



LENS CARE COMPLIANCE RATES AND PERCEPTIONS AMONG RIGID GAS PERMEABLE CONTACT LENS WEARERS – A PILOT STUDY

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SUMMARY – The aim was to estimate compliance rate among rigid gas permeable lens wearers (RGPLW) in lens system care, identify procedures in lens care process with poorest compliance levels, and assess concordance between participant reported practices and their subjectively perceived compliance. The study included outpatient RGPLW managed at Zagreb University Hospital Center in Zagreb, Croatia. They filled out a questionnaire that included demographic data, duration of lens wear, self-evaluation compliance grade, and 14 lens care procedures and wearing habits indicative of compliance. There were 50 patients (mean age 34.6 years, 68% female). Full compliance was found in a single patient. The mean number of non-compliant procedures was 5.48, with 32% of participants non-compliant in more than 50% of the compliance criteria. Critical procedures of the lens care process were infrequent lens case exchange (74%), using tap water for lens (70%), and improper case cleaning (68%). The mean lens case replacement time was 9.8 months (SD 6.76), with only 26% of patients replacing lens case at least once in 3 months. Excessive daily lens wear was associated with greater total number of non-compliant procedures ($p < 0.0008$). RGPLW were aware of their inappropriate lens care only when achieved non-compliance in almost 50% of the procedures. In conclusion, lens wearers were not aware of their extremely low compliance rate in several aspects of lens and lens case maintenance. Study results indicated the key procedures the practitioners should focus on when evaluating subjective and objective compliance and reinforcing care and hygiene education of RGPLW.

Key words: *Contact lens; Lens and lens case replacement; Lens care; Patient compliance*

Introduction

Refractive errors are recognized as a global public health problem, since they are the second most common cause of visual impairment¹. Contact lens wear is an important aspect of refractive error correction². Appropriate contact lens system maintenance is very important because it enables lens disinfection before

every application to the ocular surface^{3,4}. It removes lens and case deposits that disable washing away the microbes attached to the biofilm on the lens and case surface, reduces lens oxygen transmission, and enables moisturizing lens surfaces evenly⁵⁻⁷. Thus, it is suggested that compliance with contact lens care is the most important aspect of safe, comfortable and uninterrupted lens wear^{4,8-11}. However, compliance rate was shown to be very poor among contact lens wearers^{2,4,8,12-15}. It is not clear whether this is predominantly due to patient inadequate understanding or ignorance of the instructions, physician insufficient insight in the most common mistakes patients make in lens system care, failure

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of medical professionals to highlight the importance of adherence to every lens maintenance step^{8,16-18}, or highly variable lens care recommendations amongst various advisory bodies (manufacturer, regulatory authority, physicians, optometrists)^{6,7,19-24}. A combination of these factors is most likely the issue, and previous research pointed to a clear need for re-evaluating each of them, in particular patient practices in lens system care^{2,8,10,14,17}. Moreover, there are inconsistent ways of evaluating compliance in the published literature due to the absence of a uniform compliance evaluation questionnaire, with unique scores and compliance assessment grades^{2,7,8,13}.

Previous research established greater prevalence of non-compliance and case contamination amongst rigid gas permeable lens wearers (RGPLW) than in soft lens wearers¹⁴. Moreover, none of the fully compliant patients had contaminated lens cases¹⁴. We therefore decided to further analyze this specific group of patients.

The aim of this study was to comprehensively explore compliance rates in every aspect of RGP lens care, identify procedures in lens care process with the poorest compliance levels, and assess concordance between patient reported practices and perceived compliance.

Subjects and Methods

Subjects

We included asymptomatic RGPLW aged 12-65 years, who had worn lenses for more than one year, and presented for regular annual contact lens examination at the Zagreb University Hospital Center outpatient clinic, Zagreb, Croatia, in the period from May 2016 to October 2016. All patients at this clinic are routinely administered written instructions about proper lens wear and care management. Patients were excluded if they wore therapeutic lenses, lenses for overnight wear, or had a history of contact lens-related adverse events.

The study was performed according to the tenets of the Declaration of Helsinki and was approved by the Ethics Committee of the Zagreb University Hospital Center. Informed consent was obtained from all study subjects and their participation was anonymous and voluntary.

Compliance evaluation questionnaire

Since there is still no standard compliance evaluation instrument for contact lens wearers^{2,7,8,13,14}, we developed a questionnaire combining the available

Table 1. Compliance procedures and compliance values evaluated

Compliance procedure and reference number ^(ref)		Compliance value
Lens and case maintenance		
1	Regular lens replacement frequency ²¹	<3 years
2	Regular case solution replacement frequency ^{20,21,11}	Every day
3	Regular case replacement frequency ^{14,20-22}	<3 months
4	Topping up case solution ²⁰⁻²²	No
5	Tap water for lens cleaning instead of lens solution ^{2,20}	No
6	Tap water for case cleaning ^{2,20}	No
7	Saline solution for storage instead of lens solution ^{2,20-22}	No
8	>4 h lens soaking ²⁴	Yes
9	Hand washing before lens system hygiene ^{20,21,23,24}	Yes
10	Proper case hygiene (empty, wash with solution, air dry, pour new solution) ²³	Yes
Lens wearing habits		
11	Daily lens wear ^{25,26}	<14 hours a day
12	Sleeping with lenses ²¹	No
13	Showering with lenses ^{20,21}	No
14	Annual control examinations ^{20,21}	Yes

recommendations for lens wear and care management^{6,7,19-24} and our own clinical and research experience¹⁴.

The subjects completed a questionnaire consisting of 19 questions covering demographic data, duration of contact lens wear, self-evaluation grade in lens care compliance, and a total of 14 lens practices indicative of compliance (10 on lens and case hygiene maintenance, and 4 on lens wearing habits). Since there are no strict recommendations about maximum hours of continuous lens wear, according to studies that presented average lens wear^{25,26} of 8 to up to 13 h and our clinical experience, while trying to reflect reality, we limited daily lens wear non-compliance to ≥ 14 hours. Other measures for quantitative questions (regular frequency of lens replacement <3 years, case solution replacement once a day, case replacement frequency <3 months, and lens soaking >4 hours) were tailored according to the manufacturer's recommendations and our previous research¹⁴.

In previous studies, age under 30 and lens wear for more than 5 years were associated with more non-compliant behaviors and complications of lens wear^{11,27}. Therefore, stratification into subgroups was made accordingly.

All the compliance procedures evaluated and their values are shown in Table 1.

Patients were considered fully compliant only if the data revealed from the questionnaire met all of the proposed criteria, and non-compliant if any of these criteria were not met.

Self-evaluating compliance grade

In order to evaluate perceived compliance, patients were asked to assess their compliance with lens care and wearing habits on a 1-5 scale (1, very poor; 2, poor; 3, good; 4, very good; and 5, excellent lens system care and wearing habits).

Statistical analysis

Demographic data and frequencies of non-compliant behaviors were evaluated. The association between the number of non-compliant care steps and age, gender, excessive daily lens wear, number of years of lens wear and self-evaluation compliance grades was evaluated.

Statistical analysis was performed using Statistical Package for the Social Sciences for Windows version 13.0 (SPSS Inc., Chicago, IL, USA). Descriptive sta-

tistics was used to describe subject demographic and clinical data using mean and standard deviation (SD) for interval measures, and frequencies and percentages for categorical variables. Kolmogorov-Smirnov goodness of fit test was used to test for normality of data distribution ($p < 0.05$ was considered as a significant departure from normality).

Student's t-test was used to evaluate if there were significant test differences in the number of non-compliant procedures between the groups. ANOVA was used for the mean number of non-compliant procedures according to self-evaluating grades, and post hoc test for differences between the groups. The level of statistical significance was set at $p < 0.05$.

Results

A total of 50 patients were included in the study. Table 2 summarizes demographic, behavioral and self-assessment data. Only one (2%) patient fulfilled all of our 14 evaluated procedures set as the criteria for compliance. All other patients were non-compliant in some of 14 evaluated procedures, with the mean number of non-compliant procedures of 5.48 (SD 2.02),

Table 2. Demographic, behavioral and self-evaluating data

Parameter	n (%)
Gender	Male, 16 (32%) Female, 34 (68%)
Fully compliant patients	1 (2%)
Parameter	Mean (SD)
Age (years)	36.4 (15.5)
Number of years of contact lens wear	17.34 (12.76)
Number of non-compliant procedures	5.48 (2.02)
Lens wearing time <i>per day</i>	12.3 (3.43)
Lens case replacement time (months)	9.8 (6.76)
Self-evaluating compliance grade (1=poor through 5=excellent)	3.76 (0.77)

SD = standard deviation

while 16 (32%) patients were non-compliant in more than 50% of the established criteria of compliance.

The most common non-compliant behaviors were irregular lens storage case replacement reported by 37 (74%), using tap water for lens system cleaning by 35 (70%), using tap water for case cleaning by 34 (68%), and saline solution storage by 33 (66%) patients. Insuf-

ficient lens soaking time was reported by 29 (58%) and irregular solution replacement frequency by 28 (56%) patients (Fig. 1).

Only 26% of patients reported replacing lens case at least once in 3 months, with the mean lens case replacement frequency of 9.8 months (SD 6.76). The mean lens wearing time *per day* was 12.3 hours (SD

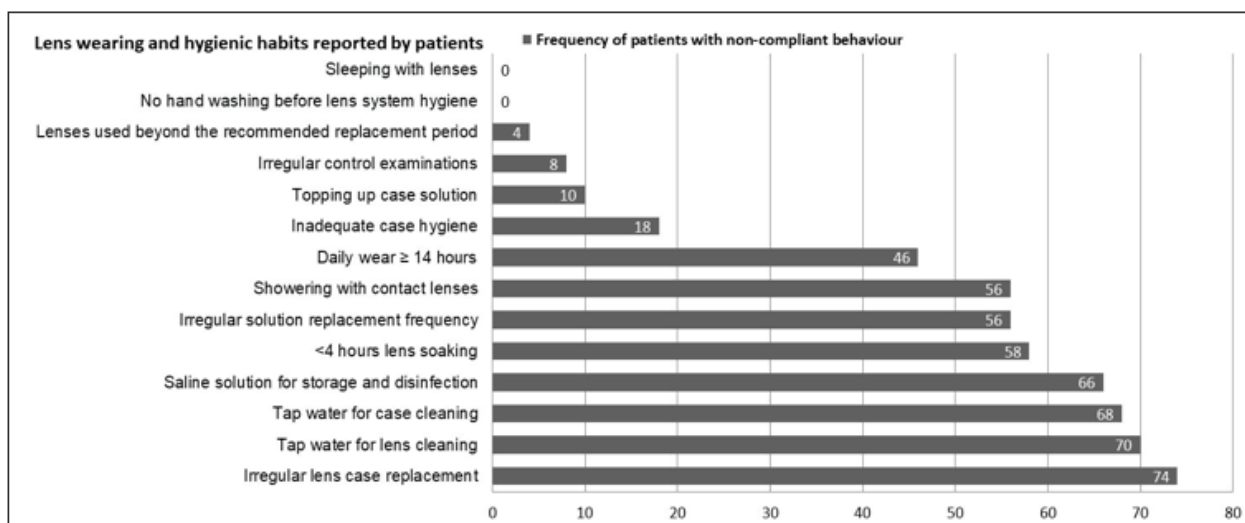


Fig. 1. Frequency of lens wearer non-compliant behaviors.

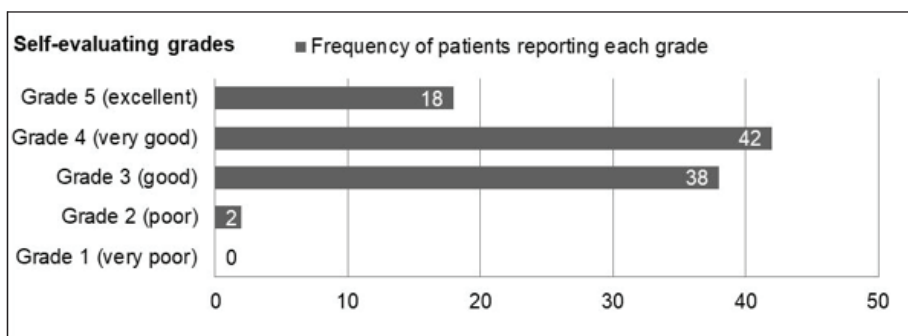


Fig. 2. Frequency of patients reporting each self-evaluation grade.

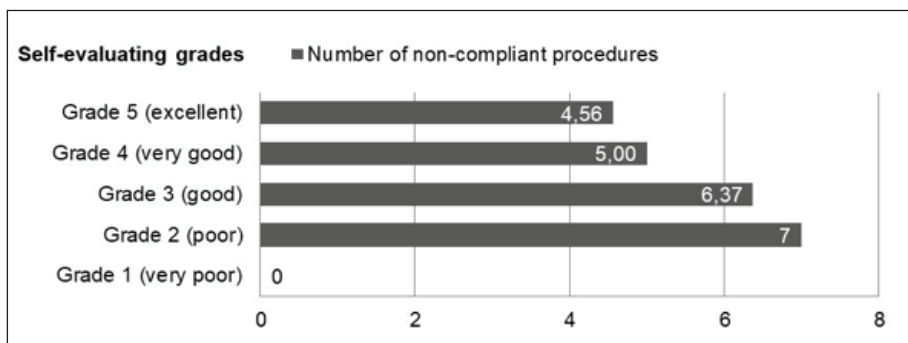


Fig. 3. Mean number of non-compliant procedures according to self-evaluation grade.

3.43), and 23 (46%) patients reported wearing lenses for 14 or more hours a day. A group of patients who reported wearing lenses for less than 14 h *per* day had a statistically significantly less non-compliant behavior than those who wore lenses for 14 or more hours daily ($t=-3.59$, $df=48$, $p<0.0008$). No statistical significance was found when comparing the number of non-compliant procedures and patient gender, age or number of years of contact lens wearing experience.

The mean self-evaluating compliance grade was 3.76 (SD 0.77) (Table 2). Eighteen percent of patients graded their compliance as excellent, 42% as very good, 38% as good, and 2% as poor (Fig. 2). The mean number of non-compliant procedures according to self-evaluating grade was as follows: 4.56 (SD 2.35) for grade 5, 5.00 (SD 1.7) for grade 4, and 6.37 (SD 1.95) for grade 3 (Fig. 3). There was a statistically significant difference between the groups as determined by one-way ANOVA ($F(2,46)=3.7$, $p=0.032$). Post hoc test analysis determined that patients who graded their compliance level as good (grade 3) had a significantly greater number of non-compliant procedures than those in group with grade 4 ($p<0.023$) and 5 ($p<0.041$). There was no statistical significance in the number of non-compliant procedures between the groups with grade 4 and 5 ($p<0.56$).

The only procedures by which the patients completely adhered to recommendations were hand washing prior to lens system handling and not sleeping with lenses (50% and 100% of participants, respectively). Regular lens exchange also achieved a very high level of compliance, recorded in 48 (96%) lens wearers (Fig. 1).

Discussion

Lens care compliance is the most important factor for safe contact lens wear^{4,8-11}. However, the level of compliance among contact lens wearers is often unsatisfactory^{4,8,10,12-15}. There are many potential reasons for such trends, which need thorough re-evaluation. Careful analysis of patient compliance in its every aspect is the basis for this process^{2,7,8,10,14,17,19}. In this study, we recorded very low levels of lens care compliance among RGPLW. On the other hand, relatively high self-evaluating compliance grades might indicate that lens wearers were not aware of their extremely low compliance rate in several aspects of lens maintenance.

The results of this study may have revealed the key procedures practitioners should focus on when constructing standardized compliance questionnaire,

evaluating subjective and objective compliance, and making more targeted strategies for patient education in lens care and wearing habits.

Aspects of compliance

Rigid gas permeable lens wearers were identified as the most non-compliant population in previous research¹⁴, and therefore we decided to focus on this group of lens wearers. Since different manufacturers have different guidelines for contact lens system maintenance^{6,7,19-24}, and on the other hand, many different scientists have different criteria for measuring compliance to manufacturers' guidelines^{2,7,8,13}, we designed our own questionnaire. The list of 14 criteria for compliance, which we evaluated, comprehensively covered different aspects of lens wear and was created based on the experience of other scientists, the most common manufacturers' recommendations, and our own clinical and research experience^{6,7,14,19-24}.

Since we made strict criteria for compliance, compliance with all these criteria was found in only one (2%) patient. Sixteen (32%) patients were non-compliant in more than 50% of the established criteria of compliance. This result is considerably worse than those reported from some other studies, which found appropriate compliance in 15% to 32% of subjects^{12,16}. This could be due to the fact that we considered all of the components of lens system hygiene, including lens, lens disinfection solution and lens storage case, as well as wearing habits, whereas other researchers often used to only partially evaluate lens system maintenance^{16,17,19}.

Irregular lens storage case replacement, less than once in 3 months, was the most common non-compliant behavior, found in 74% of patients. This fact is worrisome, since it is proven that current case age of more than 3 months is associated with lens case bacterial contamination¹⁴. Furthermore, lens case replacement time was more than three times longer than recommended^{20,21}, thus increasing the risk of developing microbial biofilm on its surface^{9,11,14}. When we add the high percentage of non-compliance to the procedures, which increases the risk of losing sterility, such as using tap water for lens system cleaning (70%), saline solution disinfection (66%), insufficient lens soaking time (58%) and irregular solution replacement frequency (56%), it is possible that it further increases the risk of lens contamination and microbial lens wear associated complications^{10,11,13}.

In previous research, excessive daily lens wear was a positive predictor of lens case contamination¹⁴; in this research, unfortunately, it was among the most common non-compliance behaviors, reported by 46% of lens wearers. We also found that patients with excessive daily lens wear had statistically significantly more non-compliant procedures in lens system. Therefore, besides information on the number of hours of lens wear during regular examination, physician might be alert to further investigate other possible non-compliant behaviors.

All patients reported hand washing prior to lens handling, and 96% of patients reported regular lens replacement interval. A longitudinal case control study should be performed to determine whether these might be the key protective factors for our patients who stayed asymptomatic for years despite such high non-compliance rates in many aspects of hygiene maintenance.

Aspects of compliance perception

The mean self-evaluating compliance grade was 3.76 (SD 0.77) (1, very poor lens system care through 5, excellent lens system care), which is surprisingly high, since only 2% of fully compliant patients were found. Patients who graded their compliance as excellent (grade 5) and very good (grade 4) did not comply appropriately in about 1/3 of evaluated procedures, indicating that patients failed to associate some of their behaviors with non-compliance. However, patients who graded their lens system care compliance as good (grade 3) had the mean number of non-compliant procedures of 6.37 (SD 1.95), yielding statistically significantly more non-compliant procedures than in those with grade 4 (very good) or grade 5 (excellent). Thus, only when they failed to comply in almost half of the lens system maintenance procedures evaluated, patients became more aware of their inappropriate lens system care (self-evaluating grade 1-3).

Several other studies also noticed overall impression of patients that they maintained good compliant procedures despite objectively low compliance scores^{12-14,16}. Therefore, at this point, it is crucial to highlight the important fact that both patients and medical professionals have to increase the level of awareness of the specific aspects of non-compliance, which are often not perceived as non-compliance, and its consequences. Thus, it will be the basis for more effective patient education.

A possible limitation of our study was a relatively small sample and using our own compliance rate questionnaire, which could limit comparison with other studies. The latter limitation is inevitable because there is still no standard, official questionnaire for evaluating lens system hygiene compliance.

Our study explored compliance among RGPLW, who had been identified as the most non-compliant group in a previous research¹⁴. However, this limited generalizability of our findings to all lens wearers. In this study, only asymptomatic lens wearers were evaluated because symptomatic patients might become aware of their non-compliance, get extra education, and are more motivated to enhance their compliance in order not to repeat an adverse event¹². They are therefore not a representative group for evaluating an average lens wearer. Moreover, asymptomatic non-compliant patient is in misconception of his/her level of non-compliance and encouraged to continue with the same faulty behaviors in lens system care.

In conclusion, in our study, we established a very low level of lens wear related compliance. Most of the existing questionnaires do not consider all the aspects of lens system care and wearing habits^{12,13}, thus providing only partial insight into compliance and consequently inappropriate assessment of the risk of contamination. Although we considered the entire lens system hygiene maintenance and also wearing habits, the extremely low full compliance rate was still surprising. On the other hand, self-evaluation resulted in relatively high grades, which implies that lens wearers were not aware of their extremely low compliance rate in several aspects of lens maintenance. Excessive daily lens wear was related to more non-compliant procedures in lens care and wearing habits. Longitudinal studies are needed to investigate excessive daily lens wear as a positive predictor of lens wear related complications. Moreover, in our daily practice, it would be useful to have some shortcuts how to recognize patients at risk of microbial lens wear associated complications. Therefore, future studies are needed to construct a validated objective and subjective compliance questionnaire for use in clinical settings, available to both medical professionals and lens wearers. This in turn will help equalize assessment of objective and subjective compliance, which could, together with more targeted strategies for education about proper lens use and its importance, ultimately improve patient compliance to the desired level. Our study could contribute to that aim.

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Sažetak

RAZINA I PERCEPCIJA SURADLJIVOSTI U ODRŽAVANJU HIGIJENE LEĆA MEĐU NOSIOCIMA TVRDIH PLINOPROPUSNIH LEĆA – PILOT STUDIJA

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Cilj je bio ispitati razinu suradljivosti nosilaca tvrdih plinopropusnih leća (NTPL) u održavanju higijene leća, utvrditi koji su koraci u postupku higijene leća kojih se najmanje pridržavaju i procijeniti povezanost između objektivne i vlastite subjektivne procjene o suradljivosti NTPL u održavanju higijene leća i kutijica za leće. Uključeni su ambulantno kontrolirani NTPL u Kliničkom bolničkom centru Zagreb, Zagreb, Hrvatska. Ispitanici su ispunili upitnik koji je sadržavao demografske podatke, dužinu nošenja leća, ocjenu za samoprocjenu suradljivosti u održavanju leća i 14 koraka i navika nošenja leća koji su važni za procjenu suradljivosti. Uključili smo 50 bolesnika (srednja dob 34,6 godina, 68% bolesnika ženskog spola). Potpuna suradljivost utvrđena je u samo jednog bolesnika. Srednji broj nesuradljivih koraka je bio 5,48, a 32% ispitanika je bilo nesuradljivo u više od 50% kriterija suradljivosti. Najkritičniji koraci nepridržavanja odgovarajuće higijene leća bili su neredovita zamjena kutijica za leće (74%), uporaba tekuće vode za ispiranje leća (70%) i nepravilno čišćenje posudica za leće (68%). Srednje vrijeme zamjene kutijica za leće bilo je 9,8 mjeseci (SD 6,76), a samo 26% bolesnika mijenjalo je kutijice u preporučenom roku od 3 mjeseca. Prekomjerno nošenje leća u danu povezano je s većim ukupnim brojem koraka nesuradljivosti ($p < 0,0008$). NTPL postali su svjesni svoje neprimjerene higijene leća tek kada bi postali nesuradljivi u gotovo 50% koraka za procjenu održavanja higijene leća. U zaključku, NTPL nisu bili svjesni svoje iznimno niske razine suradljivosti u nekoliko aspekata održavanja leća i kutijica za leće. Rezultati ove studije pokazali su ključne korake na koje bi se liječnici trebali usredotočiti kada procjenjuju subjektivnu i objektivnu razinu suradljivosti bolesnika i potiču na izobrazbu NTPL o pravilnoj brizi za leće.

Ključne riječi: *Kontaktne leće; Zamjena leća i kutijica za leće; Održavanje leća; Suradljivost bolesnika*