1. BASICS OF WAVEFRONT

1.1. Introduction

Eye care professionals have been trained to look at the eye mainly using sphero-cylindrical and ignoring any other aberrations that exist in the optical system. In the majority of our clinical situations, these sphero-cylindrical corrections address equately the visual needs of most individuals. However, there is a significant portion of the populations that notices aberrations, especially with the dilation of the pupil under mesopic and scotopic conditions. As well, optical aberrations produced by corneal changes such as keratoconus could not be adequately addressed by the use of sphero-cylindrical correction. (Maeda N et al 2003).

Helmholtz, many years ago, was able to describe that the human optical system in fact had numerous other aberrations that are not being addressed, but unfortunately our ability to measure these aberrations, and especially our ability to deal with them, was inadequate and ,therefore, largely ignored.(Marsack J et al 2002).

With the advent of refractive surgery, it became apparently quickly that correcting the sphero-cylindrical aberrations of the human eye allowed for a significant improvement in vision, but at the same time a significant deterioration in quality of vision. (Applegate RA et al 1998).

As refractive surgery became better and better in correcting the sphero-cylindrical component, we noted that more patients started to complain optical aberrations despite very good sphero-cylindrical correction, especially in situations with mesopic vision and dilated pupils. (Mrochen M et al 2001).

Wavefront systems work by measuring how light is distorted as it passes into the eye and then is reflected back. This creates an optical map of the eye, highlighting individual imperfections.

Wavefront is a very old technology that has only recently been applied to human vision. Wavefront has been used for years by astronomers who need to adjust the optics of their telescopes. A reflecting mirror within the telescope that can be deformed is adjusted using wavefront data to eliminate aberrations induced by the Earth's atmosphere. (USA eyes, 2006).

Wavefront is a promising new technology that provides an advanced method for measuring optical distortions in the eye

.measuring and treating these distortions goes beyond nearsighted, farsighted, and astigmatism determinations that have been used for centuries. As a result, physicians can now customize the refractive procedures according to each individual patient's unique vision correction needs. The treatment is unique to each eye, just as a fingerprint is unique. (Seiler T et al 2000).

1.2. Definition and optics

Light is a traveling electromagnetic wave. A wavefront is a continuous iso-phase surface. To simplify our mental picture, let's first consider waves on the surface of water (figure1.1) Imagine throwing a stone into still water and observing the expanding circles of waves. (Liang J et al 2000).

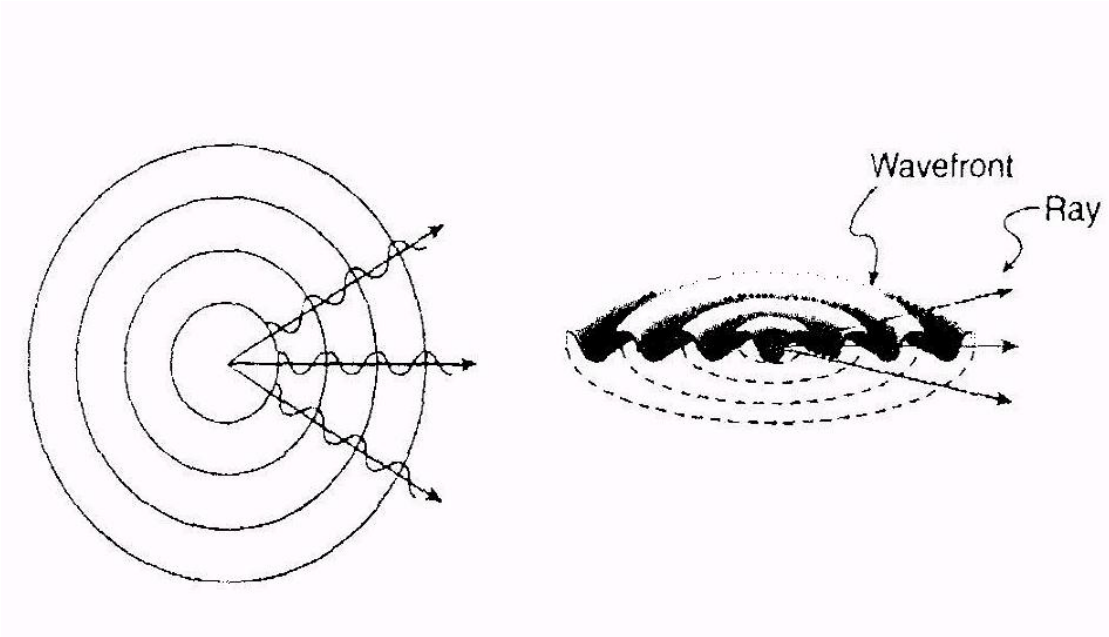

Figure 1.1 Definition of wavefront (Williams D et al 2000)