Efficacy of Brimonidine Tartarate 0.2% Ophthalmic Solution on Reducing Night Vision Difficulty and Improving Contrast Sensitivity After Laser in Situ Keratomileusis

Thesis

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List of Abbreviations

Abb.	Full term
CS	Contrast Sensitivity
DLK	Diffuse lamellar keratitis
FDA	Food And Drug Administration
HOA	Higher Order Aberrations
LASIK	Laser Insitu Keratumelusis
MMC	Mitomycin C
NVD	Night Vision Difficulties
PRK	Photo-Refractive Keratectomy
RMS	Root Mean Square
SA	Spherical Aberrations
SD	Standard Deviation
SMILE	Small Incision Lenticule Extraction
VA	Visual Acuity

Introduction

LASIK (laser in situ keratomileusis) is a surgical procedure designed to correct refractive errors. LASIK involves creating a corneal flap using a microkeratome, reshaping the cornea using excimer laser to remove tissue from the underlying stromal bed and then replacing the flap. LASIK is indicated for the correction of low, moderate, and high myopia and hypermetropia with and without astigmatism. The correction of high myopia may present a greater risk of post-LASIK complications. The surgeon should decide whether LASIK is indicated based on a full preoperative evaluation and consideration of goals and alternatives ***(Feldman and Huang, 2015)***.

Candidates for LASIK procedures should have a stable refraction for at least 12 months. The main contraindications for LASIK include patients with keratoconus, autoimmune disease, active corneal or ocular disease ***(Doane et al., 1996)***.

As LASIK is a rapidly evolving ophthalmic surgical procedure, several anatomic and refractive complications have been identified. Anatomic complications include corneal flap abnormalities, epithelial ingrowth, and corneal ectasia. Refractive complications include unexpected refractive outcomes, irregular astigmatism, decentration, visual aberrations, and loss of vision. Infectious keratitis, dry eyes, and diffuse lamellar keratitis may also occur following LASIK.

By examining the etiology, management, and prevention of these complications, the refractive surgeon may be able to improve visual outcomes and prevent vision-threatening problems. Reporting outcomes and mishaps of LASIK surgery will help to refine our approach to the management of emerging complications ***(Melki and Azar, 2001)***.

A percentage of patients complains of "glare" at night after undergoing a refractive surgical procedure. When patients speak of glare they are, technically, describing a decrease in quality of vision secondary to glare disability, decreased contrast sensitivity, and image degradations, or more succinctly, "night vision disturbances. ". In most cases of corneal refractive surgery, there is a significant increase in visual disturbances immediately following the procedure ***(Fan-Paul et al., 2002),*** and a considerable decrease from 25.6% at 1 month to 4.7% at 12 months postoperatively ***(Pop and Payette, 2004).***

This complication can lead to problems with driving or riding a bicycle during scotopic conditions due to reduced night vision, although their visual acuity (VA) measured on the Snellen screen is excellent during photopic conditions. Higher order aberrations are known to cause some of these problems ***(Haw and Manche, 2001; Marcos, 2001; Marcos et al., 2001; Moreno-Barrusio et al., 2001; Miller et al., 2002).***

The relation between pupil size and the optical clear zone is the most important in minimizing these disturbances. In LASIK, pupil size and the ablation diameter size and location are the major factors involved ***(Fan-Paul et al., 2002).***

Brimonidine tartrate is a highly selective α-2 agonist that effectively reduces mean intraocular pressure (IOP) through its effect on α-2 receptors in ciliary epithelium ***(Derick et al., 1997).*** It was found that it has a significant miotic effect especially under scotopic conditions, most likely from its α-2 adrenergic effect. Brimonidine with its miotic action is thought to improve contrast sensitivity and decrease night vision difficulties after refractive procedures ***(Kesler et al., 2004)***.

Aim of the Study

Subjective and objective evaluation of the effect of Brimonidine tartrate 0.2% ophthalmic solution on post-LASIK night vision complaints.

Chapter 1

LASIK Complications

Laser In situ Keratomileusis (LASIK) has proved to be a safe and effective procedure for the treatment of myopia, hypermetropia and astigmatism. The procedure of keratomileusis is designed to preserve Bowmann's Layer and the overlying epithelium by creating a lamellar flap of the cornea using microkeratome and then the stroma is ablated by excimer laser to correct the refractive error. Corneal flap can be repositioned accurately again on the ablated stromal bed ***(Tabbara et al., 2003).***

LASIK requires the usage of several devices intra-operatively which may result in many complications postoperatively. These complications may cause drop of vision or other annoying symptoms in otherwise healthy eyes. Knowledge about how to prevent and how to manage these complications must be advanced as long as the refractive surgeries are performed ***(Schallhorn et al., 2006).***

A) Intraoperative Complications:

1- Flap Complications

It was found that there are many intra-operative and post-operative LASIK complications related to flap creation using mechanical keratomes ***(Andreoli and Azar, 2015).*** Detection of a flap complication intra-operatively may lead us to abort the

ablation step. The surgeon may face a dilemma in managing these cases as the repeated attempts in refractive surgeries carry higher risks of complications ***(Moshirfar et al., 2010).***

Intra-operative flap complications including irregular, thin, incomplete flap, buttonhole and free cap are found in a significant higher rate with flaps created by microkeratome (0. 095%) than flaps created by femtosecond (0. 019%). Other flap complications may occur such as flap edema, shrinkage, stretching and wrinkling ***(Stonecipher et al., 2015).***

2- Decentered laser ablation

A significant amount of coma aberrations may be induced from treatment decentration in refractive surgery, which interprets that a cornea with treatment decentration is an off-axis refractive system. There will be an obvious reduction in coma aberrations when surgeon is considering the oblique incidence as the ablation zone centre will be deviated from the eye's optical axis ***(Lihua et al., 2010).***

Clinicians should consider many factors in order to achieve better visual results from refractive surgeries. They should be extensively experienced to limit treatment decentration intra-operatively. Also good alignment with the visual axis can be achieved by advancing devices of eye tracking technology ***(Wu et al., 2009).***

B) Postoperative complications:

Good intra-operative management can minimize many post-operative complications. Clinicians should pay a focused attention to infectious keratitis as it can threaten the vision severely if not managed adequately and they also should differentiate between infectious keratitis and diffuse lamellar non-infectious keratitis ***(Linke et al., 2016).***

1- Diffuse lamellar keratitis:

Diffuse lamellar keratitis (DLK) is a non-specific immunological reaction in which there is white blood cell infiltration in the interface between stromal bed and the created flap after surgical intervention ***(Randleman and Shah, 2012), Figure (1)***. Diffuse lamellar keratitis is a multifactorial rare condition which may be caused by many endogenous factors as Meibomian gland secretions or exogenous factors as powder of hand gloves, bacterial toxins on surfaces of surgical instruments and sterilization detergents ***(Gritz¸2011).***

In DLK management we aim to limit the inflammatory process and the resulting scarring, save the vision and eliminate symptoms of dryness. Medically, topical and systemic steroids can be used. Surgically, irrigation after elevating the flap is effective. Keratoplasty is also a surgical management option for DLK complicated by scarring ***(Hallak and Azar, 2015).***