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Determination of Innovative Application for Ophthalmic Lens

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***Abstract*:** *In recent years, a rapid development has taken place in ophthalmic lens technology. Main focus of the works is on development of new ophthalmic materials and on improving the performance of ophthalmic coatings. While the performance expectations from the main materials are providing high visible quality and not to break easily, expectations from ophthalmic coatings are improved scratch-resistance, light transmissions etc. and decrease in keeping dust and water etc. The aim of this study is to identify the innovation needs for ophthalmic lenses to be done in accordance with the complaints from opticians and eyeglasses users. Survey method was used in this study. Research data was collected with "Ophthalmic Lens Open Ended Questions" through the interviews. In total 200 ophthalmic lens retailers, representatives and eyeglasses users are participated in this study. After the evaluation of open ended questions, 10 retailers, 10 representatives and 10 eyeglasses users were interviewed. In this contribution, results of the study are briefly discussed and suggestions for innovative application of ophthalmic lenses are give.*

Keywords: *Eyeglasses, Ophthalmic Lens, Ophthalmic Lens Coating, Ophthalmic Lens Materials*

1. Introduction

Nowadays, mineral (Crown, Flint) and plastic (CR-39, High Refractive Index Material Lens, Polycarbonate and Trivex) are used as main materials for eyeglasses.

The first eyeglasses were made of mineral. A Mineral lens usually contains SiO2, CaO, BaO, Na2O and K2O. It has a high visual quality. It is scratch resistant and not affected by temperature and atmospheric effects. However, it is heavy and can be broken easily [1]. CR-39 (allyl diglycol carbonate) is the most common eyeglasses material. It is a plastic polymer. It is lightweight and not broken easily. It has a high vision quality. But it is scratched easily and affected by temperature and atmospheric effects [2]. Lenses with high-refractive indices are obtained by incorporating Barium, Lantanium or Lantanium and Niyobyumun into CR-39 [1]. They have a thin edge. But they have a low vision quality and they are scratched easily and affected by temperature change and atmospheric effects [3]. Polycarbonate is a thermoplastic polymer which contains carbonate groups. Polycarbonate has a thin edge and lightweight. It is not broken easily. But they have a low vision quality and they are scratched easily and affected by temperature, chemical and atmospheric effects [2]. Trivex is a new main eyeglasses material with a thin edge and lightweight. It is not broken easily. However, it has a mid-vision quality and low scratch resistance and it is affected by temperature change while not effected by chemicals [2,4].

Varieties of ophthalmic coatings are applied on these plastic main materials to increase scratch resistance, vision quality and comfort [5]. Coatings applied on eye glasses are anti-reflection coating, hard coating, tinting coating, photochromic coating [9], hidrofobic coating, mirror coating and anti-fog coating [5].

Anti-reflection coating decreases the reflection of light. This coating improves the vision quality. There are two types of ARCs. single- and multi-layer. For single-layer ARC, most common material is MgF2 while SiO/ZrO2/SiO2 and ITO/ZrO2/SiO2 are the common layers for multi-layer coatings [6]. Hard coating is applied to increase starch-resistance of lenses and polysiloxane solution is the material for this type of coating [1]. Tinting coating is generally applied for sun-glasses or sport glasses. For tinting coating, lenses are coated with light absorbing materials such as Si:Cr, Mo, Cu or TiO2, SiO, MgF2, etc. By choosing the color of light that passes through the lens, vision quality and comfort are improved. For photochromic coating, dithienylethene photochemistry is used [7]. After irradiation with UV light, dithienylethene absorbs visible light, and therefore appear colorful which increases the vision quality and comfort for users under the sun light. Hydrophobic coating repels water and sheds rain droplets. Therefore, water vapor condensation on the lenses is also avoided and this coating enables easier and quicker cleaning. As mirror coating material, chromium, aluminum and copper are used [8]. These materials are applied on the lenses to increase the reflections. They also provide high vision quality and aesthetic appearance for sportsmen.

The aim of this study is to identify the innovation needs for ophthalmic lenses to be done in accordance with the complaints from opticians and eyeglasses users.

2. Methodology

In this study, survey method is used for determining situation.

2.1. Sample

Sample of the study is composed of 200 teacher ophthalmic lens retailers, representatives and eyeglasses users. After the evaluation of open ended questions, 10 retailers, 10 representatives and 10 eyeglasses users were interviewed.

2.2. Data Collection Tool

Research data was collected with “Ophthalmic Lens Open Ended Questions” through the interviews. The Ophthalmic Lens Open Ended Questions consists of two parts. In the first part, in order to record the personal information of participants. There are questions as follows: gender, age, graduation, ıncome rate. In the second part, there are two open-ended questions. The first question is; “What is your trouble related to ophthalmic lenses?” and the second question is; “What is your innovative expectation for an ophthalmic lens? Unstructured interview technique was used in the study. After the evaluation of open ended questions, 30 participants are interviewed.

2.3. Data Analysis

Frequency tables are formed for the questions involved in the first part of the questionnaire. On the other hand, for the second part of the questionnaire, the responses of open ended questions are categorized with content analysis and the responses are tabulated according to their frequency distribution. Due to the fact that some responses can be included in more than one category, it is found that frequency number of the responses is farther than the sample size.

3. Results

3.1. Findings for the first part of Ophthalmic Lens Open Ended Questions Manuscript requirements

The gender, age, graduation, income rate of participants are shown in Table 1.

TABLE I: General characteristics of participants

Gender Rate	Frequency (%)	Age Rate	Frequency (%)
Female	39	15-29	32
Male	61	30-45	47
		45-60	18
Graduation		İncome Rate	
Primary School	11	Low	16
Secondary School	7	Middle	50
High School	33	High	3
University Master/Doctorate	42		

General characteristics of participants are shown in Table 1. Most of participants are male, in the age range of 30-40, graduate high school and have middle income rate.

3.2. Findings for the second part of Ophthalmic Lens Open Ended Questions

The result about participants trouble related to ophthalmic lenses is stated in Table II.

TABLE II Trouble Related To Opthalmic Lenses

TROUBLE	FREQUENCY
Ophthalmic lenses are scratched easily	56
Coating of ophthalmic are deformed easily.	34
Ophthalmic lenses are made dirty easily but cleaned hardly.	19
Anti-fog coatings of ophthalmic lenses have poor performance.	15
The vision quality of ophthalmic lenses is inadequate.	14

Participants complain that ophthalmic lenses are scratched and coatings are easily deteriorated. Participants also complain dirt and dust retention, not easy cleaning, low anti-fog performance and poor vision quality. In the interviews, participants also stated that the lenses were easily scratched and the coatings were damaged by chemicals and temperature change. Another highlight of the interviews is the dirt retention and difficult cleaning of the ophthalmic lenses. Participants were stated that there are some commercial lenses to overcome this problem; however, these lenses have high price and they cannot provide the desired performance.

The result about innovative expectation of PARTICIPANTS RELATED TO OPHTHALMIC LENSES IS STATED IN TABLE III.

Table III: Inovative Expectation For Ophthalmic Lens

TROUBLE	FREQUENCY
It is expected that hard scratching ophthalmic lens to be produced.	49
It is expected that durable coatings of ophthalmic lens to be produced.	19
It is expected that low priced ophthalmic lens to be produced.	16
It is expected that vision quality of ophthalmic lenses are increased.	13
It is expected that dirt-free ophthalmic lens to be produced.	12

Participants demand ophthalmic lenses that are not easily scratched, long-lasting, high-quality, dirt-resistant and affordable. Similar results were found in the interviews. In addition, the interviewees stated that lenses with high optic power don't have the same quality in every region of the lenses. In addition, it has been stated that getting rid of the colorings in the antirefractive coating surface is not possible. And also polarized is only applied sunglasses and white light is turned into yellow light by the blue light filters.

4. Conclusion

Nowadays, technological developments regarding the ophthalmic lenses are related to the main materials and coatings of the ophthalmic lenses [5]. In recent years, the use of plastic main materials in ophthalmic lenses has increased more than that of mineral main materials [3]. There are advantages and disadvantages of using plastic lenses as the main material of ophthalmic lenses. Their light weight and not easy breakability is the main advantages of plastic lenses. The main disadvantages are the easy scratching and poor vision quality [1,2,3]. To reduce these disadvantages of the main material of the plastic lenses, coatings are applied [6]. However, these coatings are found to be inadequate by eyeglasses users and suppliers. Often eyeglasses users and suppliers complain about easy scratching of ophthalmic lenses, easy deterioration of the coatings [3], quick dirt and not easy cleaning of the lenses.

In addition, eyeglasses users and suppliers are demanding the production of scratch-resistant, long-lasting, high-quality, dirt-repellant and affordable ophthalmic lenses. Considering the results of the research, it can be said that it is necessary to carry out improvement studies for the lenses of glasses by taking account the complaints and expectations of the eyeglasses users. It can also be argued that these improvement efforts will contribute to the eyeglasses market in order to enhance the satisfaction of the eyeglasses users and suppliers

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