

CONTACT LENS

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of application Ser. No. 850,857, filed Nov. 11, 1977, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention is in the field of contact lenses and more particularly, relates to contact lenses which cause the corneas of patients wearing them to assume aspheric shapes, and which correct the vision of the patients by providing single vision optics for the nonpresbyope and bifocal or multifocal optics for the presbyope.

2. Description of the Prior Art

For many years, the posterior surface of contact lenses have been made spherical and have been used to change the radii of curvature of the cornea to reduce or correct the myopia of the wearer, or patient, and to provide the patient with normal distance vision. Measurements of the radii of curvature of the myopic cornea, particularly of the central, intermediate and near peripheral zones of the cornea, up to a chord diameter of approximately 8.5 mm, reveals that the myopic cornea usually has variations in curvature from its center, or apex, to the periphery as defined above. Typically, the measurements show a difference in radii of curvature between the nasal side and the temporal side and between the superior portion of the cornea and the inferior. Contact lenses having a spherical posterior surface utilizing from two to five different radii of curvatures in adjacent zones, with the radii being greater than that of the corresponding zones of the cornea, for example, have been used to reduce the degree of myopia.

While lenses having such shapes have reduced the myopia, the resulting shape of the cornea of the wearer on the nasal side becomes substantially spherical from near the center to near the periphery with a radius of curvature substantially that of the near periphery on the nasal side before wearing such lenses. The temporal side of the cornea from near the center to the periphery of the cornea, becomes substantially spherical with a radius of curvature substantially that of the temporal near periphery of the cornea before the wearer started wearing the lenses. The superior and inferior portions of the cornea produces similar results. Stating the results in another way, each half meridian of the wearers cornea became substantially spherical from near the center to the measured near periphery and the radius of curvature of each half meridian is substantially that of the measured near periphery of the cornea prior to wearing the contact lenses.

In those lenses where the spherical radius of curvature of the central zone of the posterior surface of each lens is significantly greater than the radius of curvature of the central zone of the cornea of the patient, the radius of curvature of the central zone of the cornea increases, and can become distorted; i.e., it deviates from being spherical to a degree which adversely affects, or distorts, the patient's vision. In those lenses where the spherical radius of curvature of the central zone of the posterior surface of each such lens is significantly less than the radius of curvature of the central zone of the cornea of the patient, or if the chord diame-

ter of the central or optical zone of the posterior surface is too large and the lens is made of a material not permeable to oxygen, the radius of curvature of the central zone of the cornea becomes less and the cornea edematous. When such a lens is made of an oxygen permeable material, the radius of curvature of the center zone of the cornea decreases, but edema of the cornea may not occur.

The corneas of patients who have worn essentially spherical prior art contact lenses for a substantial period of time are reshaped so that on any single meridian, the radius of curvature will be substantially the same from the center to the near periphery. As a result, the perimeter, or edge, of the contact lens tends to extend outside, or beyond, the limbal bounds of the cornea so that the lenses are almost always decentered on the cornea. Prior art contact lenses have also had a problem providing adequate circulation of tears, lacrimal fluid, between the lens and the cornea to substantially prevent edema while providing single vision optics for the nonpresbyope and bifocal or multifocal optics for the presbyope that provides the wearer with substantially normal vision.

While other prior art contact lenses have had aspheric posterior surfaces, they have been aspheric from center to edge, which while producing, or inducing, the cornea to assume a more desirable shape conducive to better centering of a lens on the patient's cornea, they have not provided the optics needed to provide the patient with good vision. The prior art lenses have been able to provide good optics or a good shape to the cornea, but not both.

SUMMARY OF THE INVENTION

The present invention provides contact lenses for correcting the vision of the eye of a patient in which the lens body is made of a refractive material, which material may be either oxygen permeable or not. The posterior surface of the lens has a central zone, an intermediate zone and a peripheral zone. The anterior surface of the lens also has a central zone which corresponds to the central zone of the posterior surface. The two central zones define the optically effective portion, or zone, of the lens for correcting the vision of the patient. The posterior central zone of the lens has a chord diameter which is equal to or less than the measured maximum radius of curvature at the center of the cornea, and which is preferably larger than the largest measured diameter of the pupil of the eye of the wearer. The radius of curvature of the posterior central zone of the lens is chosen so that the difference between the sag depth of the posterior central zone of the lens and that of the center of the cornea over the same chord diameter is in the range of 0-15 microns. The central zone of the anterior surface has a radius of curvature which, in conjunction with the central zone of the posterior surface, provides the proper power factor to cause the wearer to have substantially normal distance vision. The intermediate annular zone of the posterior surface is aspheric, the curvature of which increases continuously from its least value adjacent the central zone to its maximum value adjacent the peripheral zone to produce, on the cornea, an aspheric surface. The peripheral annular zone of the posterior surface is beveled to provide limbal clearance when the lens edge moves to the extremity of the cornea, but not to an extent to provide excessive peripheral standoff which would irritate the