increased oxygen permeability in the RGP lens, wettability of the higher Dk lens has been a concern. The lens surface can also develop hydrophobic areas if it comes in contact with sebaceous material or other lipids.² Therefore, an effective cleaning regimen is essential to lens performance.

Menicon SF-P lenses offer high oxygen permeability due to their DK value of 102. Once again, wettability is a concern secondary to the flurosiloxanylacrylate material. It also has been suggested at a roundtable discussion that the manufacturing process could also contribute to the dry surface. The Menicon SF-P lens is lathe cut with spherical front and back surfaces.² The material of the lens is a thermoset copolymer (melafocon-A) derived from fluoromethacrylate, siloxanyl methacrylate, and methacrylic acid. At a roundtable discussion, Dr. Randall Sakamoto pointed out that lenses made in Japan have not been shown to display poor wetting, however American made lenses have been plagued with poor wettability. Dr. Sakamoto believes this discrepancy is due to the

lathing process, which is more precise in Japan than in the United States. The system in Japan also requires storage of the lenses wet after production as opposed to the American system of storing them dry.³

A distinct advantage of the Menicon SF-P design is the aspheric peripheral curves that provides maximum edge lift. This design promotes better peripheral corneal wetting and reduces the incidence of staining.³

The solutions available for use with RGP lenses are many. Traditional care systems require 4-6 hours to clean and disinfect the lenses. Patient's may find the process to be too time consuming, therefore, their compliance may be minimal. Patient compliance seems directly influenced by their satisfaction with their disinfection system.⁴ Ciba's QuickCARE System is a convenient and efficient system that many patients find easy to fit into their busy lifestyles. Since removal of lipids and deposits is essential in maintaining wettability of the Menicon SF-P lens patient compliance is essential.

There are many unique benefits to the QuickCARE system including system flexibility, speed and convenience and excellent antimicrobial activity.⁵ A major advantage of QuickCARE solution is that it is more effective against microbial activity including *Acanthamoeba castellanii*, both trophozitic and cyst form.⁵ In a study by Ajello and Ajello, the QuickCARE Starting Solution killed the majority of the organisms tested within 1 minute, compared to other systems that took 2-24 hours.⁶ At this time Ciba's QuickCARE system is FDA approved for soft contact lenses only. It would be

beneficial to have FDA approval for RGP lenses due to its excellent disinfecting capabilities secondary to the properties of the cleaning solution.

Ciba's QuickCARE system includes two solutions, a starting solution and a finishing solution. The starting solution is used to clean the lens. It consists of isopropanol alcohol, sodium chloride for hypertonicity, polyoxypropylene and disodium lauroamphodiacetate surfactants, and purified water. The finishing solution is a sterile buffered isotonic saline solution preserved with 0.006% hydrogen peroxide.⁵ In order to clean and disinfect lenses according to the system, the lenses must be digitally rubbed for 20 seconds, rinsed with finishing solution and stored in finishing solution for a minimum of five minutes. The overall time necessary to complete the disinfection step is dramatically reduced compared to other care systems for both soft and hard contact lenses.

The goal of this study was to determine the efficacy of Ciba's QuickCARE System on Menicon SF-P rigid gas permeable lenses. An in-vitro study was designed to examine any parameter changes on Menicon SF-P lenses while using QuickCARE.

METHODS

Twenty- five Menicon SF-P lenses with the following identical parameters (-3.00 Diopters, 7.80mm base curve, diameter 9.0, center thickness) were used in an in-vitro study. Twenty lenses were used in the cleaning regimen and the remaining five lenses served as controls for the study. Three baseline parameter

measurements were taken of each lens prior to commencing with the cleaning protocol.

Twenty Menicon SF-P lenses were cleaned and disinfected using Ciba's QuickCARE System. The simulated time was for a period of six months. Each lens was rubbed for 10 seconds using 5 drops of the QuickCARE Starting Solution. The time period for digitally rubbing the lenses was reduced from twenty seconds to ten seconds based on the D-values which is the time required to kill one log of microorganisms or ninety percent of the initial population.⁵ The D-values are significantly lower when compared to other soft care regiments. Additionally, the smaller surface area of the RGP lens should require less digital rubbing to remove debris as well as less solution to cover the lens. The researcher used the ring finger of her hand to rub the lens. Using the ring finger to digitally rub the lens minimizes the amount of force used on the lens.⁷ Each lens was then rinsed with tap water, and placed in a lens case containing QuickCARE Finishing Solution. Although theoretically tap water does introduce the possibility of contamination, especially worrisome *Acanthamoeba*, at the American Academy of Optometry meeting in 1994, a poster was presented by Steel and Connor proposing that a stream of tap water may be more effective at reducing *Acanthamoeba* than aerosol saline.

Between each cleaning cycle, the case was emptied of the previous finishing solution, rinsed with hot tap water, wiped with a Kimwipe and refilled with fresh QuickCARE Finishing Solution. A minimum of 5 minutes passed before each cleaning cycle was repeated. In order to determine if the contact lens case could cause

alterations to the lens, ten lenses were scooped out of the case with an index finger, and the remaining ten lenses were poured out of the case into the palm of the researcher's hand.

The five remaining lenses served as controls. One control lens did not undergo the cleaning process but was stored in QuickCARE Finishing Solution for six months. Two of the control lenses were cleaned, disinfected and stored in Allergan's Wet 'n Soak Plus Care System, according to Allergan's recommended guidelines. The same protocol was followed as the test lenses, however the cleaning time was increased to twenty seconds per Allergan's instructions. One of the lenses was scooped out of the lens case with an index finger and the other lens was poured into the palm of the hand. The remaining two lenses were digitally rubbed without any cleaning solution, but wet with QuickCARE finishing solution to facilitate the rubbing action. These lenses were rubbed for a time period of ten seconds. One of the lenses was scooped out of the case with an index finger, the other being poured into the palm of the hand. All lenses underwent the same number of cleaning cycles.

Our goal was to simulate a situation that would correspond to regular contact lens wear. Therefore, evaluation of the lenses corresponded to regular contact lens follow-up care. We assessed the lenses at intervals of 1 week, 1 month, 3 months, and 6 months. At the time of evaluation the researchers assessed any changes in base curve, power, center thickness, diameter, and surface integrity.

In order to keep researcher discrepancy to a minimum one researcher was responsible for cleaning the lenses, and the other researcher measured the lenses for parameter changes. This was a

single blind study in that the researcher conducting the measurements was unaware of the cleaning regimen or the manner in which the lenses were removed from the case. All measurements were taken with the same instruments used only by the researcher.

The overall diameter was measured using a projection magnifier. The display was in millimeters so that an accurate measurement was attained. Each lens was poured into the researcher's hand and carefully blotted with a lint-free tissue. It was then mounted upright on a wax stand concave side toward the researcher and placed on the stand of the magnifier. Alignment was adjusted so that the diameter could be read. Three measurements were then taken.

Surface integrity was subjectively evaluated using the projection magnifier. Immediately following diameter measurements the research evaluated surface defects according to scratch depth and the quantity of scratches. At this time the location and appearance of scratches were noted.

The following scale was used for evaluation.

INSERT TABLE 1 HERE

Power measurements were measured three times at each evaluation using a lensometer. The researcher documented any change in spherical or cylindrical power of each lens. Center thickness was measured using a hand-held thickness gauge. The

gauge was zeroed before each reading. The researcher took three readings per lens.

Base curve radius was measured using a radiuscope. Each lens was placed on the stage and floated with a drop of QuickCARE Finishing Solution. Three measurements were taken without removing the lens from the stage in order to keep lens handling to a minimum.

RESULTS

Statistical analysis of the parameter measurements were determined using the Macintosh Statvue program. The raw scores were entered and then analyzed for mean, standard deviation and p value. Changes in lens parameters were evaluated for each individual lens over time, as well as compared within each group of collected data. (i.e. all initial diameter readings were compared to each other.) All raw data appears in Appendix 1.

For diameter, power, center thickness and base curve no significant parameter changes occurred ($p > 0.05$).

INSERT TABLE 2 HERE

For the surface integrity parameter changes a non-parametric analysis was used. Surface integrity evaluations included the quantity of scratches and the scratch depth. The scratches that appeared were straight lines and the majority were located on the anterior surface mid-peripherally. Two lenses that were scooped

out of the case, broke during the cleaning process. There were significant changes between the lenses which were scooped out of the case, $p=.0114$, and those lenses poured into the palm of the researchers hand, $p=.0059$.

DISCUSSION

The results of the study indicate that using QuickCARE System on Menicon SF-P lenses does not significantly induce parameter changes in an in-vitro environment. However, the manner in which a patient removes his lenses from the lens case directly affects the surface integrity and life of the lens. Statistically, it was revealed that pouring a lens out of the lens case is less detrimental to the lens than scooping the lens from the case. Therefore, it is recommended that patient education on correct lens removal should be emphasized.

For a six month cleaning regimen, Allergan's care system appeared least detrimental to the lens, possibly secondary to its viscosity. It appears that QuickCARE is no more detrimental than saline and is possibly better due to the viscosity of the QuickCARE Starting Solution. However, these conclusions can only be inferred because we did not have enough positive controls.

Regardless of the daily cleaner used, it may be advantageous to store the lenses in a viscous solution. In the future, an alcohol based cleaner combined with a viscous soaking solution may be the ideal system, providing maximum cleaning with patient comfort. Although this study didn't prove conclusively the efficacy of the

QuickCARE system, it does indicate the need for further investigation.

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TABLE 1.

LENS SURFACE SCRATCH EVALUATION SCALE

SCRATCH DEPTH

- 1 Faint scratches, very shallow
- 2 Shallow scratches, easily polished
- 3 Moderate scratches, easily polished,
- 4 Moderate scratches, difficult to polish off
- 5 Deep scratches, cannot be polishes

QUANTITY OF SCRATCHES

- 1 Less than 10 scratches
- 2 10-30 scratches
- 3 30-100 scratches
- 4 Too numerous to count

TABLE 2.

P-VALUES

POWER	.3171
BASE CURVE	.2693
CENTER THICKNESS	.155
DIAMETER	.1613

lens number	initial 1	initial 2	initial 3	1 week 1	1week 2	1 week 3	1month 1	1month 2	1 month 3
L1	7.78	7.79	7.79	7.78	7.77	7.78	7.79	7.79	7.8
L2	7.81	7.82	7.81	7.81	7.81	7.8	7.81	7.81	7.81
L3	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
L4	7.78	7.8	7.8	7.78	7.79	7.8	7.79	7.8	7.8
L5	7.8	7.78	7.8	7.8	7.8	7.79	7.8	7.8	7.79
L6	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.79
L7	7.8	7.8	7.81	7.81	7.81	7.8	7.81	7.81	7.81
L8	7.81	7.81	7.81	7.81	7.8	7.81	7.8	7.8	7.81
L9	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.79
L10	7.8	7.8	7.8	7.79	7.8	7.8	7.79	7.79	7.8
L11	7.8	7.8	7.8	7.81	7.81	7.8	7.8	7.8	7.79
L12	7.81	7.81	7.8	7.8	7.8	7.8	7.8	7.79	7.8
L13	7.8	7.8	7.81	7.8	7.8	7.79	7.79	7.8	7.81
L14	7.8	7.8	7.8	7.8	7.8	7.8	7.81	7.81	7.82
L15	7.8	7.8	7.79	7.79	7.79	7.8	7.79	7.8	7.79
L16	7.8	7.78	7.8	7.79	7.79	7.8	7.8	7.8	7.81
L17	7.81	7.81	7.8	7.8	7.8	7.81	7.81	7.81	7.8
L18	7.8	7.8	7.81	7.81	7.81	7.81	7.81	7.81	7.81
L19	7.79	7.8	7.8	7.81	7.81	7.8	7.81	7.82	7.82
L20	7.8	7.8	7.8	7.8	7.8	7.81	7.8	7.8	7.81
L21	7.8	7.8	7.8	7.81	7.81	7.8	7.8	7.8	7.8
L22	7.8	7.8	7.8	7.8	7.81	7.81	7.81	7.81	7.82
L23	7.79	7.79	7.8	7.8	7.8	7.8	7.8	7.8	7.8
L24	7.8	7.8	7.8	7.8	7.8	7.81	7.8	7.8	7.81
L25	7.8	7.8	7.8	7.8	7.8	7.8	7.79	7.8	7.8
MEAN	7.7992	7.7996	7.8012	7.8	7.8004	7.8008	7.8004	7.802	7.8036
STD. DEV.	4.49756971	4.50044813	4.50044813	4.49756971	4.49469688	4.49756971	4.4975586	4.50044813	4.5033321

3 months 1	3 months 2	3 months 3	6 months 1	6 months 2	6 months 3		MEAN	STD. DEV.
7.78	7.79	7.79	7.8	7.8	7.81		7.78933333	4.50047035
							7.81	5.52250396
7.8	7.8	7.8	7.8	7.8	7.8		7.8	4.5033321
7.79	7.8	7.8	7.8	7.8	7.81		7.796	4.50047035
7.8	7.8	7.81	7.81	7.81	7.82		7.80066667	4.50911669
7.8	7.8	7.8	7.81	7.81	7.81		7.80133333	4.50622162
7.8	7.81	7.81	7.81	7.81	7.81		7.80733333	4.50622162
7.8	7.8	7.81	7.81	7.81	7.8		7.806	4.50622162
7.79	7.8	7.8	7.8	7.8	7.8		7.79866667	4.5033321
7.81	7.81	7.82	7.81	7.81	7.82		7.80333333	4.50911669
							7.80111111	5.51543289
7.81	7.81	7.8	7.81	7.82	7.82		7.80533333	4.51199512
7.8	7.8	7.81	7.82	7.82	7.82		7.80466667	4.50911669
7.81	7.81	7.81	7.81	7.81	7.82		7.80733333	4.50911669
7.81	7.82	7.82	7.82	7.82	7.82		7.804	4.50911669
7.81	7.81	7.82	7.81	7.81	7.81		7.80266667	4.50622162
7.81	7.81	7.81	7.81	7.81	7.81		7.80733333	4.5091056
7.81	7.81	7.82	7.81	7.82	7.82		7.81066667	4.50911669
7.81	7.81	7.81	7.82	7.82	7.83		7.81066667	4.50914996
7.8	7.8	7.81	7.82	7.82	7.82		7.806	4.50911669
7.8	7.81	7.81	7.82	7.82	7.82		7.80666667	4.50911669
7.81	7.81	7.82	7.81	7.81	7.81		7.80866667	4.50622162
7.8	7.8	7.8	7.8	7.8	7.8		7.79866667	4.50044813
7.8	7.8	7.81	7.8	7.8	7.8		7.802	4.5033321
7.8	7.8	7.79	7.79	7.8	7.8		7.798	4.5033321
7.178	7.1804	7.1832	7.184	7.1852	7.1872			
4.49756971	4.50044813	4.4975586	4.50044813	4.5033321	4.50622162			

DIAMETER RAW DATA

lens number	initial 1	initial 2	initial 3	1 week 1	1week 2	1 week 3	1month 1	1month 2	1 month 3	3 months 1	3 months 2	3 months 3	6 months 1	6 months 2	6 months 3
L1	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18
L2	9.18	9.19	9.19	9.18	9.19	9.19	9.18	9.19	9.19						
L3	9.18	9.19	9.19	9.18	9.18	9.19	9.19	9.19	9.18	9.19	9.19	9.18	9.19	9.19	9.19
L4	9.18	9.19	9.19	9.18	9.19	9.19	9.18	9.18	9.19	9.18	9.18	9.19	9.18	9.18	9.18
L5	9.18	9.18	9.19	9.18	9.18	9.18	9.18	9.19	9.19	9.19	9.19	9.18	9.19	9.19	9.18
L6	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18
L7	9.19	9.19	9.19	9.19	9.19	9.18	9.19	9.19	9.18	9.18	9.18	9.19	9.18	9.18	9.19
L8	9.19	9.19	9.19	9.18	9.18	9.19	9.19	9.19	9.18	9.18	9.18	9.19	9.18	9.18	9.19
L9	9.18	9.18	9.19	9.18	9.18	9.19	9.18	9.18	9.18	9.18	9.18	9.19	9.18	9.18	9.19
L10	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.17	9.18	9.18	9.18	9.18	9.18	9.18
L11	9.18	9.18	9.19	9.18	9.18	9.19	9.19	9.19	9.19						
L12	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.18	9.19	9.18	9.18	9.19	9.18	9.18	9.19
L13	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19
L14	9.18	9.18	9.17	9.18	9.18	9.17	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18
L15	9.18	9.18	9.18	9.18	9.18	9.18	9.19	9.18	9.18	9.19	9.19	9.18	9.19	9.19	9.18
L16	9.18	9.18	9.19	9.19	9.19	9.18	9.19	9.19	9.18	9.19	9.19	9.18	9.19	9.19	9.18
L17	9.19	9.2	9.2	9.19	9.19	9.18	9.19	9.19	9.2	9.19	9.19	9.19	9.19	9.19	9.19
L18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18
L19	9.19	9.19	9.2	9.19	9.19	9.19	9.19	9.19	9.2	9.19	9.19	9.19	9.19	9.19	9.19
L20	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19
L21	9.18	9.18	9.19	9.18	9.18	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19
L22	9.18	9.18	9.18	9.17	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18
L23	9.18	9.18	9.19	9.18	9.18	9.19	9.19	9.19	9.18	9.19	9.19	9.18	9.18	9.18	9.19
L24	9.19	9.19	9.19	9.18	9.19	9.2	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19
L25	9.18	9.19	9.19	9.18	9.19	9.19	9.18	9.19	9.19	9.18	9.19	9.19	9.19	9.19	9.19

LENS NUMBER	INITIAL 1	INITIAL 2	INITIAL 3	MEAN INITIAL	1 WEEK 1	1 WEEK 2	1 WEEK 3	1 MONTH 1	1 MONTH 2	1 MONTH 3	3 MONTH 1	3 MONTH 2	3 MONTH 3	6 MONTH 1	6 MONTH 2	6 MONTH 3	MEAN 6 MONTH
L1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.199	0.199	0.2	0.199	0.198	0.198	0.198333333
L2	0.198	0.198	0.2	0.19866667	0.2	0.2	0.2	0.2	0.2	0.2							0
L3	0.2	0.2	0.199	0.19966667	0.199	0.199	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
L4	0.2	0.2	0.205	0.20166667	0.205	0.205	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
L5	0.2	0.199	0.2	0.19966667	0.2	0.205	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
L6	0.195	0.195	0.195	0.195	0.192	0.192	0.195	0.192	0.195	0.195	0.195	0.195	0.195	0.195	0.195	0.195	0.195
L7	0.188	0.188	0.19	0.18866667	0.188	0.188	0.19	0.189	0.189	0.188	0.189	0.189	0.189	0.188	0.188	0.188	0.188
L8	0.193	0.193	0.193	0.193	0.194	0.193	0.193	0.192	0.192	0.19	0.192	0.192	0.193	0.192	0.192	0.192	0.192
L9	0.199	0.199	0.2	0.19933333	0.199	0.199	0.199	0.199	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
L10	0.19	0.19	0.192	0.19066667	0.19	0.19	0.192	0.192	0.192	0.191	0.192	0.192	0.191	0.189	0.189	0.1898	0.189266667
L11	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2							0
L12	0.188	0.19	0.19	0.18933333	0.19	0.192	0.19	0.192	0.192	0.19	0.192	0.191	0.191	0.19	0.189	0.189	0.189333333
L13	0.189	0.189	0.19	0.18933333	0.19	0.19	0.19	0.189	0.189	0.189	0.19	0.19	0.19	0.19	0.191	0.19	0.190333333
L14	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
L15	0.192	0.192	0.193	0.19233333	0.193	0.193	0.192	0.193	0.193	0.193	0.19	0.191	0.191	0.191	0.191	0.191	0.191
L16	0.192	0.191	0.19	0.191	0.19	0.19	0.191	0.191	0.191	0.192	0.191	0.191	0.191	0.19	0.19	0.19	0.19
L17	0.185	0.185	0.186	0.18533333	0.184	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185
L18	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.19	0.189	0.19	0.189	0.189	0.189	0.188	0.188	0.188	0.188
L19	0.199	0.199	0.198	0.19866667	0.199	0.199	0.198	0.198	0.199	0.199	0.198	0.198	0.198	0.198	0.198	0.198	0.198
L20	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
L21	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
L220	0.195	0.195	0.195	0.195	0.195	0.195	0.195	0.195	0.195	0.196	0.196	0.196	0.196	0.196	0.196	0.196	0.196
L23	0.195	0.196	0.196	0.19566667	0.198	0.198	0.197	0.196	0.196	0.196	0.196	0.196	0.196	0.196	0.196	0.196	0.196
L24	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
L25	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19

lens number	initial 1	initial 2	initial 3	mean initial	1 week 1	1week 2	1 week 3	1month 1	1month 2	1 month 3	3 months 1	3 months 2	3 months 3	6 months 1	6 months 2	6 months 3	mean 6 month
L1	-3	-3	-3.12	-3.04	-3	-3.12	-3.12	-3	-3	-3.12	-3	-3	-3.12	-3.12	-3.12	-3.12	-3.12
L2	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3							0
L3	-3	-2.87	-3	-2.9566667	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3.12	-3.12	-3	-3.08
L4	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
L5	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
L6	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
L7	-3	-3	-3.12	-3.04	-3	-3	-3.12	-3.12	-3.12	-3.12	-3.12	-3.12	-3.25	-3.12	-3.12	-3.25	-3.1633333
L8	-3	-3	-3.12	-3.04	-3	-3.12	-3.12	-3.12	-3	-3.12	-3.12	-3.12	-3.12	-3.12	-3.12	-3.12	-3.12
L9	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3.12	-3.12	-3.12	-3.12	-3.12	-3.12
L10	-3	-3	-3.12	-3.04	-3	-3	-3	-3	-3.12	-3.12	-3.12	-3.12	-3.12	-3.12	-3.12	-3.12	-3.12
L11	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3							0
L12	-3.12	-3.12	-3	-3.08	-3	-3	-3.12	-3	-3	-3.12	-3.12	-3.12	-3.12	-3.12	-3.12	-3.12	-3.12
L13	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3.12	-3.12	-3.12	-3.12	-3.12
L14	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3.12	-3.04
L15	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3.12	-3.12	-3.12	-3.12	-3.12	-3.12
L16	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3.12	-3.12	-3.08
L17	-3	-3	-3.12	-3.04	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3.12	-3.04
L18	-3	-3.12	-3.12	-3.08	-3	-3	-3.12	-3	-3	-3	-3	-3	-3	-3	-3.12	-3	-3.04
L19	-3	-3	-3	-3	-3	-3	-3	-3	-3.12	-3	-3	-3	-3.12	-3.12	-3.12	-3.12	-3.12
L20	-3	-3	-3	-3	-3	-3	-3	-3	-3.12	-3	-3	-3	-3.12	-3.12	-3.12	-3.12	-3.12
L21	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3.12	-3.12	-3.12	-3.12	-3.12
L22	-3	-3	-3	-3	-3	-3	-3	-3	-3.12	-3	-3.12	-3	-3	-3.12	-3	-3.12	-3.08
L23	-3	-3	-3	-3	-3	-3	-3	-3	-3.12	-3	-3	-3.12	-3.12	-3	-3.12	-3.12	-3.12
L24	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3.12	-3.12	-3.12	-3.12	-3.12
L25	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3

lens number	pre treatment	post treatment	
L1	0	6	
L2	0		
L3	0	5	
L4	0	6	
L5	0	4	
L6	0	2	
L7	0	2	
L8	0	2	
L9	0	2	
L10	0	2	
L11	0		
L12	0	3	
L13	0	3	
L14	0	4	
L15	0	7	
L16	0	4	
L17	0	2	
L18	0	3	
L19	0	3	
L20	0	0	
L21	0	4	
L22	0	0	
L23	0	7	
L24	0	0	
L25	0	0	