بسم الله الرحمن الرحيم

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شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

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INTRODUCTION

Corneal refractive surgeries require precise corneal correction to achieve ideal visual outcomes and visual quality. For that reason, Femtosecond laser (FL) was introduced utilizing ultrafast pulses to create precise ocular tissue ablation [(1)], and is commonly used in corneal refractive surgeries to create corneal flaps in femtosecond laser-assisted in situ keratomileusis (Femto-Lasik). Recently, FL has also increasingly been used to create a transparent refractive lenticule in femtosecond lenticule extraction (FLEx) with a lifted corneal flap.[(2)]

Small incision lenticule extraction (SMILE) was introduced as a next-generation stromal lenticule refractive procedure, further optimizing FLEX. As a flap-free technique, an instrastromal lenticule was cut by a femtosecond laser and removed through a small corneal incision. With use of only a small incision (2–4 mm in width) for removal of the lenticule, the corneal integrity was left almost intact. [(3,4)]

Because of its excellent effect, safety and predictability, SMILE has been widely accepted worldwide for the treatment of myopia and myopic astigmatism. [(5, 6)]

It is now considered as an alternative procedure to conventional laser in-situ keratomileusis (LASIK) because of its potential advantages of reduced denervation, faster

resolution of post-operative dry eye, improved biomechanics, and no flap-related risks. [7, 8]

In addition SMILE induces much less higher-order aberrations (HOAs) compared to traditional LASIK. [9, 10]

Increased HOAs postoperative may promote visual complaints such as glare and halos, reduced contrast sensitivity and poor night vision.

Some studies reported an increase in coma and HOAs but not in spherical aberrations after SMILE. [11, 12]

This study is aimed to detect the effect of SMILE on quality of vision and the incidence of higher order aberrations following SMILE refractive surgery.

Aim of the Work

The aim of the study is to detect the effect of SMILE on quality of vision and the incidence of higher order aberrations following SMILE.

Chapter 1

SMILE

Introduction and history

Small incision lenticule extraction (SMILE) is a relatively new refractive procedure designed to treat a multitude of refractive errors such as myopia, hyperopia, presbyopia, and astigmatism. The procedure involves using a femtosecond laser to create a corneal lenticule which is extracted whole through a small incision without the use of an excimer laser. It is reported to achieve effects similar to laser-assisted in situ keratomileusis (LASIK) with excellent post-operative outcomes.[13]

In 2007, an intrastromal lenticule method was introduced as an alternative to LASIK called Femtosecond Lenticule Extraction (FLEx) intended for patients with extreme myopia. After improvements to scan modes and energy parameters, improved visual recovery times were noted, with refractive results similar to LASIK. Following the implementation of FLEx, a procedure called small incision lenticule extraction (SMILE) was developed, involving a small 2-3 mm incision used to allow for extraction of the whole corneal lenticule without the need to create a flap.[14]

While still in its early stages of proclivity amongst surgeons, SMILE is noted for achieving similar effects as LASIK but with some possible benefits such as faster recovery

of post-op dry eye, re-innervation of corneal nerves, and a potential biomechanical advantage. The commencement of this procedure began in September 2011 and is established in various locations such as Europe, China and India. The clinical trial in the USA began in June 2012 and has been expanded by the US FDA after initial signs of success in a small sample of patients. To date, 255 patients have been treated at five centers in the USA. Outside of the USA, there are 150 centers in a total of 38 countries that perform the procedure. [15]

Surgical Procedure

SMILE can be performed under topical anesthesia. The patient is positioned supine under the femtosecond laser, and the untreated eye is covered and taped to prevent corneal dehydration. Two drops of 0.8% oxybuprocaine tetrachloride are applied 5 minutes before operation and again just before the lid speculum is installed. A contact glass interface that consists of a peripheral ring of small suction ports is attached to the femtosecond laser to keep the patient's eye fixated in the correct position while the lenticule is created. The curved contact glass ensures precise contact to the corneal surface during laser application and is available in various sizes (S, M, L, and type KP). The size of the contact glass should correspond to the white-to-white distance of the patient. A small (S)-sized contact glass is generally preferred, with small white-to-white distances. The patient is positioned under the laser head. It is important to dry the ocular surface, especially the inferior

fornix, with a sponge to remove any excess tear fluid or ocular surface secretions. This can be performed by placing a disposable sponge in the inferior fornix while the patient is being aligned to the interface cone. Some surgeons advocate the use of a speculum with a suction device to remove excess tear fluid. Once the patient is under the laser head, the bed is elevated to allow contact with the interface and the anterior corneal surface. Before contact the patient is asked to fixate on a green light from the femtosecond laser for accurate centration. The bed then is elevated further to allow complete contact with the corneal surface. The degree of contact with the ocular surface can be ascertained by the spread of the tear fluid meniscus. In most cases when the tear fluid has spread to three quarters of the width of the cornea, suction is applied. Following suction, the patient is still able to fixate on the green light due to a low intraocular pressure rise.[16,17] Good centration is important because no built-in tracker exists.[18] Patients who have high astigmatism treatments should be marked in the horizontal axis on the slit lamp before the laser procedure. Once under the interface and suction applied, the interface can be rotated to ensure that the marked horizontal axis on the eye is in alignment with that of the horizontal meridian through the right eyepiece in the microscope of the laser, to counter any cyclotorsion. [17]

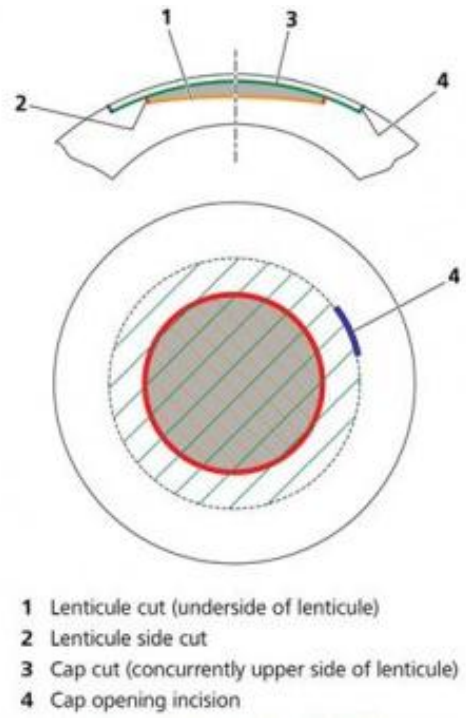

Figure (1): Incision geometry of the SMILE procedure.

Femtosecond Laser Application

SMILE is performed with four sequential laser cuts to create a corneal lenticule and a tunnel incision: [19] a posterior lenticule surface cut in a spiral-in pattern (refractive cut), [20] a vertical cut along the circumference of the lenticule, [21] an anterior lenticule surface cut in a spiral-out pattern (corneal cap), and [22] a superiorly placed 2–4 mm tunnel vertical incision cut that gives access to the lenticule from the corneal surface. It is preferred to rotate the incision to the superior temporal side in the right eye and superior nasal in the left eye to ease the access for a right-handed surgeon and to avoid any superior pannus and intraoperative bleeding, which may be

common in patients who wear contact lenses. The spiral-in pattern of the posterior lenticule cut maximizes the time the patient can focus on the fixation target and minimizes the risk of suction loss due to eye movements. Cutting the posterior surface first ensures that the gas bubbles do not block the laser application of the anterior surface cut. The spiral-in and spiral-out laser firing sequence has also been shown to cause minimal disruption to the collagen lamellae. [23] The laser refractive application takes approximately 20–25 seconds depending on the laser settings. Suction is released automatically after treatment. The following laser settings can be altered by the surgeon and to determine the lenticule thickness and treatment zone. For the lenticule: lenticule diameter, minimum lenticule thickness, and lenticule side cut angle. For the corneal cap: cap thickness, cap diameter, incision position, incision width, and incision side cut angle. The laser settings are determined by the preoperative refractive status, together with the preference and experience of the surgeon. Surgeons starting with SMILE should perform cases with lenticule thickness of above 70 μm (minimum lenticule thickness of 15 μm) because it will be easier to perform the removal. Surgeons with more experience with the procedure may perform treatments of −1 D. [24]

Lenticule Removal

Lenticule removal includes several key stages. The eye can be fixated with a pair of forceps to avoid sudden eye movements during the intrastromal maneuvers. The incision is

opened with a Sinskey hook. The two lenticule planes are identified in each corner of the incision. The remaining tissue bridges of the upper surface are broken with a blunt spatula and the lenticule is separated from the cap. The blunt spatula should be gently maneuvered over the lenticule with no major resistance from the remaining tissue bridges. A gentle sweeping movement is advocated ensuring that the dissection passes over the complete area of the anterior surface of the lenticule. The same maneuver is performed on the posterior surface of the lenticule. The lenticule then can be removed through the incision using a pair of forceps. Some surgeons flush the intrastromal pocket with balanced salt solution to remove remaining debris and minimize the risk of epithelial ingrowth. However, the fluid may possibly induce small fluid pockets in the interface and can delay the immediate visual recovery. [25] After lenticule removal, the cap can be massaged with a sponge to remove residual tension folds to the periphery, to minimize irregularities and microfolds on the visual axis when correcting highly myopic patients. One drop of fluoroquinolone and corticosteriod are then applied at the end of the procedure.[26, 27]

Postoperative Management

A postoperative regimen may include topical moxifloxacin, 3 times daily for one week and topical prednisolone 4 times daily for 1 week then 3 times daily for 2 weeks and lubricant six times daily for 6 weeks. The patient should use lubricating drops to ease the discomfort in the

postoperative period. Daily activities can be performed, but the patient should avoid swimming pools and extensive eye rubbing during the first 2 weeks. Slit-lamp examination should be performed 1 day, 1 week, and 1 and 3 months after the operation. We normally assess refractive outcome with formal refraction at 1 and 3 months.[28]

Postoperative Complications

After almost all laser refractive procedures ***Corneal haze*** (5.6%) is a well-known early postoperative complication and is associated with corneal keratocyte apoptosis and wound healing. The corneal haze usually decreases over time.[29, 30]

In combination with corneal haze ***early dry eyes*** (3.2%) may be seen at day 1 after surgery. In several studies, the flap-free approach has been shown to preserve the sub-basal nerve layer density better after SMILE compared with FS-LASIK in both short- and longer-term studies.[31–33] Corneal sensitivity recovery is faster after SMILE. However, early postoperative dry eye symptoms are comparable with flap-based procedures.[31, 34] Tear break-up time (TBUT), Schirmer's test, and tear meniscus height were similar after SMILE and FLEX up to 6 months after operation in a contralateral eye study.[31]

Epithelial ingrowth (0.5%) is seen when epithelial cells proliferate at the incision site or are displaced into the interface during lenticule removal. Epithelial ingrowth to the interface is

rarely seen after SMILE. Epithelial islands may be spotted at the incision site, often in relation to a minor tear after lenticule removal difficulties. The epithelial islands may be left alone if there is no progression observed and can be also scraped off the border of the incision using a pocket epithelial remover or treated with Nd:YAG laser. Only in very severe cases with epithelial ingrowth to the interface center does it become visually significant. [35] An alternative option is to perform a conversion of the pocket to a flap to allow a more extensive irrigation of the stromal interface, if the epithelium cannot be removed through the small incision. [32, 35]

Diffuse lamellar keratitis **(DLK)** (0.2%), also known as Sands of Sahara or interface inflammation, typically appears after 1–3 days, accompanied by decreased visual acuity, pain, and photophobia.[36] High laser energy settings during photodisruption increase the risk of diffuse lamellar keratitis.[37] Thin stromal lenticules may increase the risk of DLK, because gas bubbles after photodisruption accumulate within a small stromal area and provoke a strong inflammatory response.[36] DLK is frequently reported in conjunction with central aberrations and postoperative epithelial defects.[39] DLK may be successfully treated with topical corticosteroids or flushing the interface in some cases. In rare cases, a bacterial or fungal organism can be the cause of the inflammation and should always be considered if the patient does not respond to the

treatment. Higher incidence of DLK has been reported when the interface has not been irrigated following the procedure. [38]

Conclusion

SMILE has emerged as a new technique for correcting myopia and myopic astigmatism that preserves the corneal integrity by creating a corneal cap with no risk of flap displacement as may be seen after LASIK and FLEX. Several studies have shown SMILE to have high efficacy, predictability, stability, and safety with fewer postoperative HOAs than after LASIK. In the future, the development and refinement of SMILE may open up new ways of correcting hyperopia by removal of a piece of tissue that flattens the corneal curvature. Until then, LASIK and PRK are the recommended corneal treatment for correcting low hyperopia.[32]