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Development of Eye Drops Container for Metered Dose

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Abstract

People's fatigue is increasing due to the advancement of life and the development of the industry. Especially, the eyes' health is getting worse because it is exposed to various displays such as smartphones and monitors. The amount of eye drops continues to increase and in general, the eye drops are accommodated in the eye drop container having a funnel-shaped container cap. The user bows his/her head with the eyes open and presses the eye drop container to drop the eye drops through the container cap to be injected into the eye.

Conventional eye drop containers do not have an indicator for the correct dose, so the patient should simply inject the eye drop by tilting or pressurizing the eye drop depending on the patient's sense. For this reason, chemical liquid is wasted or the effectiveness of the chemical liquid is reduced due to the inability to handle a fixed amount of the chemical liquid.

In order to solve this problem, the automatic eye drop dosing device is suggested to detect the position of the user's eye most suitable for the eye drop through the sensor to automatically administer the appropriate amount of eye drops. The new eye drop case through design that can give stability in use was developed. Finally, it is judged that the design was well made for the purpose in the early stage of research.

Keywords: Eye drop container, Eyelotion, Metered dose

I. INTRODUCTION

With the enhancement of modern life and development of industry, fatigue level is increasing in many people, and due to the prolonged exposure to various displays, such as smartphones or monitors, the eye health of modern people are easily prone to deterioration. Therefore, the use of eye drops is continuously increasing.[1-2]

Generally, eye drops are housed in an eye drop container with a funnel-shaped cap, and the user presses the container to drop the contents to the eye through the cap while tilting the head back or in the position that is convenient to administer eye drop.[3-4] In the existing eye drop containers, there is no index to administer an accurate amount, and patients have to tilt the container or add pressure based on their feeling, causing problems such as wasting medicinal fluid, injuring the eye due to the container, or being less effective because a proper dose of medicine was not administered.[5-7]

In order to solve these problems, this study developed a product like an automatic eye drop administration device, which detects the most appropriate position of user's eyeball using a detection sensor and automatically administer a proper dose of eye drop. Automatic eye drop administration device requires complex components and technology, so its cost increases and is difficult to be commercialized. It also causes inconveniences such as having to charge the battery before use, therefore, this study attempted to solve such problems.

II. RESEARCH DESCRIPTION

II.I Theoretical Background

In case of artificial tears, when artificial tears with 0.3% concentration hyaluronic acid and one with 0.1% concentration hyaluronic acid are administered, the height of tear meniscus increased significantly immediately after administering both artificial tears; in particular, the height of tear meniscus increased significantly higher immediately, 5 minutes and 30 minutes after administering 0.3% concentration than 0.1% concentration. In conclusion, artificial tears with 0.3% concentration hyaluronic acid has longer duration time than lower concentration, but it may cause deterioration in the quality of vision due to high tear meniscus that was created by excessive tears in the beginning. Therefore, proper artificial fear prescriptions are necessary for dry eye patients based on individual characteristics. The disposable container for artificial tears usually contains 0.3~0.8ml of collyrium for 8~20 drops, and regular container varies from 5~20ml. When administering eye drop, proper dosage varies depending on the concentration, so it varies by the user. Also, eye drops are not easy to self-administer and a significant amount is lost during administration, so the design of product is very important to improve this problem.

II.II Major Research Description

The factors that need to be prioritized before developing an eye drop case are: preventing eye drop from being dropped somewhere else to minimize the amount of loss during administration, being easily fixated and administering a proper dosage in a single use, and having sufficient medicinal effect upon one administration.

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It also needs to be designed to block the contact between eye drop inside the container and outside air to prevent decomposition, and the operation principle of eye drop case needs to be designed simple for anyone to use it easily.

Ⅱ.Ⅲ Material and Design of Eye Drop Case

For the material of eye drop case, polypropylene was selected as it is not easily damaged and is durable, and the design of case was made in consideration of ergonomic factors such as stability and comfortable grip when it was held in hand. Also, it was designed not to feel burdensome in hand when using the product, and included spill-proof design because it had to be used upside down.

III. RESULTS AND DISCUSSION

III.I Eye Drop Case Designing

Eye drop case was designed based on ergonomic elements, considering factors such as stability during use and spill-proof feature. Fig. 1 presents the component design of the eye drop case. The eye drop case consists of support, spray-type nozzle, nozzle cap, middle case, pump and down case.

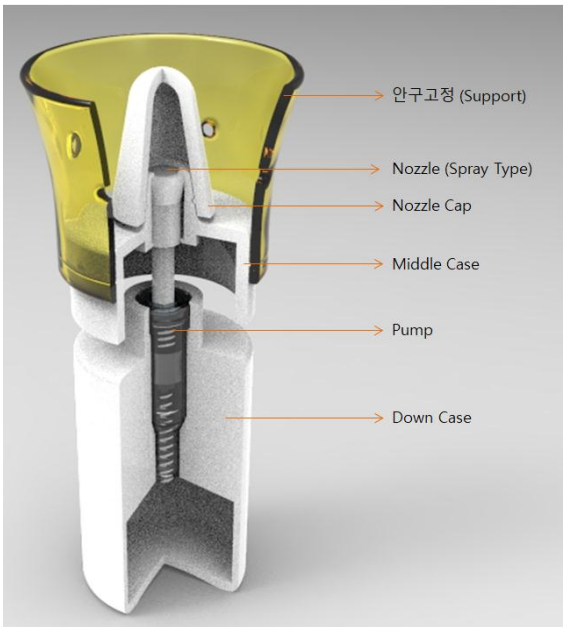

Fig. 1. Eye Drop Case Component Design

Fig. 2 below presents the design drawing of components that form the pump. Pump consists of nozzle case, nozzle neck, door, o-ring, upper spring, air vent, pump case, air vent case, lower spring, and rubber ring. In terms of operation principle, when the pump is pressed down, air vent is pushed down, and the solution stored in nozzle neck is discharged through the nozzle, where the amount of eye drop discharged is designed at a dose of 0.5ml. When the nozzle case is released after the fluid is discharged, spring returns and blocks the air vent, which makes the eye drop fill up through the rubber ring due to vacuum.

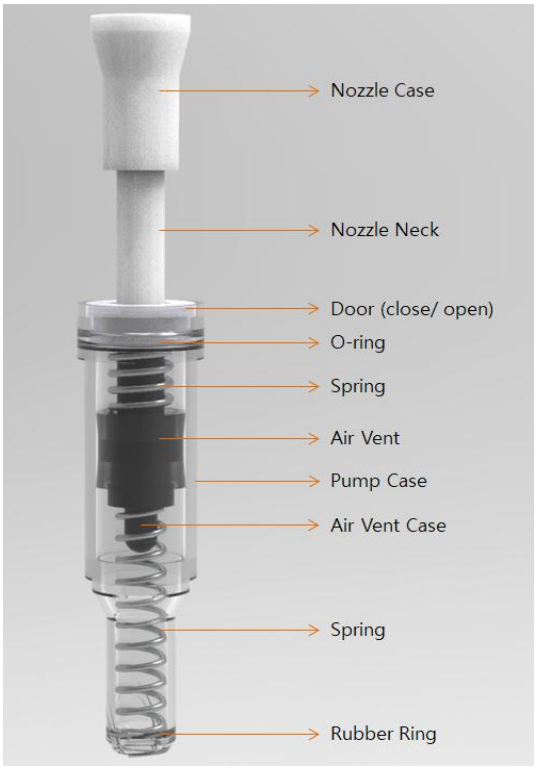

Fig. 2. Eye Drop Case Pump Component Design

Fig. 3. Expected Eye Drop Case Design and Size

In case of the produced eye drop case, it consists of the body, nozzle cap, and eye support, where the eye support is in contact with the eye to prevent blinking, and the body is pressed to discharge eye drop.

III.I I Eye Drop Case Design Result

Eye drop case was designed to enable an administration of proper dosage with a single operation, and hold the eye area to prevent blinking during administration. Also, the inside and outside the container are completely blocked to prevent the decomposition of eye drop. Fig. 4 presents the inner structure drawing of the case.

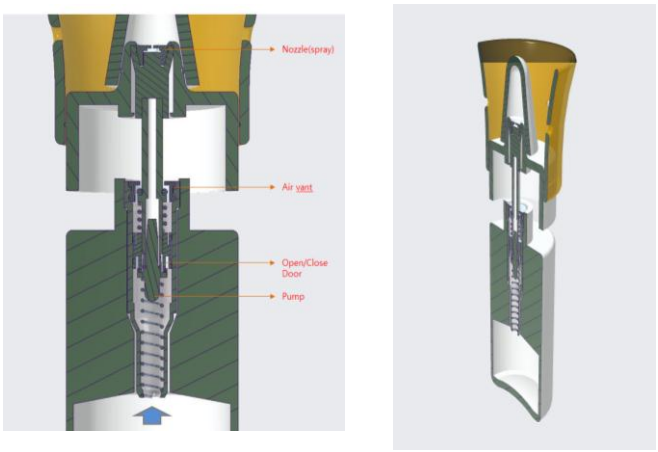

Fig. 4. Inner Structure of Eye Drop Case

The eye drop case to be developed pumps the liquid using pump and spring, and pulls the eye drop to the nozzle, which would cause no functional or internal defects. Also, in order to solve the vacuum status inside due to air blockage, a small air hole was designed at the open/close door part to allow external air to be let in as much as the amount of eye drop released.

The eye drop case to be developed would enable an administration of a proper dosage through a single spray, unlike existing products, and would prevent loss of medicine due to spilling. It would also prevent blinking caused by repulsion or fear.

The major consideration of the eye drop case to be developed through design and search, including stability during use, spill-proof function, and inside/outside blocking, seems to be properly applied, and the function of pump was properly designed according to the purpose of study, such as administration of proper dosage through a single pump, and ease of use.

IV. CONCLUSION

1. Eye support part was designed to solve blinking caused by user's repulsion and fear.
2. Case was designed in proper size to give stability during use.
3. The inside and outside of case are completely blocked to prevent decomposition of eye drop.
4. Unlike existing eye drop cases, it can administer a proper dosage through a single spray, and prevent loss of eye drop due to spilling.
5. Finally, the designed was made appropriately through thedesign and search in the early stage of research according to the purpose of development.

ACKNOWLEDGEMENTS

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