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Review Article

A REVIEW ON RESEARCH OF RANGE AND MAIN COMMODITY CHARACTERISTICS OF SOFT CONTACT LENSES

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ABSTRACT

Contact lenses are the most convenient and common means of vision correction worldwide. Soft contact lenses in the world are used by a vast majority of contact vision correction enthusiasts (about 90 % of patients) because the lenses are easy-to-use at the very first application and require almost no adaptation, they have high flexibility, small thickness, and as a result the users feel they have a high comfort level immediately after wearing and also the soft lenses are suitable for correction of all major refractive errors of the eye. The analysis of the range and basic commodity characteristics of soft contact lenses, which are present in the pharmaceutical market of Ukraine has been performed. On the basis of Ukrainian market analysis it has been found that dominant positions of soft contact lenses market have: South Korea, Indonesia, joint ventures of EU countries (UK, Italy, Spain), the US and Singapore, and Australia.

Keywords: range, classification, soft contact lenses, eye, contact lenses, optical system, trade names

INTRODUCTION

Since many people around the world suffer from vision problems, the means of vision correction are very popular worldwide. According to the information in the specialised literature, the most popular means of vision correction are contact lenses.Thanks to modern technology, nowadays easy-to-use contact lenses can be created, which retain their properties for a long time[1,2]. The use of contact lenses allows consumers to significantly improve the quality of life. First of all, it gives users some advantages over using just spectacle correction as contact lens and an eye form a single optical system, thereby achieving high quality of vision correction[3,4].

The history of contact lenses began in 1508, when famous Leonardo da Vinci drew a scheme of the optical device, in which through a ball filled with water a person with poor eyesight was able to see better. The use of lenses that had a direct contact with the eye was first theoretically grounded in 1730 by the scientist De Lamoureux.

In the 20-ies of XX century the mass production of contact lenses by famous German optical company «Carl Zeiss» began.

In 1981, in the US and Western Europe, lenses for extended wearing appeared. In 1987, contact lenses that allowed changing eye color appeared for the first time. 1996 is marked by the first appearance of lenses on sale with a filter that protected eyes from UV light exposure[5,6].

2000 saw the advent of the first contact lenses of silicone hydrogels having high gas permeability, designed for long-term continuous wearing (up to 1 month without removing overnight)[7,8].

Since the contact lenses first appearance, many improvements in their design have been made, which allowed to improve their performance.The first lenses had a big thickness, often causing distortion of visual perception. Over the years, experts were perfecting the design and technology of lenses production that resulted in increase of their operational parameters and significantly improved their characteristics for consumers[9,10].

The development of soft lenses gave a powerful impetus to the contact lenses industry. Such lenses are comfortable at the first application and require almost no adaptation, that's why many people who used glasses before, switch to wearing contact lenses. Soft contact lenses are used by a vast majority of contact vision correction enthusiasts in the world because they have high flexibility and small thickness, and as a result the users feel they have a high comfort level immediately after wearing and also soft lenses are suitable for correction of all major refractive errors of the eye[11,12].

Thus, soft contact lenses are the most convenient and common means of vision correction in the world.

This paper is aimed at the analysis of the range and main merchandising characteristics of soft contact lenses, which are present in the pharmaceutical market of Ukraine.

The paper uses data of state registration presented in the State Register of medical equipment and medical products for the group: soft contact lenses.

DISCUSSION

From the results of the research we have established the following. All trade names of soft contact lenses, registered in Ukraine as of 01.01.2017 (35 trade names of soft contact lenses) were classified by us into several groups depending on their commodity and consumer characteristics. At the preliminary stage of research we have reviewed the basic approaches used in the world to determine certain characteristics of this group of products.

Contact lenses are lenses, which are made of transparent materials (non-ionic and ionic polymers), which are worn directly on the eyes for vision correction (i.e. to improve visual acuity), except cosmetic contact lenses, which can not only correct vision, but also decorate eyes[13,14].

Depending on the material contact lenses are as follows: hard contact lenses (gas-proof and gas-permeable contact lenses) and soft contact lenses (silicon hydrogel contact lenses and hydrogel contact lenses)[14,15].

In the global market of contact vision correction soft lenses prevail; on average, in the world about 90% of patients wear them, and only 10% of patients wear hard contact lenses, and gas-proof hard lenses are almost not used at present [16,17].

FDA (US food and drugs administration) provides a classification of soft contact lenses based on the properties of materials used, they are divided into 4 groups:

- Group 1: lenses of non-ionic polymers with low moisture content (<50% water).
- Group 2: non-ionic polymer lenses with high moisture content (> 50% water).
- Group 3: lenses of ionic polymers with low moisture content (<50% water).
- Group 4: lenses of ionic polymers with high moisture content (> 50% water).

According to the published documentation, the most popular among consumers today Silicon hydrogel lenses[18] belong to groups 1 and 3, as they have a low moisture content. The lenses with a low moisture content are usually more timeproof and have better resistance. They are more efficient in production, thinner, less dehydrated on an eye. However, they have low oxygen permeability and therefore their wearing causes more pronounced corneal edema as a result of its hypoxia[19].

Lenses with high moisture content are more comfortable. A patient adapts to them more quickly, they can be worn longer during the day. But, such lenses are not timeproof, they are easy to break, deposits are produced on them more often and in larger quantities (especially on lenses of the 4th group polymers by FDA classification). Such lenses dehydrate easily on the eye and sometimes do not provide stable visual acuity. Lenses of ionic materials are less resistant to the accumulation of protein deposits compared to non-ionic polymers lenses.

Soft contact lenses are classified [20] according to:

- their purpose;
- the diameter of contact lenses;
- replacement term;
- manufacturing technology;
- shape.

By their perpose contact lenses are: optical, decorative, color and cosmetic.

Optical lenses are for vision correction (myopia, hypermetropia etc.).

Decorative or color ones (to enhance natural eye color or change it completely).The set of color contact lenses, registered in Ukraine has been divided by us into two groups: intense color lenses, able to change the natural eye color completely and tinted lenses intended for patients with light eyes.

Cosmetic lenses are intended for correction of various congenital or acquired in an injury eye defects. Sometimes such lenses are used to mask cataracts or iris defects of a patient. Cosmetic (color) lenses are manufactured with optical power for cosmetic effect in ametropia people or without optical power - just for a cosmetic effect - for people with good vision.

Medical or therapeutical contact lenses are chosen to protect the cornea, and acceleration of its lesions epithelialization, as well as a tool for delivery and prolongation of drugs action and so on.

Depending on the diameter the contact lenses are classified into:

- scleral (diameter 15 to 21 mm);
- corneal (diameter 9 to 11 mm);
- corneoscleral (diameter 12 to 15 mm).

Historically, the first contact lenses were hard scleral. But scleral lenses of large diameter were not convenient for patients and are practically not used by now. Modern corneal lenses are usually hard. Corneoscleral lenses are typical soft lenses.

By the replacement term the soft contact lenses are divided into:
1. Conventional contact lenses. A term of their service is 6 months to 1 year. Available in glass bottles. Usually produced by grinding.
2. Contact lenses for planned replacement.
a) plan-replaceable contact lenses (frequent replacement) are usually replaced quarterly. Available in blisters.
b) frequent planned replacement contact lenses (disposable) are replaced once a month and later. Available in blisters. Lenses of this type first appeared in 1988.
c) daily replaceable contact lenses (one day) (single use, worn in the morning, removed in the evening and thrown away). Available in blisters. Lenses of this type appeared in 1994.

The planned replacement of contact lenses is certainly a great improvement in vision correction, because frequent replacement of contact lenses has a number of advantages over the lenses for extended wearing, namely good optical properties; availability of spare lenses in case of unexpected loss or damage; decrease of risk for the eye infection; good wettability of all parts of the lens, which increases comfort when wearing contact lenses and reduces staining of the cornea; decrease of mechanical irritation of the eye by deposits on contact lenses; decrease of allergic reaction to the deposits on the lens.

The one-day contact lenses category has been developing extra successfully over the last few years. Most patients would like to have, if possible, the selected lenses of this category. In addition to the general advantages of planned replacement, they have also additional useful properties.

The advantages of one-day soft contact lenses are: the most suitable option for cases of irregular wearing; possible application for patients with allergic diseases of the eye; possible use in patients with inflammatory diseases of eyelids (eg. blepharitis) in remission; no need for lenses care.

In some countries (such as England, Italy) lenses of this type are used by 40% of patients.The main reason why the one-day lenses have not forced other soft contact lenses out of the market is their relatively high price that is higher when worn daily than that of planned replacement lenses together with care products.

For the production of soft contact lenses the following methods are used: molding, casting, combined method and sometimes grinding.

The methods of molding and casting are used only for production of soft contact lenses. In molding (or rather, centrifugal shaping) a liquid monomer is poured into the mold and it polymerizes in the process of centrifugation by means of special techniques. In casting a liquid primer is poured in between two stationary shapes (mold and punch) and then it polymerizes (UV is often used for that).

The combined method implies the use of solid gas permeable material blanks that have a molded front surface and their back (optical) surface is whetted. This method is used for manufacturing soft lenses. Hard lenses are usually made by grinding.

According to their shape the contact lenses are divided into spherical, toric, bifocal and orthoceratologic. Spherical contact lenses are designed to correct nearsightedness (myopia), farsightedness (hypermetropia).Toric lenses are used to correct astigmatism. Bifocal contact lenses have two zones: one for distance vision and the other for near vision designed to correct age presbyopia. Orthoceratologic contact lenses are intended to be used during sleep. Their principle of action is to change the shape of the cornea, which allows going without lenses during the day.

The packaging of soft contact lenses consists of polypropylene nest covered by several film layers on top, made of plastic, aluminum, adhesives and polypropylene.The cavity itself, which is also called the "shuttle", is usually made of high hardness plastic. The "shuttle" is filled with a special solution needed for proper storage - typically it's saline. Blisters are sterilized with steam and pressure up to the final sterility.

The packaging is well-sealed and allows minimal transmission of water vapor through the laminated layer, which in turn enhances the useful lifetime. During the packaging, the lens retains its hydrated state.

On each group package of contact lenses there are appropriate designations:

- D - indicates the optical power of the lens or the number of diopters, which we usually call the "ins" and "outs";
- BC - base curvature of the cornea - the individual value determined during the examination by ophthalmologist using special equipment;
- DIA - diameter of the lens, which can vary depending on the model.

Marking on the packaging of soft contact lenses must contain the following basic elements: a trademark of the manufacturer; the name of the contact lens; lens material; the radius of curvature (BC, BCR); lens diameter (D, OAD); optical power in diopters; type of sterilization; the composition of the contact lens; lot number; expiration date.

Since most contact lenses used in the world are soft ones we have studied the soft contact lenses registered in Ukraine (Table 1).

Table 1: Review of soft contact lenses, which are represented in the pharmaceutical market of Ukraine with trade names and manufacturers

Trade name of soft contact lenses	Manufacturer
Soft contact lenses Gelflex: Sofclear, Sea Clear, Ningaloo	Company Benra Pty Ltd trading as Gelflex Laboratories, Australia
Soft contact lenses	Clearlab SG Pte Ltd, Singapore
Soft contact lenses : OKVision® Infiniti, OKVision® Season, OKVision® Prima, OKVision® Fusion Soft Contact Lenses: OKVision® Infiniti, OKVision® Season, OKVision® Prima, OKVision® Fusion	NEW BIO CO., LTD, Korea
Soft contact lenses	Mark'ennovy Personalized Care Ltd. (UK), Mark'ennovy Personalized Care S.L.(Spain), UK, Spain
Soft contact lenses Maxima	CooperVision, Inc. (USA), Clearlab SG PTE Ltd. (Singapore), Soleko SpA. (Italy), Sauflon Pharmaceuticals Limited (UK) for Maxima Optics (UK) Limited (UK), USA, UK, Singapore, Italy
Soft contact lenses TU 33.4-30777117-001: 2005	Limited Liability Company "LIKON" Ukraine
Soft contact lenses Bono	Medios Co., Ltd., Korea
Soft contact lenses: NewGen 38, NewGen 45 Premium, NewGen 55 Premium, Tutti Premium, Tutti Classic, Tutti Natural, Tutti CirCle	BESCON Co., Ltd., Korea
Soft contact lenses Air Optix Night & Day	P.T. Ciba Vision Batam, Indonesia
Soft contact lenses: Focus Monthly Visitint, Focus Toric Monthly Visitint, Focus Softcolors Monthly - Royal Blue, Focus Softcolors Monthly - Aqua, Focus Softcolors Monthly - Evergreen	P.T.Ciba Vision Batam, Indonesia
Soft contact lenses for continuous prolonged wearing from polyacrylamide "Aqualan" TU 33.4-24926593-001: 2007	Limited Liability Company "Aqualan" Ukraine
Soft contact lenses CLEAR 55, CLEAR 55A, CLEAR 58, CLEAR ALL-DAY, CLEAR 1-DAY	Clearlab International Pte Ltd (Singapore), Clearlab UK Limited (UK), Singapore, UK
Soft contact lenses Maxima	Maxima Optics (UK) Ltd, U.K.

The analysis of the soft contact lenses scope in the market of Ukraine has been carried out considering all kinds of soft lenses. In total, 35 trade names of soft contact lenses are represented, where the products of foreign companies have dominant positions.Thus, the share of optical lenses of foreign production in the Ukrainian market is 97.14%. The undisputed leader in terms of trade names of optical lenses imported to Ukraine is South Korea (16 names). With a significant margin in the second position by the number of products proposed on the market are optical lenses produced in Indonesia and a joint venture companies of EU countries (UK, Italy, Spain), USA and South East Asia (Singapore). On the whole, the share of trade

names for the presented geographic segment is 34.28 %.The third position is represented by the products of companies from Australia (3 trade names).The analysis of optical lenses scope by importing countries is presented in Figure 1.

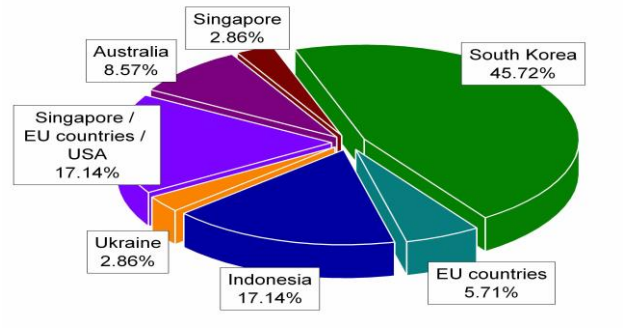

Figure 1: The structure of the soft contact lenses market

As you can see in Figure 1 the most important characteristic of the Ukrainian soft contact lenses market is its dependence on the import. The largest share (%) of products is from countries such as Korea, Singapore, Indonesia, Italy, etc. In the soft contact lenses market the products of such foreign companies prevail: Clearlab SG Pte Ltd, Singapore, PTCiba Vision Batam, Indonesia Maxima Optics (UK) Ltd, UK and Korean companies: NEW BIO CO., LTD; BESCON Co., Ltd., Korea and Medios Co., Ltd., Korea. The segment of home manufacturer of lenses includes products from such companies as LLC "Aqualan" and "LIKON."

CONCLUSION

Soft contact lenses are promising and convenient means of vision correction worldwide. In the global market of contact correction of vision soft lenses prevail; on average, in the world they are worn by about 90% of patients. The use of contact lenses allows consumers to significantly improve the quality of vision as contact lens and eye form a single optical system. On the basis of Ukrainian market analysis it has been found that a dominant position in the range of soft contact lenses take: South Korea (45.72%), Indonesia (17.14%), joint ventures of EU countries (UK, Italy, Spain), USA and Singapore (17.14%) and Australia (8.57%).

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