Basrah Journal Of Surgery

Original Article

Bas J Surg, December, 20, 2014

COMPARISON BETWEEN PHOTOREFRACTIVE KERATECTOMY (PRK) AND LASER IN SITU KERATOMILEUSIS (LASIK) OUTCOME AFTER SIX MONTHS IN TREATMENT OF MYOPIC ASTIGMATISM

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Abstract

Astigmatism is corrected by either by toric lenses or surgical intervention including laser refractive surgery. Photorefractive keratectomy (PRK) is performed with the excimer laser which can accurately ablate corneal tissue to an exact depth with minimal disruption of surrounding tissue, it is done by removing the epithelial layer up to Bowman layer which then ablate with anterior stroma. Laser in situ keratomileusis (LASIK) is also performed with the excimer laser, but with creation a flap involving the stroma.

This study aimed to compare the differences in visual outcome after 6 months between PRK and LASIK in treatment of astigmatism. It is a retrospective study in which 222 eyes of 115 patients (some of them had only astigmatism in one eye) who underwent laser refractive correction in Al-Hakeem General Hospital in Annajaf city to correct their astigmatismic refractive error were included in the study, 152 of astigmtismic eyes were corrected by LASIK (82 of female eyes and 70 of male eyes), 67 of astigmatismic eyes were corrected by PRK (35 of female eyes and 32 of male eyes). Patients were grouped into six groups according to their refractive error: G1: less than 1.0 dioptre, G2: 1.0-1.9 dioptres, G3: 2.0-2.9dioptres, G4: 3.0-3.9 dioptres, G5: 4.0-4.9dioptres and G6: 5.0-14.0 dioptres. The outcome of visual acuity was followed-up by autorefraction six months postoperatively and were grouped into five groups according to their visual outcome: a:emmetropia, b:no correction, c:undercorrection, d: increase the refractive error, e: overcorrection.

The results shows that in those with astigmatism between 0.25-0.9 dioptre, no statistically significant association was found between outcome and type of operation (P=0.66). In those with astigmatism between 1.0-1.9 dioptres, statistically significant association was found between outcome and type of operation (p=0.023). In those with astigmatism between 2.0-2.9 dioptres, statistically significant association was found between outcome and type of operation (P=0.0009). In those with astigmatism between 3.0-3.9 dioptres, statistically significant association was found between outcome and type of operation (P=0.001). In those with astigmatism between 4.0-4.9 dioptres, no statistically significant association was found between outcome and type of operation (P=0.113). In those with astigmatism between 5.0-14.0 dioptres, no statistically significant association was found between outcome and type of operation (P=0.92).

In conclusion, there is no statistical significant difference after 6 months of correction of astigmatism wither by LASIK or PRK at different levels of refractive error.

Introduction

Astigmatism is a very common condition that affects the vision of approximately 80% of all people. This condition occurs due to an irregular curvature of the cornea, or front surface of the eye. Astigmatism is often referred to as a refractive error, because the curvature of the cornea causes light to be focused away from its intended target, the retina. This usually causes blurred vision, at all distances, and can be present with other conditions like nearsightedness or farsightedness. The most common symptoms of astigmatism are distortion of

vision at any distance, headache, fatigue, eye squinting or head tilting. The symptoms of astigmatism can vary in severity. There are some people who have astigmatism that is so mild that they do not require any corrective treatment in order to function normally.

Types of Astigmatism: Myopic astigmatism: One or both principal meridians of the eye are nearsighted. (If both meridians are nearsighted, they are myopic in differing degree). Hyperopic astigmatism: One or both principal meridians are farsighted. (If both are farsighted, they are hyperopic in differing degree). Mixed astigmatism: One principal meridian is nearsighted, and the other is farsighted. Astigmatism also is classified as regular or irregular. In regular astigmatism, the principal meridians are 90 degrees apart (perpendicular to each other). In irregular astigmatism, the principal meridians are not perpendicular. Most astigmatism is regular corneal astigmatism, which gives the eye a football shape.

Treatment

Almost all degrees of astigmatism can be corrected with properly prescribed eyeglasses or contact lenses. For a person with only a slight degree of astigmatism, corrective lenses may not be needed at all, as long as other conditions, such as nearsightedness or farsightedness, are not present. If the astigmatism is moderate to high, however, corrective lenses are probably needed.

Corrective lenses (eyeglasses or contact lenses). For astigmatism, special soft contact lenses called toric lenses are prescribed. Soft toric lenses have greater light bending power in one direction than the other. Another option, particularly for higher amounts of astigmatism, is a gas permeable rigid contact lens. After performing various tests, your eye doctor will determine the ideal prescription for your astigmatism.

Surgical correction

1.Limbal relaxing incisions/arcuate-keratotomy: involves making paired arcuate incisions on opposite sides of the cornea in the axis of the correcting 'plus' cylinder (the steep meridian).

2. Lens surgery involves using a 'toric' intraocular implant incorporating an astigmatic correction, Postoperative rotation of the implant away from the desired axis occurs in a significant minority.

3. Conductive keratoplasty (CK) involves the application of radio frequency energy to the corneal stroma and can correct low to moderate and hypermetropic astigmatism. Burns are placed in one or two rings in the corneal periphery using a probe.

4. PRK and LASEK. 5. LASIK.

Photorefractive keratectomy (PRK) is performed with the excimer laser, which can accurately ablate corneal tissue to an exact depth with minimal disruption of surrounding tissue. Myopia is treated by ablating the central anterior corneal surface so that it becomes flatter; approximately 10/-lm of ablation will correct 1 D of myopia. Hypermetropia is treated by ablation of the periphery so that the centre becomes steeper. PRK is able to correct astigmatism up to 3 D.

Technique

a. The visual axis is marked and the corneal epithelium removed.

b. The patient fixates on the aiming beam of the laser.

c. The laser is applied to ablate only Bowman layer and anterior stroma.

The cornea usually heals within 48-72 hours aided by a bandage contact lens. A subepithelial haze invariably develops within 2 weeks and persists for 1-6 months. It rarely causes diminished visual acuity but may give nocturnal glare[1-3].

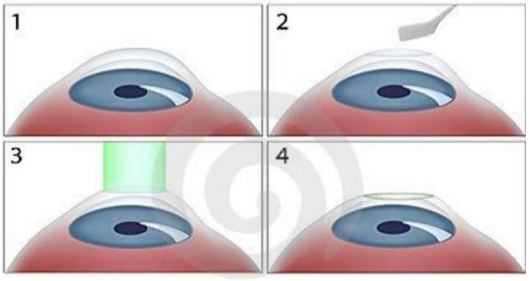
Complications include slow-healing epithelial defects, corneal haze and haloes, poor night vision and regression of refractive correction. Uncontrol problems include decentred ablation, scarring, abnormal epithelial healing, irregular astigmatism, hypoaesthesia, sterile infiltrates, infection and acute corneal necrosis[1,3-6].

Laser in situ keratomileusis: (LASIK): It is more versatile than PRK and LASEK and can astigmatism of up to 5D. To decrease the risk of subsequent ectasia, a residual corneal base of at least 250 mm thickness must remain after the flap has been cut and tissue ablated. The amount of tissue removed and the total treatment is therefore limited by the original corneal thickness. The thickness of the flap can be varied but thinner flaps are more difficult to handle and more prone to wrinkling[1,7-9].

Technique

a. A suction ring is applied to the globe; this raises the intraocular pressure to over 65 mmHg, and may temporarily occlude the central retinal artery and extinguish vision.

b. The ring is centred on the cornea and provides a guide track into which an automated microkeratome is inserted.



Photorefractive Keratectomy (PRK)

c. The keratome is mechanically advanced across the cornea to create a thin flap, which is reflected.

d. Suction is released and the bed is treated with the excimer laser as for PRK.

e. The flap is repositioned and allowed to settle undisturbed for 30 seconds.

Compared to PRK, the procedure offers the advantages of minimal discomfort, faster visual rehabilitation, rapid stabilization of refraction and minimal stromal haze[1,3,4].

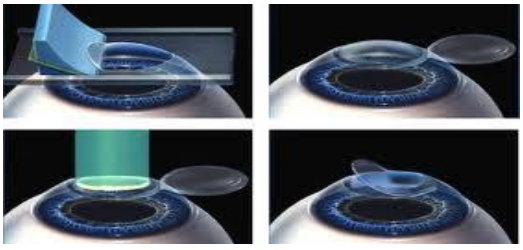
Patients and methods

A 222 eyes of 115 patients (some of them had only astigmatism in one eye) who were done a laser refractive correction in Al-Hakeem General hospital in Annajaf city to correct their astigmatismic refractive error were included in this retrospective study.

The correction of astigmatismic refractive error correction was done by Nidek machine and all operations were done by the same surgeon.

Even that now LASIK become more used than PRK but still there are many indications to perform the PRK in which the surgeon in this study consider the following indications for PRK:

Astigmatism (0.75D to 3.0D)-Higher corrections are associated with regression of the effect; therefore, LASIK is the preferred procedure.



Patients with documented evidence of a change in manifest refraction of less than or equal to 0.5D (both cylinder and sphere

components) per year for at least 1 year prior to the date of preoperative examination.

Patients aged 21 years for the reduction or elimination of myopia from 0D to -6.0 D spherical myopia at the spectacle plane with up to -3.0 D of astigmatism

Patients aged 21 years or older with naturally occurring hyperopia from +1.0 D to +4.0 D spherical equivalent, with no more than 1.0 D of refractive astigmatism.

PRK in corneas previously treated with LASIK[10,11].

Both PRK and LASIK use excimer laser to ablate the corneal curvature but they differ by that in LASIK a flap is done consist of epithelium, bowman layer and part of stroma, while in PRK only epithelium was removed up to bowman layer.

LASIK

A 152 of astigmtismic eyes were corrected by LASIK (82 female eyes and 70 male eyes), 67 of astigmatismic eyes were corrected by PRK (35 of female eyes and 32 of male eyes). Patients were grouped into six groups according degree of refractive error: G1: less than 1.0 dioptre, G2: 1.0-1.9 dioptres, G3: 2.0-2.9dioptres, G4: 3.0-3.9 dioptres, G5: 4.0-4.9dioptres and G6: 5.0-14.0 dioptres.

The outcome of visual acuity was followed-up by autorefraction (using TOMEY machine) six months postoperatively were grouped into five groups according to their visual outcome: a:emmetropia, b: no correction (same degree), c:undercorrection, d:increase the refractive error, e: overcorrection.

We exclude all pre-existing other organic or complications that not related to our procedures. We use the SPSS 20 program version 5 with p value regarding as statistically significant at 0.05, using Chi-Square and standard mean deviation.

Results

Sample was 222 eyes (mean age ± SD 29.41 ± 7.2) with range from 19-45 years as shown in table I.

Seventy two eyes (46.8%) of those with LASIK correction were males compared to 82 eyes (53.2%) females, while in PRK 33 eyes (48.5%) were males and 35 eyes (51.5%) were females, with no statistical association; p= 0.46; as shown in table II.

Table I:Age group distribution

	N	Minimum	Maximum	Mean	Std. Deviation
age	222	19	45	29.41	7.227

Table II: Distribution according to type of operation and gender

Sex		Top		Total	P
		LASIK	PRK		
Male	Count	72	33	105	0.46
	% within top	46.8%	48.5%	47.3%	
female	Count	82	35	117	
	% within top	53.2%	51.5%	52.7%	
Total	Count	154	68	222	
	% within top	100.0%	100.0%	100.0%	

Figure 1: Distribution of the sample according to the gender.

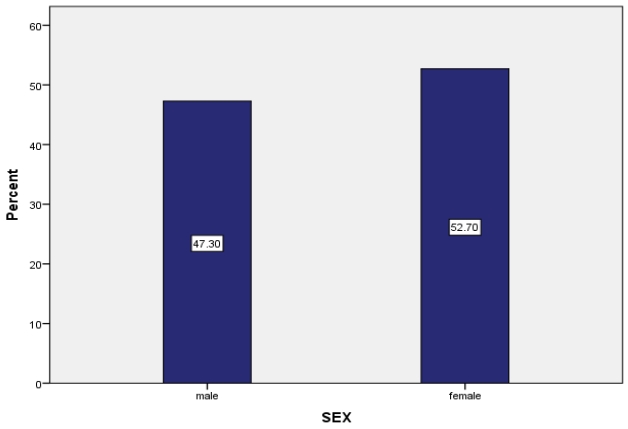
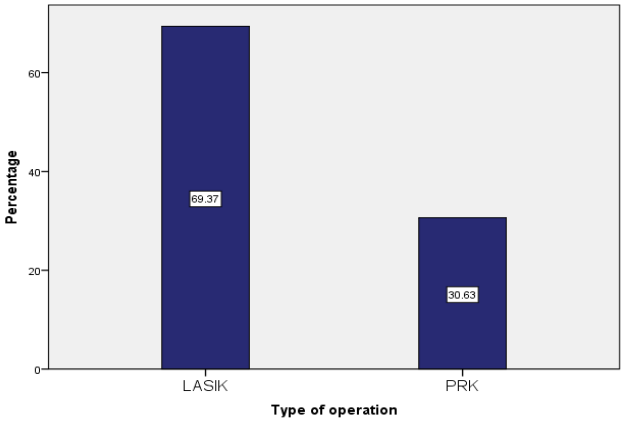


Table III: Distribution according to type of operation and outcome in those with refractive error = 0.25-0.9 dioptres

OUTCOME		Top		Total	P
		LASIK	PRK		
emmetropia	Count	2	0	2	0.66
	% within OUTCOME1	100.0%	0.0%	100.0%	
No change	Count	4	5	9	
	% within OUTCOME1	44.4%	55.6%	100.0%	
under correction	Count	9	4	13	
	% within OUTCOME1	69.2%	30.8%	100.0%	
Worse	Count	4	8	12	
	% within OUTCOME1	33.3%	66.7%	100.0%	
overcorrection	Count	4	5	9	
	% within OUTCOME1	44.4%	55.6%	100.0%	
Total	Count	23	22	45	
	% within OUTCOME1	51.1%	48.9%	100.0%	

Figure 2: Distribution of the sample according to the type of operation.



No statistically significant association was found between outcome and type of operation in those with pre operative refractive error 0.25-0.9 dioptre where P= 0.66; as shown in table III.
Statistically significant association was found between outcome and type of operation those with 1.0-1.9dioptres p=0.023, as shown in table IV.

Table IV: Distribution according to type of operation and outcome in those with refractive error = 1.0-1.9 dioptres

OUTCOME		top		Total	P
		LASIK	PRK		
Emmetropia	Count	1	0	1	0.023
	% within OUTCOME1	100.0%	0.0%	100.0%	
No change	Count	1	9	10	
	% within OUTCOME1	10.0%	90.0%	100.0%	
Under correction	Count	21	7	28	
	% within OUTCOME1	75.0%	25.0%	100.0%	
Worse	Count	1	0	1	
	% within OUTCOME1	100.0%	0.0%	100.0%	
overcorrection	Count	13	6	19	
	% within OUTCOME1	68.4%	31.6%	100.0%	
Total	Count	37	22	59	
	% within OUTCOME1	62.7%	37.3%	100.0%	

All eyes with outcome of emmetropic are operated by LASIK, while 8 eyes (80%) with no correction postoperatively are operated by PRK, while 26 eyes (86.7%) with undercorrection postoperatively were operated by LASIK, while 11 eyes (91.7%) with overcorrection postoperatively are operated by LASIK, with statistically significant association P=0.0009 in group 2.0-2.9 dioptres as shown in table V.

Table V: Distribution according to type of operation and outcome in those with refractive error = 2.0-2.9 dioptres

OUTCOME		Top		Total	P
		LASIK	PRK		
Emmetropia	Count	2	0	2	0.0009
	% within OUTCOME1	100.0%	0.0%	100.0%	
No change	Count	2	8	10	
	% within OUTCOME1	20.0%	80.0%	100.0%	
Under correction	Count	26	4	30	
	% within OUTCOME1	86.7%	13.3%	100.0%	
overcorrection	Count	11	1	12	
	% within OUTCOME1	91.7%	8.3%	100.0%	
Total	Count	41	13	54	
	% within OUTCOME1	75.9%	24.1%	100.0%	

All eyes (5) with outcome of no correction were operated with PRK while for undercorrection all (8 eyes) were corrected with LASIK, and 3 eyes (60%) of those with overcorrection operated by LASIK and 2 eyes (40%) with PRK in those group with refractive error between 3.0-3.9 dioptres with statistically significant P= 0.001, as shown in table VI for group 3.0-3.9 dioptres.

Table VI: Distribution according to type of operation and outcome in those with refractive error = 3.0-3.9 dioptres

			top		Total	P
			LASIK	PRK		
OUTCOME1	No change	Count	0	5	5	0.001
		%within OUTCOME1	0.0%	100.0%	100%	
	Under correction	Count	8	0	8	
		%within OUTCOME1	100.0%	0.0%	100%	
	overcorrection	Count	3	2	5	
		%within OUTCOME1	60.0%	40.0%	100%	
Total		Count	11	7	18	
		%within OUTCOME1	61.1%	38.9%	100%	

Table VII show that all eyes (13 eyes) with no correction were corrected by LASIK, while 12 eyes (92.3%) with overcorrection were corrected by LASIK and 1 eye (7.7%) was corrected by PRK, with no statistically significant association was found in group 4.0-4.9 dioptres p=0.113.

Table VII: Distribution according to type of operation and outcome in those with refractive error = 4.0-4.9 dioptres

OUTCOME		top		Total	P
		LASIK	PRK		
emmetropia	Count	1	0	1	0.113
	% within OUTCOME1	100.0%	0.0%	100.0%	
No change	Count	0	1	1	
	% within OUTCOME1	0.0%	100.0%	100.0%	
Under correction	Count	13	0	13	
	% within OUTCOME1	100.0%	0.0%	100.0%	
overcorrection	Count	12	1	13	
	% within OUTCOME1	92.3%	7.7%	100.0%	
Total	Count	26	2	28	
	% within OUTCOME1	92.9%	7.1%	100.0%	

Table VIII show 11 eyes (84%) of those with undercorrection were operated by LASIK as well as 5 eyes (100%) of these with overcorrection with no statistically significant association was found in group =5.0-14.0 dioptres p=0.92.

Table (VIII): distribution according to type of operation and outcome in those with refractive error = 5.0-14.0 dioptres

OUTCOME		Top		Total	P
		LASIK	PRK		
Under correction	Count	11	2	13	0.92
	% within OUTCOME1	84.6%	15.4%	100.0%	
overcorrection	Count	5	0	5	
	% within OUTCOME1	100.0%	0.0%	100.0%	
Total	Count	16	2	18	
	% within OUTCOME1	88.9%	11.1%	100.0%	

Discussion

The revolution in using both LASIK and PRK to correct corneal refractive error need a careful assessment and evaluation especially for the long term outcome of these two procedures and the comparison between them. There are many benefits associated with both PRK and LASIK. Who could have predicted more than 20 years ago, when the first PRK was performed. Both PRK and LASIK have enabled millions of people with myopia or hyperopia to achieve spectacle independence, and both procedures share other characteristics such as low complication rates and predictable outcomes in the treatment of low refractive errors[2,7,9,12].

In this study we try to find if there is any differences in the outcome between the two procedures in correcting of astigmatism of varying degrees of refractive error after six months of follow-up.

All of our patients had their operation done by the same machine and same ophthalmological surgeon to avoid any bias in this study.

222 eyes (mean age±SD 29.41±7.2) with range from 19-45 years, which is the ideal age for doing corneal refractive surgery[5,8,13-15].

Seventy two eyes (46.8%) of those with LASIK correction were males compared to 82 eyes (53.2%) females, while in PRK 33 eyes (48.5%) were males and 35 eyes (51.5%) were females, with no statistically significant association; p= 0.46 and this is consistent with Jay H. Krachmer[16], Donald R. Sanders et al[17], Helen K. Wu. Refractive Surgery[18], Donald R. Sanders[19], L. Alió y Sanz et al[20] Miyai T et al[21], they found that threre is no significant statistical association in preference of type of operation regarding the gender.

No statistically significant association was found between outcome and type of operation in those with pre operative refractive error 0.25-0.9dioptre where P= 0.66, and this is consistent with Jorge L. Alió y Sanz et al[20], ARTHUR B. CUMMINGS et al[22], Richard A. Erdey[23], Thomas Kohnen et al[24], Brian S. Boxer Wachler et al[25], DAMIAN B. LAKE et al[26], Dr. Francis Priceet al[27] and Kyung-Sun Na et al[28], they found that both type of operations have the same outcome in correction of astigmatism of this refractive error after six months.

Statistically significant association was found between outcome and type of operation those with 1.0-1.9 dioptres p=0.023, many studies like Jorge L. Alió y Sanz et al[20], Miyai T et al[21], Richard A. Erdey[23], Thomas Kohnen et al[24], DAMIAN B. LAKE et al[26], Dr. Francis Price et al[27], Kyung-Sun Na et al[28] and Sadhana V et al[29] found that there is no significant statistically association was found between outcome and type of operation in those with preoperative refractive error 1.0-1.9dioptres.

In group 2.0-2.9 dioptres, all eyes with outcome of emmetropia are operated by LASIK, while 8 eyes (80%) with no correction postoperatively are operated by PRK, 26 eyes (86.7%) with undercorrection postoperatively were operated by LASIK, 11 eyes (91.7%) with overcorrection postoperatively are operated by LASIK, with statistically significant association P=0.0009, other studies like Jorge L. Alió y Sanz et al[20], ARTHUR B. CUMMINGS et al[22], Thomas Kohnen et al[24], Brian S. Boxer Wachler et al[25], DAMIAN B. LAKE et al[26], Dr. Francis Price et al[27] and Kyung-Sun Na et al[28] found there is no difference in outcome between the two types of operation after six months in correction of astigmatism of this range of refractive error.

In those patients with preoperative refractive error 3.0-3.9dioptres all eyes[5] with outcome of no correction were operated with PRK while for undercorrection all (8 eyes) were corrected with LASIK, and 3 eyes (60%)

of those with overcorrection operated by LASIK and 2 eyes (40%) with PRK with statistically significant P= 0.001, studies likeJorge L. Alió y Sanz et al[20], Miyai T et al[21], Thomas Kohnen et al[24], DAMIAN B. LAKE et al[26], Dr. Francis Price et al[27], Kyung-Sun Na et al[28] and Sadhana V et al[29] found that there is no statistically significant association was found between outcome and type of operation.

In group 4.0-4.9,all eyes (13 eyes) with no correction were operated by LASIK, while 12 eyes (92.3%) with overcorrection were corrected by LASIK and 1 eye (7.7%) was corrected by PRK, with no statistically significant association was found dioptres p=0.113, studies like Jorge L. Alió y Sanz et al[20], ARTHUR B. CUMMINGS et al[22], Thomas Kohnen et al[24], Brian S. Boxer Wachler et al[25], DAMIAN B. LAKE et al[26], Dr. Francis Price et al[27] and Kyung-Sun Na et al[28] found there is no differences in outcome between the two types of operation after six months in correction of astigmatism of this range of refractive error.

In group =5.0-14.0 dioptres,11 eyes (84%) of those with undercorrection were operated by LASIK as well as 5 eyes (100%) of these with overcorrection with no statistically significant association was found p=0.92,this is consistent with Jorge L. Alió y Sanz et al[20], ARTHUR B. CUMMINGS et al[22], Thomas Kohnen et al[24], Brian S. Boxer Wachler et al[25], DAMIAN B. LAKE et al[26], Dr. Francis Price et al[27] and Kyung-Sun Na et al[28], they found that both type of operations have the same outcome in correction of astigmatism of this refractive error after six months.

Conclusion

In conclusion, to our knowledge this is the first report of comparison in the outcome between LASIK and PRK after 6months in correction of astigmatism in Iraq. Our study showed no statistically significant difference after 6 months of correction of astigmatism wither by LASIK or PRK in different level of refractive error.

Recommendations

1. We recommend that even in the absence of difference in outcome in correction of astigmatism between LASIK and PRK after 6 months of operation care should be taken in the selection of patient to each type of operation.
2. We recommend for the next researches to increase sample size to get more accurate results.
3. We recommend for next researches to follow-up the patients for longer duration than six months to evaluate the long term differences between LASIK and PRK.

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