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A review of five simple optical models of the eye and its application in current treatments

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Abstract
The present study examines five simple optical models of the eye and its application in current mange **.**So far, many models have been proposed to study the optics of the human eye. In recent years, there has been an increase in surgeries on the anterior part of the eye, such as photoactive cataclysm and corneal transplantation, which shows the importance of further examination of the optics of the eye and measuring the quality of vision. And shows that the use of these models is still popular in most clinics.

Keywords: eye, model, optics, review, and simple

Introduction
Detailed study of an eye model can be a tool for examining refractive eyelids and anterior eye surgeries such as refractive surgery cataracts and corneal transplants, etc. Now a day, in ophthalmology models using for vision and optical concepts for a century, such as Helmholtz and Gullstrand models. These models indicate that the details have many problems which need for more research to solve these problems. That research will discuss optical parts of human eyes and also shows the need for applied research in human eye optics. The proposed models of the eye are mostly mathematical models that are difficult to use in the fields of optical research of the eye and clinical issues. On the other hand, some models are based on the anatomical and physiological characteristics of the eye obtained by experiments. These purely either mathematical or physiological models have little applications. But combining the two, that is, presenting a physics model based on the measured quantities of the eye related to normal people, can be useful in eye research. In other words, schematic eye models that can derive optical coordinates from anatomical specifications can be more useful. These models can be used to help design optical components of the eye or to assess the quality of vision, simulation experiments, as well as to better understand the role of different optical components. Furthermore, schematic eye models are essential for evaluating the optical characteristics of the ocular base such as focal length. In some eye models, the main purpose is to provide anatomical accuracy of the eye. But some of models cannot give a good result for a correct anatomical surgery. There are many reasons why models with anatomical correction are useful, such as an accurate understanding of the physiological-optical function of the human eye; which is impossible without an accurate anatomical model. Besides, in refractive surgery, cataract surgery and correct anatomical model is a necessary tool to determine the optical characteristics of the eye before surgery, refractive surgery, cataract surgery, and correct anatomical model is a necessary tool to determine the optical profile of the eye before surgery. There has been an interest in the physiological and optical characteristics of the human eye, and how they relate to the quality of vision from ancient times [(2).] So far, a lot of research has been done in the world. In this article, an attempt has been made to introduce five essential models out of 30 models.

Materials and Methods
In this paper, five eye models are discussed which are presented by researchers, including spherical refractive surfaces and conical sections for the cornea, as well as the introduction of a newer model that presents corneal surfaces with more complex mathematical equations.

Results
Based on the application of five models of the human eye, it is possible to provide better quality vision and also to perform the surgery of the anterior part of the eye more accurately and to enable more accurate vision.

Optics models of the human eye based on the cornea and lens
Early scientists made eye models just to show how the eye works, and these models were the same for all eyes. Many eye diseases are treated with surgery today [(1).] These surgeries include corneal refractive surgery cataracts (RK, AK, PRK), LASEK and LASIK, and corneal transplantation. But for this, we need the optical model of the eye to understand the refractive elements of the eye, so we must have a unique model for each human eye. Our visual system is very complex, but we know that the anterior part of the eye plays the most important role in refracting light. Therefore, most eye models, model the cornea and lens. Before and after surgeries, we must measure the optical, anatomical, and geometric characteristics of the eye to compare them with the normal eye. Helmholtz and Clapper were the first to understand the image of an object formed upside down on a grid. Schooner showed the results experimentally in the human eye. Newton was the first to discover the aberration of eye color, and Huygens created an eye model to show the reverse image and the beneficial effects of spectacle lenses. Stigmatism was observed by Thomas Young and spherical aberration was measured by

Wellman. The first ocular model was presented by Listing, which was a series of spherical surfaces separated by a homogeneous medium with a constant refractive index [2]. The listing model created a routine that led to the production of many models over 100 years. The most famous of them was the Emsley model.

The first model in this research is the Helmholtz model, which is shown in Figure (1) and its parameters are shown in Table (1).

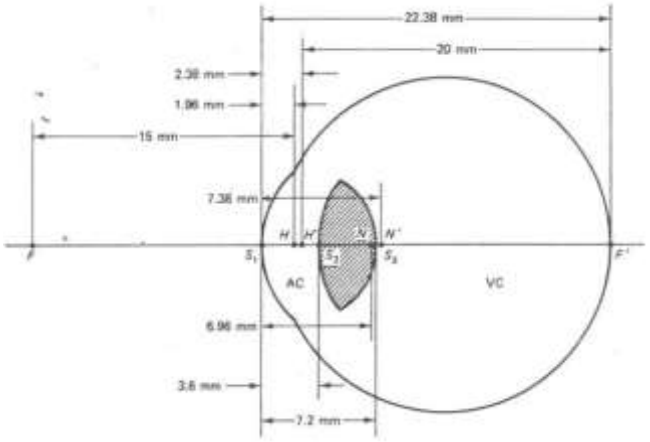

Fig 1: Helmholtz eye model[2]

Table 1: Helmholtz eye characteristics

Levels	Radius mm	The distance between the levels of millimeters	Refractive index
Cornea	0/8	6/2	333/1
The anterior surface of the lens	0/10	6/3	450/1
The posterior surface of the lens	0/-6	18/15	333/1

Another model to be studied is Glestrand, who won the Nobel Prize in Physiology for Optical Diopters in 1911. For research, the average lens refractive index he considered was 0.413 and the axial distance of the cornea to the network was 24.18 mm. The two parameters ensured that the parallel rays entering the eye were perfectly on the focal lattice. The Golstrand three-level model allowed changes in lens power by adjusting the curvature of the anterior and posterior surfaces. This feature is very useful for image location calculations when the natural lens is replaced by a fixed synthetic lens during cataract surgery [2]. The simplified three-level schematic eye of Glesterland is shown in Figure 2 and its parameter in Table 2.

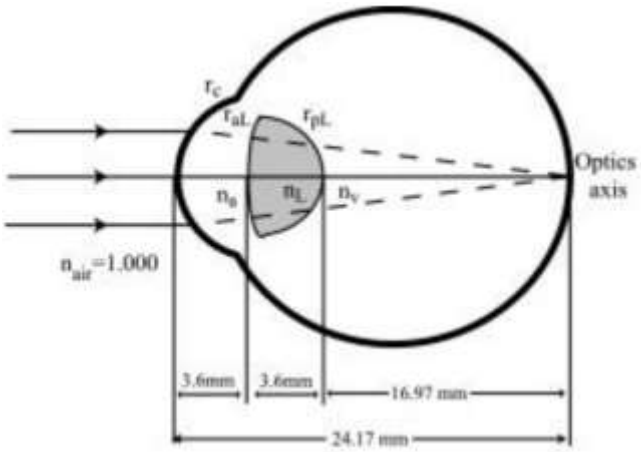

Fig 2: Gullstrand three-level model[3]

Table 2: Three-level specifications of Gullstrand

Levels	Radius mm	The distance between the levels of millimeters	Refractive index
Cornea	8/7	6/3	336/1
The anterior surface of the lens	0/10	6/3	413/1
The posterior surface of the lens	0/6-	97/16	336/1

Gullstrand introduced another model called the six-level model, the specifications of which are shown in Table 3. Figure 3 shows the refractive indices of different parts of the eye along with the location of the cardinal points of this model.

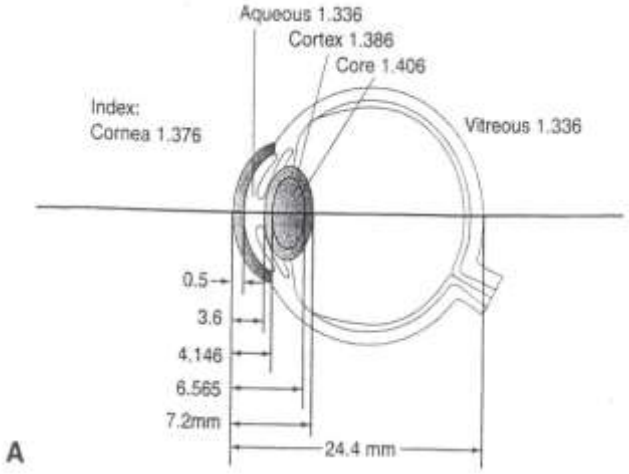

Fig 3a: Six-level Glesterland model[3]

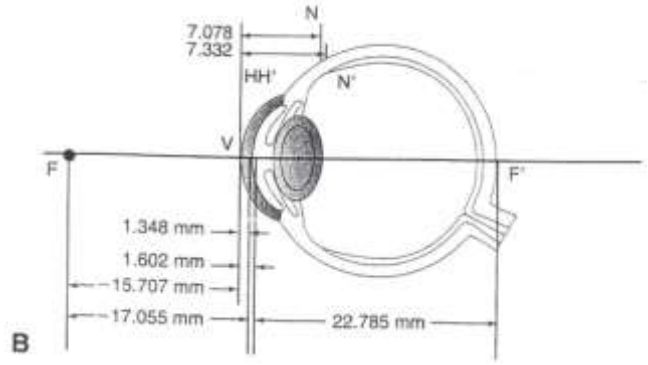

Fig (3b): Six-level Glesterland model ***(3)***

Table 3: Specifications of the six-level model of Golstrand

Levels	Radius mm	The distance between the levels of millimeters	Refractive index
The anterior surface of the cornea	8/8	0	376/1
The posterior surface of the cornea	8/6	5/0	336/1
The anterior surface of the lens	10	6/3	386/1
The anterior surface of the lens nucleus	911/7	143/4	406/1
The posterior surface of the lens nucleus	76/-5	565/6	386/1
Network	-6	2/7	336/1
	20/-12	40/24	**----**

The 60-dip standard Emsley eye is one of the simplest and most widely used eye models in ophthalmology studies. This model includes a refractive surface and there is only one refractive index between air and vitreous humor. The axial distance between the cornea and the network is 22.22 mm. Unlike the simplified three-level schematic eye, matching calculations cannot be performed [4]. Two main points and two-node points are combined to form a group point (N –H). The power of the corneal surface is 60 diopters. The standard 60 diopter eyes of Emsley are shown in Figure 4 and their parameters are shown in Table 4.

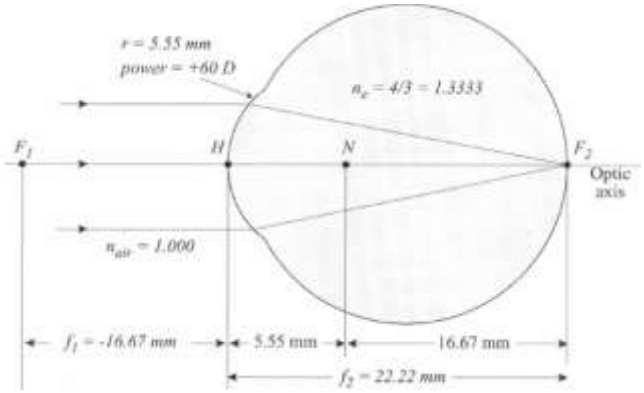

Fig 4: Emslie model [5]

Table 4: Decreased eye characteristics of Emsley standard diopter

Levels	Radius mm	The distance between the levels of millimeters	Refractive index
Cornea	***5/55***	***22/22***	***1/3333***

Dander simplified my work, expressing it with a refractive surface. The focal length was 15 mm and the posterior focal length was 20 mm. The group dot was behind the main screen [5]. The dendritic model is shown in Figure 5.

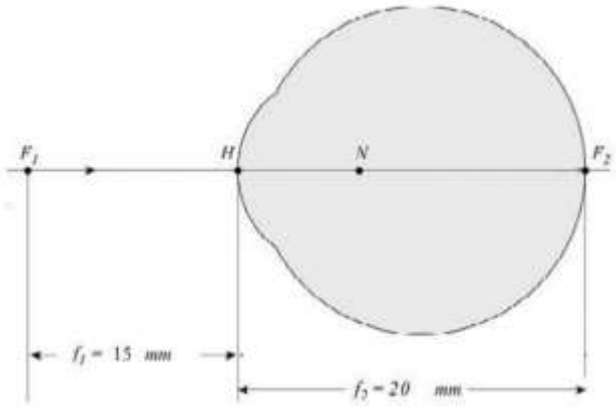

Fig 5: Dandruff model [6]

Discussion

According to the models that were examined, we can divide the models into the following four general categories. Classic models, simplified models, models with refractive surfaces of conical sections, complex models. Classic models are models that are designed based on physiological and optical measurements of the eye at the time of presentation and show that the purpose of presenting these models is to give the overall performance of eye optics. Helmholtz model and the Gullstrand chemical eye are the examples of this kind of models. Because classical models are based on mathematical and optical basesand their application is difficult in the clinical space, so simplified models were presented that can easily perform optical application on human eyes without mathematical and optical theory under clinical condition. Such as simplified models of Glister, Emsley, and Dander [7].

When the eye was examined more carefully and used the devices of corneal topography as well as new measuring systems that accurately measure the geometric and anatomical characteristics of the anterior and posterior surfaces of the cornea and lens. Studies have shown that the curvature of refractive surfaces of the eye can be measured in the form of conical sections of the model, which became more important when prescribing hard contact lenses. So the models include the refractive surfaces of the conical sections of the models such as Walker, Lee Grand, Dolmen, and Bren [9]. By taking more precise measurements of the cornea and lens, the researchers found that the shape of the refractive surfaces of the eye was more complex than that of the conical sections. So complex models with very complex

equations were presented .At present, the process of these models is being completed and they can examine the refractive levels of the eye and the quality of vision (the quality of creating a net in the network) simultaneously. These models will be theoretical models which can be used for frontier part of eyes surgery [8]. But it should be considered because the measuring instruments that the anatomical, physiological and geometric characteristics of the refractive surfaces of the eye are related to the cornea and lens with the desired accuracy for these models are currently under construction and completion, so it can be predicted that use these models under the clinical condition in future. It answers to the question of vision. Examples of these models are Blacker, Smith, and Masa Jada.

Conclusion

Examining different eye models can be very useful for better presentation in Mani. Therefore, according to this research that we have done, we reach to the conclusion that classic and simplified models are uses still now and accepted in many cases. Complex models require very accurate measurements that are not currently used in the clinic and are only considered theoretically. Refractive surgery and cataract surgery for several years in conical sections and their application. Anterior eye surgeries as well as careful eye examination in clinical conditions using models can promise more accurate vision for ocular patients in this field.

References

1. Abolmasimi, Maryam, *et al*. Investigation of optical models of the human eye. Iranian Journal of Medical Physics, Volume 8, Consecutive 30 Spring 90, 2011.
2. Dubbelman M, van der Heijde GL, Weeber HA. The thickness of the aging human lens was obtained from corrected Scheimpflug images. Optom Vis Sci. 2001; 78(6):4116.
3. Ivanoff A. About the spherical aberration of the eye. J Opt Sci Am. 1956; 46(10):901903.
4. Bennett AG, Rabbetts RB. Clinical visual optics. Oxford: ButterworthsHeinemann, 1989.
5. Carvalho Luis Alberto. A Simple mathematical model for simulation of the human optical system based on in vivo corneal data. Braz J Biomed Eng. 2003; 19(1):29-37.
6. Agarwal S, Agarwal A, Apple D. Textbook of Ophthalmology. 1st ed. New Delhi: Jaypee brothers , medical publishers, 2002.
7. Howcroft MJ, Parker JA. Aspheric curvatures for the human lens. Vision Res. 1977; 17(10):121723.
8. PopiolekMasajada A, Kasprzak HT. A new schematic eye model incorporating accommodation. Optom Vis Sci. 1999; 76(10):7207.
9. Pomerantzeff O, Pankratov M, Wang GJ, Dufault P. Wideangle optical model of the eye.Am.j.Optom. Physiol. Opt. 1984: 61(3):16676. F