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Professional paper

Do the New Materials Keep Their Promises Regarding Good Lubrication?

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A B S T R A C T

To investigate the lubrication on different soft contact lenses during a week of wearing them. Twenty-five subjects participated in this research for six weeks and they wore six different soft contact lenses (Pure Vision B&L, Pure Vision II B&L, Air Optix, Focus N&D CIBA, Biofinity Cooper, Acuvue Oasys J&J). The contact lenses were randomly selected and the subjects did not know which contact lens they were wearing. Lubrication was examined on each individual three times: at the moment they first inserted the contact lenses, after all day wearing them and after one week, all using the standard »Tear analyses procedure« with the Slitlamp and immediately followed by recorded grade (1–5). After one week every test person also gave their own evaluation of the contact lenses with a grade from 1–5. After six weeks, every test person had every contact lens in both of their eyes. The results were statistically analyzed and compared: statistics of favorites of the test persons; statistics of objective results of the optometrist; statistics of differences and the correlation between right and left eye; statistics of correlation of test persons result and optometrists result. The conclusion was made after the statistical analysis.

***Key words**: complications contact lens, tear analysis procedure, soft contact lenses, BUT, slitlamp*

Introduction

»A normal tear film is required to maintain the health and function of the ocular surface. The pathological changes seen in dry eye disease affect all components of the tear film, changing the ocular surface environment from »ocular surface supportive« to »pro-inflammatory«. In this chapter we will discuss the makeup of the normal tear film and how it provides a supportive and protective environment for the mucosal surfaces of the eye – the cornea and conjunctiva[1].«

»The tear film is formed by glands in the eyelids conjunctiva, and the lacrimal glands. It is distributed over the ocular surface by the action o the eyelids, from where it evaporates, or drains via the nasolacrimal ducts. It contains lactoferrin lysozyme, immunoglobulins, and cells, including polymorphonuclear leukocytes and macrophages which prevent infection. An adequate tear film is essential for maintaining the health of the ocular surface and the optical quality of the eye and provides lubrication[2].«

Materials and Methods

The following text will describe how we tested promised lubrication of 6 different soft contact lenses. Producers are constantly developing new materials for contact lenses and each one of them claims that they are the best on the market, provide best lubrication, best oxygen transmissibility and best visual acuity. The following soft contact lenses where tested: Pure Vision, Pure Vision II, Air Optix, Acuve Oasys, Biofinity, and Focus N&D. For this test we had 25 participants, 10 males and 15 females, ages between 19 and 32. Each test person wore each lens for at least one week in both of their eyes. The research in all lasted for almost 8 weeks. Each person had different contact lens in both of his eyes and was not aware from which producer the lens came from.

The goal was to make the test persons as objective as possible, because most of them had experience with wearing contact lenses and already have formed their opinions and had their favourites. The methods that we used

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TABLE 1
USED CONTACT LENSES AND MATERIALS INFORMATION

Name	Acuve Oasys	Air Optix	Pure Vision 2	Biofinity	Pure Vision	Focus N&D
Material	Senofilcon A + PVP	Lotrafilcon B	Balafilcon A	Comfilcon A	Belafilcon A	Lotrafilcon A
Water content	38%	33%	36%	48%	36%	24%
DK/L	145	108	130	160	112	175
Base curve	8.4 and 8.8	8.6	8.6	8.6	8.3 and 8.6	8.4 and 8.6
Diameter	14	14.2	14	14	14	13.8
Producer	Vistacon Johnson&Johnson	Ciba Vision	Bausch&Lomb	CooperVision	Bausch&Lomb	Ciba Vision

for lens examining and a questionnaire intended for maintaining client's personal impressions are described further in the text.

Tear meniscus analysis[3]

The inferior tear lake is approximately 0.3 to 0.4 mm in height in normal individuals. Changes in the size of the meniscus, such as absence or increased size are associated with an unstable tear film and imply that the contact lens in the eye is making these changes. (SLITLAMP METHOD[3] – diffuse lighting, 20x magnification)

Tear film and flow analysis[3]

The act of blinking spreads the tear film over the surface of the eye. The tear film is formed by glands in the eyelids conjunctiva, and the lachrymal glands. It is distributed over the ocular surface by the action o the eyelids, from where it evaporates, or drains via the nasolacrimal ducts. An adequate tear film is essential for maintaining the health of the ocular surface and the optical quality of the eye. (SLITLAMP METHOD – diffuse lighting, 40x magnification)

BUT (break up time)[3]

To do this test the client must hold his eye open after blinking several times. Using the slit-lamp we scanned the tear film for the first breakup or black spot. While doing this it is possible to get a good view of the interference colors of our clients tear film. Normal breakup time is considered borderline if it is less than 10 seconds and frankly abnormal if it is less than 5 seconds. (SLITLAMP METHOD – diffuse lighting, 40x magnification)

Contact lens analysis[3]

We were checking the movement of the lens, if there were any deposits on the surface and if it was to flat or to steep. (SLITLAMP METHOD – diffuse lighting, 40X magnification)

Each test person also answered a questionnaire after one week of wearing the lenses. They had to give a grade of the lens, say if it caused blurry vision, and if they had any trouble with putting it out and did the lens feel dry or caused any pain or discomfort.

In our study we used six differnet contact lenses (Table 1) out of silicone hydrogel material. The used lenses are important brand markes. Every contact lens has an FDA accreditation.

Results

The tear meniscus remained almost the same through our research, although a small drop in its size is visible. We were checking the values of the tear meniscus at the first point when the contact lens was fitted in the eye (Figure 1) and the same value after at least one week of wearing that lens (Figure 2). The average size of the lower tear meniscus was inside the borders of normal values at the beginning of the test and remained the almost same at the end. The slightly drop in size can be related with constant wear of contact lenses, but none of the tested lenses dried the eye out of the normal limits (the inferior tear lake is approximately 0.3 to 0.4 mm in height in normal individuals). Apart from clients that already had problems with dry eyes the rest did not complain about their eyes being dry.

Next was the tear flow at the first moment (Figure 3) and after one week (Figure 4). The quality of the tear film is assessed by examining how fast it spreads across the surface of the cornea and by estimating its density.

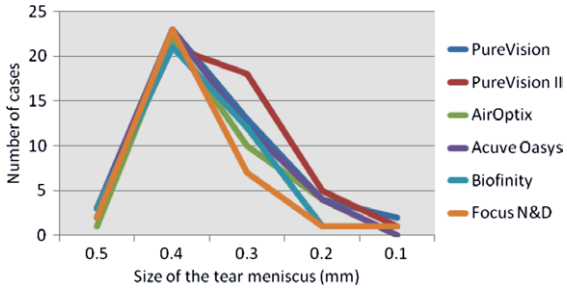

Fig. 1. Tear meniscus at the first moment.

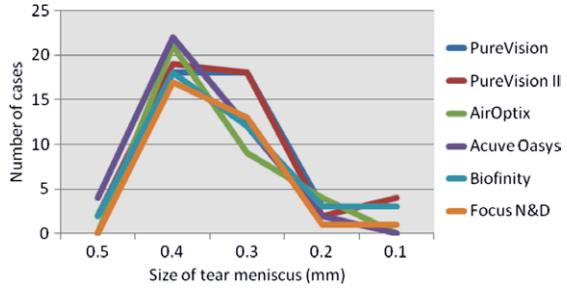

Fig. 2. Tear meniscus after one week.

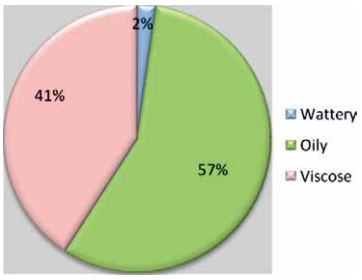

Fig. 3. Tear flow at the first moment.

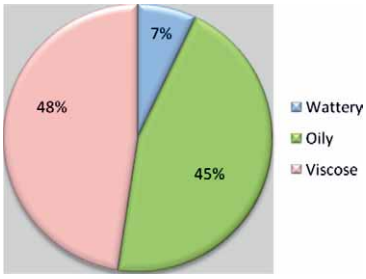

Fig. 4. Tear flow after one week.

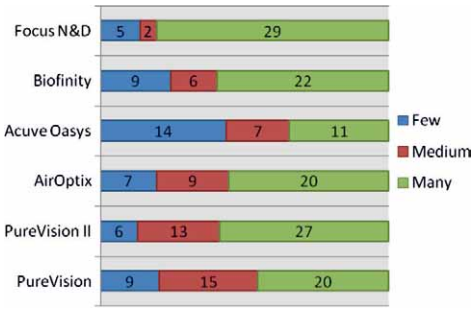

Fig. 5. Amount at the first moment.

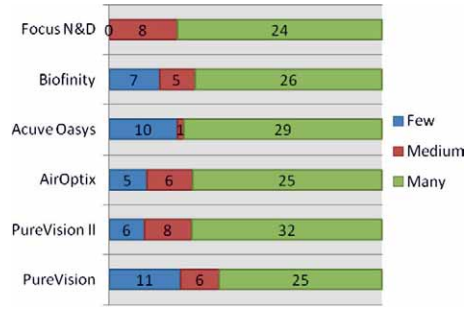

Fig. 6. Amount after one week.

There are three types of tear film: watery, viscose and oily. Watery tear film spreads very fast and is not very dense, viscose is a little bit slower and denser that watery and oily tear film spreads very slow and has high density. This can easily be seen immediately after the client blinks, we have repeated this for several times to make our assessment as accurate as possible.

The act of blinking spreads the tear film over the surface of the eye. This is mainly due to the action of the upper eyelid, which dips into the tear reservoir formed at the margin of the lower eyelid. In that moment we cans see the proteins and the lipids in the tear film beeing spread across the surface of the eye. Inadequate and incomplete blinking is a common cause of symptoms in the contact lens wearer. If the tear film becomes unstable souch as alterations in the composition, volume or the hydrodynamics of the fluid, it can cause problems for the eye. At the first moment (Figure 5) 20.74% eyes had few cells, 25.72% had medium amount of cells and 53.54% had allot cells. After one week (Figure 6) increase of the amount is obvious. 16.66% had few cells, 14.52% had medium and 68.82% had allot cells in the tear film.

Depending on the colors we see there are three different types of classifications of the type of the tear film: watery (silver, grey, and white), viscose (blue, purple, and grey), oily (red, yellow, and green). It is very important to do a correct assessment of the type of the tear film for it can significantly improve the comfort of the contact lens. By doing so we can choose the best material for that exact client and help prevent the eye from getting dry, irritated or painful. Each circle represents one contact lens, the smallest in the middle is Pure Vision, next to it Pure Vision II and then Air Optix, Acuve Oasys, Biofinity and Focus N&D). If we compare the colors at the first moment (Figure 7) and after one week (Figure 8) we can see that only a small change is visible and that the tear film has mostly oily and viscose color

Deposits reduce oxygen transmission through the lens, may increase the area of adsorption of chemicals from eye drops or care solutions and may increase bacterial adherence. There are two main types of deposits we can find on a contact lens: organic deposits (proteins, lipids, mucin, carbohydrates, mixed-composition substances, microorganisms and pigments) and inorganic deposits (calcium salts, salts of iron oxides, mercury and color changes). Deposits on a contact lens can cause los of visual acuity and ocular irritation. It is in the producer's

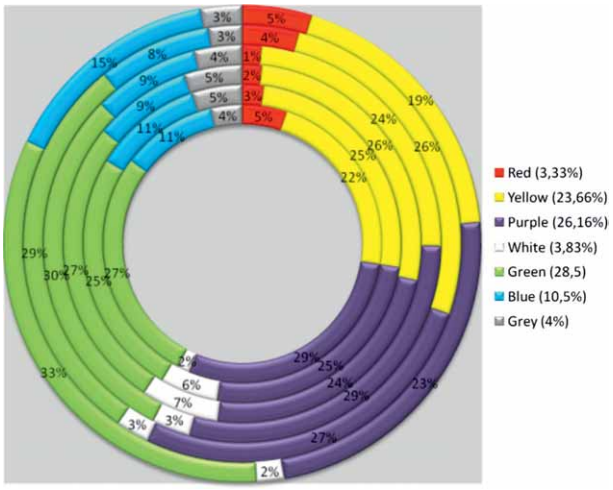

Fig. 7. Interferntial colours at the first moment.

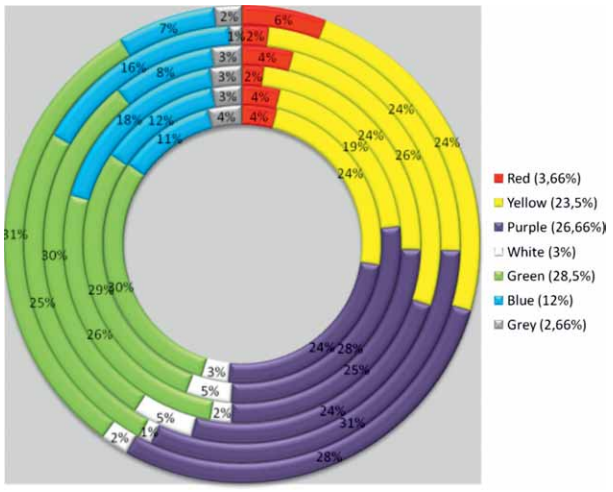

Fig. 8. Interferential colours after one week.

interest to keep the deposit level as low as possible. The amount of deposits on the surface of the contact lens at the first moment (Figure 9) and after one week of wearing them (Figure 10) did not cause any problems for the client's eyes.

Lens movement is considered important, as it promotes post-lens tear film exchange and mixing. Movement is quantified as the vertical change in lens position before and after a normal blink. Lens movement of less than 0.1 mm can be considered inadequate, and movement of more than 1.0 mm is excessive. Well fitted contact lens shows about 0.3 mm of movement. A flat lens will press the apex of the cornea and can cause damage

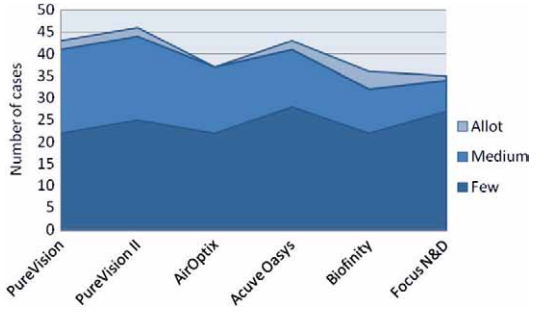

Fig. 9. Deposits at the first moment.

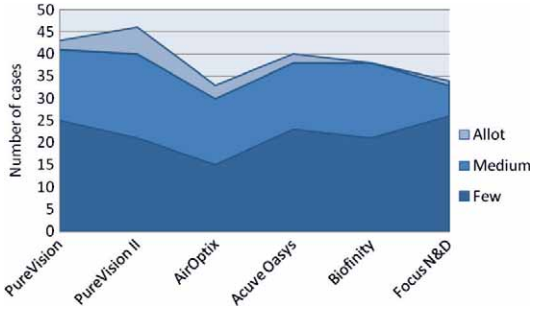

Fig. 10. Deposits after one week.

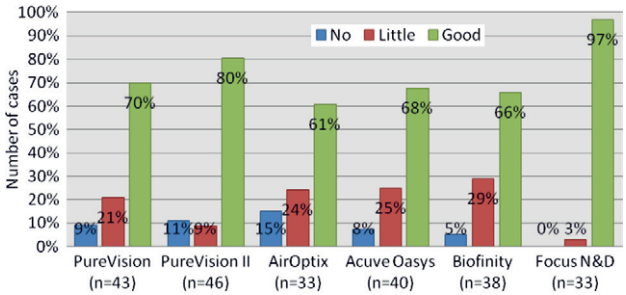

Fig. 11. Lens movement at the first moment.

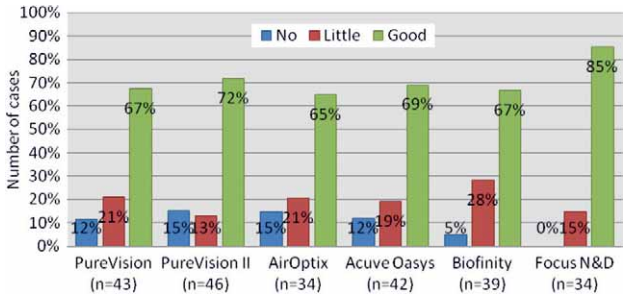

Fig. 12. Lens movement after one week.

and irritation and a steep contact lens causes neovascularization because of lack of oxygen. In this test the contact lenses generally had very good movement at the first moment (Figure 11) and after one week (Figure 12) and did not cause any problems for the client's eyes.

Pre-lens tear film breakup time is the easiest way to quantify the pre-lens tear film stability. After the patient blinks several times and a properly wetting pre-lens tear film is seen, ask the patient not to blink and count the time in seconds until the first appearance of significant pre-lens tear film thinning or breakup. In practice, breakup times less than 5 to 10 seconds are a potential concern, particularly if the patient also reports symptoms of dryness. A reduced pre-lens tear film breakup time may be associated with increased lens deposition and with increased symptoms of dryness. During this test period almost no change in the »BUT« was noticed (Figures 13 and 14).

Senofilcon A + PVP (Acuve Oasys)

The final results of the right eye shows 3.83 ± 1.18 and 3.70 ± 1.25 on the left eye. 57% of the test persons gave the same mark for this contact lens on both sides. A level of more than 50% is not a very high level of recognition. Counted 33% gave a mark with the smallest step of difference of mark ± 1.0. Finally 90% of all test persons gave the same, or nearly ± 1.0 the same mark. The minimal mark was 1.0 and the highest mark was 5.0. So in this case were given all the marks of comfort and discomfort. The higher (5.0) and the lower (3.0) quartile show that more that most of the test persons gave a mark between 3.0 and 5.0. This means, that this contact lens has an extreme high level of good lubrication and comfort.

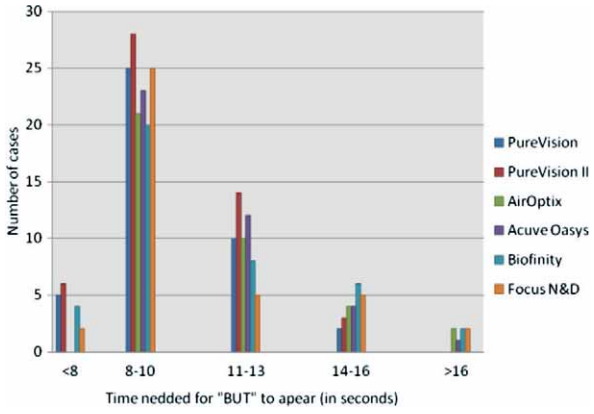

Fig. 13. Break up time at the first moment.

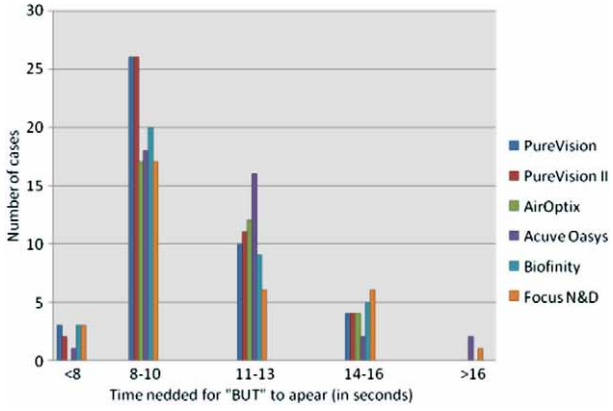

Fig. 14. Break up time after one week.

Lotarfilcon B (AirOptix)

The final results of the right eye shows 3.74 ± 0.94 and 3.52 ± 1.06 on the left eye. 38% of the test persons gave the same mark for this contact lens on both sides. This is the lowest level of recognition in this study. Counted 38% gave a mark with the smallest step of difference of mark ± 1.0. Finally 76% of all test persons gave the same, or nearly ± 1.0 the same mark. The minimal mark was 1.0 and the highest mark was 5.0. So in this case were given all the marks of comfort and discomfort. The higher (4.0) and the lower (3.0) quartile show that more that most of the test persons gave a mark between 3.0 and 4.0. This means, that this contact lens has a slightly lower level of good lubrication and comfort, than other tested contact lenses in this study.

Balafilcon A (PureVision II)

The final results of the right eye shows 3.74 ± 1.16 and 3.52 ± 1.10 on the left eye. 52% of the test persons gave the same mark for this contact lens on both sides. A level of more than 50% is not a very high level of recognition. Counted 28% gave a mark with the smallest step of difference of mark ± 1.0. Finally 80% of all test persons gave the same, or nearly ± 1.0 the same mark. The minimal mark was 1.0 and the highest mark was 5.0. So in this case were given all the marks of comfort and discomfort. The higher (5.0) and the lower (3.0) quartile show that more that most of the test persons gave a mark between 3.0 and 5.0. This means, that this contact lens has a higher level of good lubrication and comfort.

Comfilcon A (Biofinity)

The final results of the right eye shows 4.04 ± 0.62 and 3.74 ± 1.04 on the left eye. 57% of the test persons gave the same mark for this contact lens on both sides. A level of more than 50% is not a very high level of recognition. Counted 28% gave a mark with the smallest step of difference of mark ± 1.0. Finally 85% of all test persons gave the same, or nearly ± 1.0 the same mark. The minimal mark was 1.0 and the highest mark was 5.0. So in this case were given all the marks of comfort and discomfort. The higher (4.0) and the lower (4.0) quartile show that more that most of the test persons gave a mark of 4.0. This means, that this contact lens has a higher level of good lubrication and comfort.

Balafilcon A (PureVision)

The final results of the right eye shows 3.35 ± 1.14 and 3.48 ± 1.06 on the left eye. 47% of the test persons gave the same mark for this contact lens on both sides. This is the second lowest level of recognition in this study. 33% gave a mark with the smallest step of difference of mark ± 1.0. Finally 80% of all test persons gave the same, or nearly ± 1.0 the same mark. The minimal mark was 1.0 and the highest mark was 5.0. So in this case were given all the marks of comfort and discomfort. The higher (4.0) and the lower (3.0) quartile show that more that most of the test persons gave a mark between 3.0 and 4.0. This means, that this contact lens has a slightly lower level of lubrication and comfort, but is still very good.

Lotrafilcon A (Focus N&D)

The final results of the right eye shows 4.26 ± 0.77 and 4.39 ± 0.67 on the left eye. 81% of the test persons gave the same mark for this contact lens on both sides. A level of more than 50% is not a very high level of recognition. 81% is the highest result of recognition we could find in the whole study. Counted 19% gave a mark with the smallest step of difference of mark ± 1.0. Finally 100% of all test persons gave the same, or nearly ± 1.0 the same mark. The minimal mark was 3.0 and the highest mark was 5.0. So in this case only marks of comfort and discomfort between 3.0 and 5.0 were given. The higher (5.0) and the lower (4.0) quartile show that more that most of the test persons gave a mark between 4.0 and 5.0. This means, that this contact lens has the highest level of lubrication and comfort during this test period.

A critical point is that the Focus N&D is the only one of tested contact lenses without a handling tint and she has the smallest diameter of all lenses in the study. So the question is, did gave test persons the same mark for the recognition of the same feeling of good lubrication, or for the recognition of the same color and the smallest diameter of the contact lens?

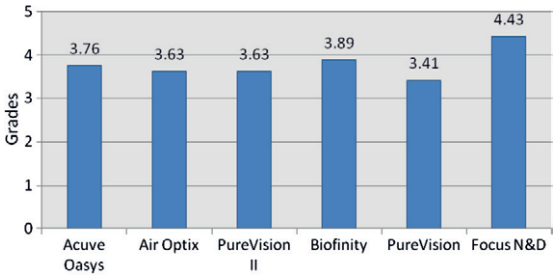

Fig. 15. Overall grades given by the test persons.

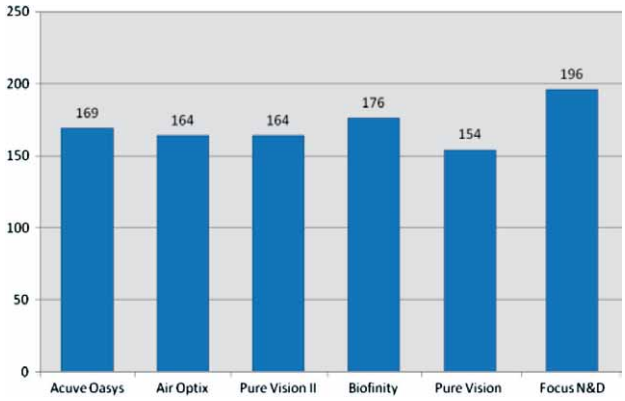

Fig. 16. Final score of lubrication.

Final Score Of Lubrication And Overall Grades (Figures 15 and 16)

Focus N&D provide the best lubrication and received the highest grade 4.43 ± 0.70 (196), second are Biofinity 3.89 ± 0.88 (176), third Acuve Oasys 3.76 ± 1.18 (169), Air Optix 3.63 ± 0.97 (164) and Pure Vision II 3.63 ± 1.10 (164) share the fourth place, and the fifth place are Pure Vision 3.41 ± 1.11(154).

Discussion and Interpretation of the Results

These methods on these exact contact lenses were used for the first time on University of Applied Science Velika Gorica in March 2012.

With our methods we did not find that any of the tested lenses caused problems for the test persons eyes, also none of them had any complications managing the lenses. Changes in the quality and quantity of the tear film were small, deposits on the lenses did not cause any infections or poor visual acuity and the lenses had good movement and did no damage. In our conclusion, all of the tested lenses stand up to the standards that they promise and provide good lubrication, of course with some variations in the final results.

The overall grade is more of subjective nature of the clients than from the results we gathered during the test period. In some occasions the same lens in one eye got a low score and in the other a perfect score. Knowing that the clients did not know which lens they had in their eyes, this can be associated to a number of different factors that may not have anything to do with the quality of the lens.

58% of the clients gave the same grade to the same lens in both of their eyes, and 29% gave a ± 1 grade difference. In total that is 87% of all grades given, so we can say that in most cases the recognition of comfort of the lubrication between left and the right eye was found.

The best score of lubrication had the Lotrafilcan A material. It has a water content of 24%. So this contact lens has a lower level of tear film suction then other lenses. The Dk/l is 175 barrers. The good moisture-rich feeling comes from a plasma–coated surface. Her level of recognition is 100%. This is not the best result, but we are not sure, that this is right, because this is the only contact lens in our study, without a handling tint and with the smallest diameter. So maybe test persons gave them the same mark, because they found them as a result of the visual perceptibility.

The next best moisture-rich contact lens is out of Senofilcon A material, mixed with PVP (Polyvinyl-Pyrrolidon) has a water content of 38% and recognition of 90%. The Dk/l is 145 barrers. The chance for a good result of recognition out of the visual perceptibility is lower, because she has the same color and the same diameter, then other tested contact lenses.

The third best result reached a contact lens, out of Comfilcon A material with a water content of 48%. The Dk/l is 160 barrers. The recognition was 85%. The material has extra-long silicon-chains, with water-binding--arms for the good wetting.

In the conclusion today silicon-hydrogel-contact lenses have a high level of oxygen transmissibility and a more and more better level of moistening then before. In the moment it is very close to the level like the old hydrogels. The next generations of silicon-hydrogel-contact-lenses will be more moisture-rich than now. The next topic of performance of contact lenses will be the lubrication. So contact lenses wearing will become more comfortable in future.

Acknowledgements

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To the University of Applied Sciences Velika Gorica, that we had the permission to do this work with their instruments and in their laboratory rooms.

To all our test persons, which were cooperative to wear all the different contact lenses, to hold them to the rules of testing and came for observing their eyes.

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DA LI NOVI MATERIJALI ODRŽAVAJU OBEĆANU VLAŽNOST I PODMAZIVANJE OKA?

SAŽETAK

Provjeriti razinu lubrikacije oka na različitim mekanim kontaktnim lećama nakon tjedan dana nošenja. Dvadeset i pet test osoba sudjelovalo je u istraživanju koje je trajalo šest tjedana. U tom periodu nosili su šest različitih mekanih kontaktnih leća (PureVision B&L, PureVision II B&L, Air Optix CibaVision, Focus N&D CibaVison, Biofinity CooperVision, Acuvue Oasys J&J). Testirane kontaktne leće bile su nasumično odabrane te test osobe nisu znale koje leće imaju u očima. Lubrikacija oka testirana je na svakoj osobi 3 puta: odmah nakon stavljanja leće u oko, nakon jednog dana nošenja i nakon tjedan dana, pritom koristeći standardne metode analize suznog filma sa biomikroskopom te sustav ocjenjivanja dobivenih rezultata (1–5). Nakon tjedan dana svaka je test osoba dala vlstitu procjenu kontatkne leće koju je nosila davanjem ocjena isto tako 1–5. Nakon šest tjedana svaka test osoba je u svakom oku imala svaku testiranu kontaktnu leću. Rezultati su statistički obrađeni te uspoređeni na sljedeći način: subjektivne ocjene test osoba, objektivni rezultati od strane optometrista, korelacija između rezultata test osoba i optometrista, razlike između ocjena lijevog i desnog oka. Zaključak je donešen nakon detaljne statističke analize.