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ASPHERIC CORNEAL CONTACT LENS SERIES

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ABSTRACT OF THE DISCLOSURE

A contact lense series is disclosed utilizing conicoids of revolution for both surfaces of the contact lens. A series of lenses is illustrated wherein the back or corneal surface thereof has apical radii of curvature ranging from 6.50 mm. to 8.50 mm. in steps of 0.05 mm. For each apical radius of curvature eccentricities are provided in the range from 0.40 to 1.60 in steps of 0.10. The lens series is designed to provide a corneal surface of the lens which is substantially of the same shape as the front surface of the cornea of the patient and the specification teaches how to coordinate the front and rear surfaces of a lens so that the entire lens is of minimum thickness and weight.

This invention relates to an improvement in corneal contact lens series design, utilizing conicoids of revolution, hereinafter called conoids, for both surfaces of the contact lens. This invention takes into account the curvature of the front surface of the cornea at its apex, the general shape of said corneal surface, and the thickness of the contact lens resulting from the incorporation of power in the lens. As will be elaborated upon later, the lens series is so designed as to provide corneal contact lenses in which the corneal surface of the contact lens is substantially of the same shape as the front surface of the cornea, and in which the shapes of the convex and concave surfaces of the contact lens cooperate to minimize lens thickness and weight.

In the drawings:

FIG. 1 represents a series of conoid lenses according to this invention for various eccentricities and for various apical radii of curvature;

FIG. 2 is a drawing showing the meridian sections of osculating negative conoid surfaces of contact lenses, all having the same apical radius of curvature and the same diameter but of different eccentricities;

FIG. 3 is a drawing illustrating how a contact lens formed according to this invention has a negative surface which closely approximates a corneal surface;

FIG. 4 is a drawing illustrating how a contact lens with center thickness greater than edge thickness, and formed according to this invention, can be of minimum thickness when the front and back surfaces have the same slope at the periphery of the lens;

FIG. 4A is a view similar to FIG. 4 according to the lens series design of this invention showing a lens of minimum thickness of negative power in which the center and edge thickness are substantially equal;

FIG. 5 is graph plotting the front surface of different apical radii of curvature against eccentricity for a paraboloid base curve defining the back surface of the contact lens, all made according to this invention;

FIG. 6 is a graph plotting the central thickness of a series of lenses against the back vertex power for coaction with the paraboloid base curve according to the teaching of this invention; while

FIG. 7 is a graph plotting various front surface apical radii of curvature against the back vertex power for coaction with the paraboloid base curve according to the teaching of this invention.

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At the present time, corneal contact lenses are made with spherical surfaces, with the exception that the periphery of the corneal surface of the lens may consist of narrow coaxial zones of spherical surfaces which tend to flatten the lens at the periphery. Such lenses are specified in terms of front and back surface radii of curvature, central thickness, diameter of the central optical zone which is a zone of constant curvature on the corneal side of the lens surrounded by peripheral flattened zones, dioptric power of the lens, and the overall diameter of the lens.

In the lens series of this invention, the corneal surface of each lens is either a prolate ellipsoid, a paraboloid, or a hyperboloid of two sheets, and the front surface is either an oblate ellipsoid, a sphere, a prolate ellipsoid, a paraboloid, or a hyperboloid.

Each lense of the series of this invention is then specified in terms of: the apical radius of curvatures and eccentricity of the corneal surface and the apical radius of curvature and eccentricity of the front surface, central and edge thickness, dioptric power of the lens, and overall diameter. There is no need to specify the diameter of an optical zone, as is customarily done with spherical contact lenses, since both surfaces of each lens of the series are continuous and regular.

The anterior surface of the human cornea is not spherical, though it may approach a spherical shape in rare instances, and studies of the corneal shape by keratoscopy and keratometry show that it is generally ellipsoidal in shape. It may also be generally paraboloidal or generally hyperboloidal in shape.

The corneal front surface may not have axial symmetry, as shown by those instances in which the corneal front surface is more highly curved on one side as compared to the opposite side, and in those instances in which the said surface is essentially symmetric about an axis, it may not be a surface of revolution, but may resemble an ellipsoid not of revolution, or an elliptic paraboloid, so that even at the corneal apex, there is an elliptic point. Despite all the known variations in corneal curvature (topography), contact lenses with extensive spherical surfaces have been applied to the human eye with relatively good visual results.

This invention has as one object the providing of a series of contact lenses having as the corneal or negatively curved surface, hereinafter called the base curve, a range of conoids of apical radii of curvature encompassing those found in human corneas and including those values from 6.50 mm. to 8.50 mm., and of eccentricities from 0.40 to 1.60, designed to closely approximate the known range in sizes and shapes of the human cornea.

A second object of this invention is the use of conoids, including the sphere, as the front surface of the contact lens, such that for each base curve of a specified diameter, minimum thickness lenses are obtained by the use of oblate ellipsoids, spheres, prolate ellipsoids, paraboloids, and hyperboloids in accordance to the power of the lenses as they are strongly negative, moderately negative, weakly negative, powerless, and weakly positive, moderately positive, and strongly positive, respectively.

With the combination of front and back surface conoids as taught in this invention, minimum thickness light weight contact lenses are designed, which, because of their light weight and base curve shaped generally like the cornea, will tend to remain centered on the cornea even though the lens may be of a smaller than usual diameter. Also, since both surfaces of the lenses of this invention are continuous and regular, there is no distortion of vision through the periphery of the lenses, as in the case of contact lenses with spherical surfaces only, in which, as mentioned above, there has been an attempt to