A Comparative Study On The Effect Of Femtosecond Laser Versus Mechanical Microkeratome Flap Creation On Corneal Biomechanics

Thesis

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By

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AD	**Ablation depth**
CCT	**Central corneal thickness**
CH	**Corneal hysteresis**
CRF	**Corneal resistance factor**
DLK	**Diffuse lamellar keratitis**
FS	**Femtosecond**
FT	**Flap thickness**
GAG	**Glucosaminoglycans**
HOA	**High order abberations**
LASIk	**Laser in situ keratomileusis**
MK	**Mechanical microkeratome**
MRSE	**Manifest refractive spherical equivalent**
Nd:YAG	**Neodymium doped yttrium aluminum garnet**
ORA	**Ocular response analyzer**
PG's	**Proteoglycans**
RSB	**Residual stromal bed**
TLSS	**Transient light-sensitivity syndrome**

Introduction

Since the development of corneal photoablation with the excimer laser in refractive surgery, many studies have reported the safety and the ability of this technique for the correction of ametropia, with good anatomic and visual results ***(Sugar et al., 2002 and Hammond et al., 2005).***

Excimer laser refractive surgery is the most commonly used operation for correcting myopia. This refractive surgery uses the excimer laser to ablate corneal tissue and to reshape the cornea, changing its refractive power. The procedures are divided into two main groups: laser assisted in situ keratomileusis (LASIK) and surface treatments ***(Min et al., 2008).***

Laser in situ keratomileusis is currently the procedure of choice for correcting moderate to severe myopia and myopic astigmatism. In this technique, a hinged flap is created and folded back, and the exposed stroma is photoablated using an excimer laser. In LASIK for myopia, stromal tissue is ablated so that the curvature of the central cornea is flattened to compensate for the excessive refractive power or longer axial length of the myopic eye ***(Suzuki et al., 2006).***

The creation of a corneal flap is one of the fundamental steps in LASIK. A LASIK flap can be created with a mechanical microkeratome or femtosecond laser. The flap consists of epithelium, Bowman's layer and anterior stroma. Excimer laser beam is then applied directly to the stroma. Once ablation is completed, the flap is repositioned ***(Fong , 2007).***

Mechanical microkeratome systems produce a meniscus shaped flap, with the flap being thinner in the center and thicker in the periphery. These flaps show variability in both flap thickness and diameter with a standard deviation of approximately 20 to 40 µm in thickness and ± 0.3 mm in diameter ***(Ucakhan , 2002).***

The femtosecond laser is a solid state infrared laser with a 1053 nm wavelength used to create corneal flaps in LASIK. The femtosecond laser creates focused cavitation spots within the stroma delivered in a raster pattern that begins at the hinge and progresses temporally. The spots are placed 5 to 12 µm apart, and as the microcavitation bubbles expand, the spots coalesce, forming a resection plane. After the horizontal plane is created, the pattern changes to a vertical one, creating an edge around the flap. Dimensions of the flap (thickness, diameter, hinge size, location) are controlled using computer software. During treatment, the cornea is flattened with a suction applanating lens to immobilize the eye and to allow treatment of a geometrically simpler planar cornea ***(Ratkay-Taub et al., 2001).***

Compared to a flap created with a mechanical microkeratome, a femtosecond laser flap offers several potential advantages; more uniform flap thicknesses, customizable flap diameter and hinge position, smoother stromal beds, and lower rates of flap creation complications ***(Patel et al., 2007).***

In addition to anatomic data, an examination of the biomechanical properties of each cornea could be helpful in analyzing their individual qualitative properties before a photoablative procedure ***(Kerautret et al., 2008).***

The ***Ocular Response Analyzer®*** (ORA; Reichert, Buffalo, NY), is the first device to allow exploration of the corneal viscoelastic and biomechanical properties. It utilizes a rapid air impulse and an advanced electro-optical system to record two applanation pressure measurements; one while the cornea is moving inward and the other as cornea returns. Due to its biomechanical properties, the cornea resists the dynamic air puff causing delays in the inward and outward applanation events, resulting in two different pressure values ***(Schweitzer et al., 2010).***

Each ***Ocular Response Analyzer®*** measurement signal generates a total of 42 parameters (37 waveform parameters, Waveform score, Corneal Hysteresis, Corneal Resisting Factor, IOP_g "Goldmann" and IOP_{cc} "Corrected Corneal"). Waveform parameters are mathematical representations of waveform shape characteristics such as peak height, area, slopes, etc. ***(Http://www.reichert.com, 2016).***

Aim of the work

To compare the effects of femtosecond laser and mechanichal microkeratome on the biomechanical properties of the cornea using ***Ocular Response Analyzer®*** in patients undergoing myopic laser refractive surgery.

Patients and Methods

Our study will include 100 eyes with myopia (mild – moderate) and myopic astigmatism (simple and compound)

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The patients will be divided randomly into two groups :

- ***Group (A):*** 50 eyes in which femtosecond laser will be used for flap creation (FS 200 Wavelight).

- ***Group (B):*** 50 eyes in which mechanical microkeratome will be used for flap creation (Moria M2 automated microkeratome).

Inclusion criteria:

1. Age: 20 years or more and 40 years or less.
2. Refractive error:
    - Myopia up to -6.00 diopters.
    - Astigmatism up to -3.00 diopters.
    - Stable refraction.