DEVELOPMENT OF VARIABLE FOCUS LENSE INTENDED TO BE MOUNTED ON THE ELECTRICAL ARTIFICIAL EYEBALL THAT CAN OPERATE WITHIN THE HUMAN EYE SOCKET

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ABSTRACT

This study aimed to develop a variable focus lens intended to be mounted on an electrical artificial eyeball that can operate within the human eye socket. Since the development of a variable focus lens requires the definition of an electrical artificial eyeball in this study, we defined it as an electrical artificial eyeball with an external shape that follows the human eye socket. The concept of the variable-focus lens to be developed is a variable-focus lens that can adjust the focal distance with a single lens like the crystalline lens of a lens and is compact and lightweight. In addition, in order to make the structure of the lens similar to that of a crystalline lens, the surface and interior of the lens are made of separate materials. The focal length was adjusted by applying force from around the lens to cause displacement in the shape of the lens itself. Since the crystalline lens, which is used as the reference lens for the lens to be developed, is a part of the living body, there will be individual differences in each value. Therefore, each value of the crystalline lens in this study was defined using the Gullstrand schematic eye. However, since there were values that could not be determined using only these values, a model of the crystalline lens was created based on each value of the crystalline lens and the concept of the variable focus lens, and these values were derived by analyzing them. The method used was to analyze the displacement when the model was deformed by applying a force to it from the circumference like a crystalline lens. Since there were two possible directions of force application, compressive and tensile, we created models corresponding to each direction of force. The results of this analysis showed that the model applying force in the compressive direction allowed the crystalline lens of the eye to adjust its focus. However, the model applying force in the tensile direction was not suitable as a crystalline lens. Based on the results of this analysis, I decided to define the variable focus lens to be developed as a model in which force is applied in the compressive direction. The defined variable-focus lenses were verified by comparing the optical performance of the electrical artificial eyeball with that of a living eye to verify whether they are useful as a replacement for the eye. As a result of this verification, it was found that the defined variable-focus lens is likely to function as a substitute for the eyeball at steady state, but not at stressful section. Therefore, it was suggested that the variable-focus lens may be able to function as a substitute for the eyeball even during the stress section by reviewing the method of force application.