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Original research

The effect of eye dominancy on patients' cooperation and perceived pain during photorefractive keratectomy

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Abstract

Purpose: To find a possible association between patients' cooperation, perceived pain, and ocular dominance in patients who undergo photorefractive keratectomy (PRK).

Methods: One hundred-one eligible candidates for PRK refractive surgery were recruited. Preoperative exams were performed for all patients, and the dominant eye was specified. The surgeon was unaware about which eye was dominant. After surgery, the surgeon completed a cooperation score form for each patient. Ocular cyclotorsion, cooperation, and perceived pain scores were compared between the first-second eye surgeries and between dominant-non-dominant eyes surgeries.

Results: The dominant eye was the right eye in 68 patients and the left eye in 33 patients. First, eye surgery was performed on the dominant eye in 56 patients and on the non-dominant eye in 45 patients. Cooperation score and perceived pain were not significantly different between the first and second eye surgeries ($P = 0.902$ and $P = 0.223$, respectively), but cyclotorsion was more in the second eye ($P = 0.031$). Cooperation score, pain score, and cyclotorsion were not significantly different between dominant and non-dominant eye surgeries ($P = 0.538$, $P = 0.581$, and $P = 0.193$, respectively). Also, there was no correlation between cooperation score and duration of the surgery for the first or second eye ($P = 0.12$ and $P = 0.78$).

Conclusion: During PRK surgery, the patients' cooperation and perceived pain did not seem to be associated with eye laterality or dominancy.

Keywords: Patient's cooperation; Pain perception; Ocular dominance; Photorefractive keratectomy

Introduction

Elimination of refractive errors by performing selective refractive surgical procedures are becoming increasingly popular. Newer techniques and advanced surgical tools are introduced in order to improve surgical outcomes and patients' satisfaction.[1] Aberrometry guided devices and eye tracking systems have been introduced in order to correct higher order aberrations and technical errors during surgery. Beside incorporating highly qualified devices and flawless techniques, intraoperative patients' cooperation is a key factor for success of surgical procedures.[2] Intraoperative eye and head movements can happen because of ocular pain and stress, and it can occur in different ways when operating each eye. Researchers have shown that there is a dominancy in body organs, such as hands, eyes, and brain hemispheres, and pain perception can be influenced by lateral dominancy.[3,4]

Although there are controversies, studies have shown a relationship between hand laterality, gender, and pain perception.[4–7] Intraoperative pain perception has a direct effect on patients' cooperation. To the best of our knowledge, this is the first study aimed to assess the relationship between

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eye dominancy, intraoperative cooperation, perceived pain, and ocular cyclotorsion in patients undergoing photorefractive keratectomy (PRK).

Methods

In this comparative case series, among candidates for PRK surgery, 101 eligible subjects were recruited and referred to refractive surgery center of Khatam Eye Hospital, Mashhad, Iran. The study adhered to the tenets of the Declaration of Helsinki, and the ethics was approved by the local ethical committee. Written ethical consent was obtained from all participants.

Participants aged between 20 and 47 years had no contraindications for refractive surgery, with no history of systemic or ophthalmic diseases and ocular surgeries. Patients underwent preoperative examinations consisting of uncorrected and best corrected visual acuity measurements, dry and cycloplegic refraction, topography, and Orbscan imaging. The dominant eye of each individual was identified by the sighting dominant eye test (hole formed by hands),[8] in which the patients were asked to extend their arms out in front of them and create a triangular opening between their thumbs and forefingers by placing their hands together at a 45-degree angle. With both eyes open, they centered this triangular opening on a distant object, such as a wall clock. Then they were asked to close their left eye. If the object stayed centered, their right eye (the one that was open) was considered their dominant eye. If the object was no longer framed by their hands, their left eye was their dominant eye. Intraoperative perceived pain was evaluated by Verbal Rating Scale (VRS),[9,10] in which pain severity is graded by patients, from 0 (no pain) to 4 (debilitating pain). The time point for pain recording was immediately after surgery.

For each patient, after determination of the dominant and non-dominant eye by a research team member, the first eye surgery (right or left eye) was randomly selected from a pocket. The surgeons were unaware about the dominant eye.

To our knowledge, there is not a cooperation grading system for refractive surgery. Intraoperative patients' cooperation for each eye was recorded by the surgeons from 1 (no cooperation) to 5 (full cooperation), based on a modified cooperation grading system which was originally used for phacoemulsification surgery (Table 1).[11,12] Factors such as patients' cooperation when epithelial removal, fixation maintenance during laser application, and number of intraoperative interruptions due to loss of fixation and reminders needed for re-fixation were considered for cooperation grading.

Table 1
Patient's cooperation grading system.

Description	score
Full cooperation	5
Need up to 2 intraoperative reminders	4
Need more than 2 intraoperative reminders	3
Need to change the eye position by joystick	2
Need to change the eye and head position manually	1

Surgeries were performed by two skilled refractive surgeons (A.E. and S.S.). One drop of Tetracaine 0.50% (Sina Daru Co, Iran) was instilled 5 min before the operation. Patients underwent PRK surgery by TENEO 317 (TECHNOLAS Perfect Vision, Bausch & Lomb Company, Germany), and corneal epithelium debridement was performed manually using the hockey knife, after it was exposed to 20% alcohol for 20 s. The two eyes were operated sequentially in a single session.

Data analysis was performed by SPSS statistical software for windows (Version 23, SPSS, Inc., Chicago IL). Normal distribution of data was assessed using Kolmogorov-Smirnov test. Paired *t*-test was applied for comparison between dominant and non-dominant eyes. Correlation between time of surgery, cooperation score, pain score, and ocular rotation was assessed using Pearson test. For all results, $P < 0.05$ was considered statistically significant.

Results

Of 101 participants who were eligible for the study, 28 (27.7%) were males, and 73 (72.3%) were females. Mean age ± standard deviation (SD) of the patients was 29.60 years ± 5.58 (20–47 years). In 68 patients (67.3%), the dominant eye was the right eye, and in 33 patients (32.7%), it was the left eye. In 56 subjects (55.4%), the first operated eye was the dominant eye, and in 45 subjects (44.6%), the first operated eye was the non-dominant one.

Women reported more perceived pain than men, but it was not significantly different (Table 2). During first eye surgery, cooperation score was more in women than men ($P = 0.036$), but cyclotorsion was not significantly different between genders (Table 2).

Table 2
Distribution of cooperation and pain score, cyclotorsion, and duration of surgery by sex.

Eye	Males	Females	*P*-value
Cooperation			
First	3.96 ± 0.92	4.32 ± 0.66	0.036
Second	4.25 ± 0.80	4.22 ± 0.80	0.863
Dominant	4.11 ± 0.92	4.30 ± 0.74	0.272
Non-dominant	4.10 ± 0.83	4.23 ± 0.74	0.461
Pain			
First	0.32 ± 0.47	0.36 ± 0.59	0.78
Second	0.39 ± 0.50	0.48 ± 0.63	0.513
Dominant	0.43 ± 0.50	0.43 ± 0.57	0.975
Non-dominant	0.28 ± 0.46	0.41 ± 0.64	0.348
Ocular cyclotorsion			
First	2.33 ± 2.03	2.52 ± 2.50	0.719
Second	2.97 ± 2.20	3.11 ± 2.47	0.783
Dominant	2.73 ± 2.37	2.53 ± 2.29	0.701
Non-dominant	2.57 ± 1.88	3.10 ± 2.76	0.334
Surgery duration (sec)			
First	7.50 ± 2.72	5.92 ± 2.53	0.194
Second	7.75 ± 3.28	5.93 ± 2.06	0.132
Dominant	7.50 ± 3.02	5.77 ± 2.04	0.133
Non-dominant	7.71 ± 3.01	6.08 ± 2.53	0.187

There was no significant correlation between age and cooperation score, pain score, and cyclotorsion ($P > 0.05$ for all).

Patients' cooperation score was not significantly different between the first eye and second eye surgeries ($P = 0.902$). However, ocular cyclotorsion was significantly higher when performing operation on the second eye in comparison with the first one (3.07 ± 2.39 vs. 2.46 ± 2.37, respectively, $P = 0.031$) (Table 3). Although it was not significantly different, perceived pain was higher during second eye surgery (0.45 ± 0.59 vs. 0.35 ± 0.55, for the second and the first eye, respectively, $P = 0.223$). Also, cooperation score and perceived pain were not significantly correlated for the first and second eye surgeries ($P = 0.883$ and $P = 0.912$, respectively).

When comparing dominant eye versus non-dominant eye surgeries, the cooperation score, pain score, and ocular cyclotorsion were not significantly different between the two eyes ($P = 0.538$, $P = 0.531$, and $P = 0.193$, respectively) (Table 4). However, ocular cyclotorsion was significantly higher when the second eye surgery was on the non-dominant eye ($P = 0.015$) (Table 5). Also, cooperation score and perceived pain were not significantly correlated ($P = 0.20$ and $P = 0.328$, in dominant and non-dominant eye, respectively).

The results showed no significant difference between the first and second eye surgical time (6.52 ± 2.65 vs. 6.62 ± 2.67, first and second eye, respectively; $P = 0.724$). In addition, there was no significant correlation between the time of the surgery and cooperation score of the first and second eye ($P = 0.12$ and $P = 0.78$, respectively). Surgery duration was not correlated with pain score of the first and second eye ($P = 0.14$ and $P = 0.924$, respectively). Also, there was no significant correlation between surgery duration and pain score in the dominant and non-dominant eye ($P = 0.555$ and $P = 0.603$, respectively).

Table 3
Mean ± standard deviation (SD) of cooperation score, perceived pain, and ocular cyclotorsion and surgery duration, in the first and second eye operations.

	First eye	Second eye	*P*-value
Cooperation	4.22 ± 0.76	4.23 ± 0.80	0.902
Pain	0.35 ± 0.55	0.45 ± 0.59	0.223
Ocular cyclotorsion	2.46 ± 2.37	3.07 ± 2.39	0.031
Surgery duration (sec)	6.52 ± 2.65	6.62 ± 2.67	0.724

Table 4
Mean ± standard deviation (SD) of cooperation score, perceived pain, and ocular cyclotorsion and surgery duration in the dominant and non-dominant eye surgeries.

	Dominant	Non-dominant	*P*-value
Cooperation	4.25 ± 0.79	4.20 ± 0.76	0.538
Pain	0.42 ± 0.55	0.38 ± 0.60	0.581
Ocular cyclotorsion	2.58 ± 2.30	2.95 ± 2.48	0.193
Surgery duration (sec)	6.43 ± 2.54	6.71 ± 2.78	0.284

Discussion

Today, refractive surgeries incorporate accurate tools and modern techniques, aiming to provide perfect vision for patients. No matter how capable the devices are, patients' cooperation is a key factor for the final success. Since refractive surgeries are performed under topical anesthesia, the patients are aware of what happens in the operating room, and their cooperation may be influenced by stress, pain, and the atmosphere of the surgery room. Also, their reactions can be affected by the eye laterality or dominancy. To the best of our knowledge, for the first time, we evaluated the effect of ocular laterality on patients' cooperation, pain perception, and ocular rotation during PRK surgery. Also, we assessed these factors between the two genders. Pain perception in men and women has been investigated in previous studies, and the results are controversial. Vallerand[13] reported that women have a lower pain threshold than men, and they experience more pain severity. However, according to previous records, these gender differences do not occur during the neonatal period.[4] Many other factors such as anxiety, temporal summation, bio psychophysical factors, and depression may contribute to gender differences regarding pain perception, but their roles are still ambiguous.[14] In our study, although it was not markedly different, mean perceived pain in females was generally higher than males, regardless of the first or second eye surgery or the dominant or non-dominant eye surgery. However, our findings revealed higher cooperation scores for women than men.

We did not find similar studies on the relationship between right or left eye dominancy and perceived pain. Our findings showed that right and left dominant eyes were not significantly different, regarding reported cooperation score, perceived pain and cyclotorsion.

According to the results of the present study, patients' cooperation and perceived pain was not influenced by the eye dominancy. In other words, doing surgery on the dominant or

Table 5
Comparison of mean ± standard deviation (SD) of cooperation and pain score and ocular cyclotorsion and duration of the surgery, between the two eyes, when the first surgery was the dominant or non-dominant eyes.

	Dominant eye was the first eye (n = 56)			Non-dominant eye was the first eye (n = 45)		
	First eye	Second eye	*P*-value	First eye	Second eye	*P*-value
Cooperation	4.17 ± 0.81	4.14 ± 0.82	0.766	4.29 ± 0.67	4.36 ± 0.76	0.519
Pain	0.37 ± 0.67	0.41 ± 0.59	0.727	0.24 ± 0.53	0.51 ± 0.59	0.063
Ocular cyclotorsion	2.27 ± 2.09	3.11 ± 2.31	0.015	2.74 ± 2.72	2.89 ± 2.50	0.718
Surgery duration (sec)	6.75 ± 2.34	7.08 ± 2.54	0.394	6.22 ± 3.15	6.00 ± 2.87	0.559

non-dominant eye was unrelated to the patients' cooperation and pain perception. Also, although ocular cyclotorsion was higher when operating on the non-dominant eye, it was not significantly different between the two eyes. In their study, Aslankurt et al.,[11] compared the patients' cooperation and perceived pain when performing phacoemulsification on the dominant or non-dominant side. Their results showed that cataract surgery on the dominant side can be more painful, and the patients have less intraoperative cooperation. In Aslankurt's study, the dominant and non-dominant sides were selected from different patients, and the results can be affected by inter individual variation in cooperation.

El Rami et al.[9] compared the perceived pain during laser in situ keratomileusis (LASIK) between the first and second eyes. Their results showed that, with unclear reasons, patients perceived more pain during LASIK on the second eye, and patients' pain perception was directly related to their cooperation. In our study, pain scores were not correlated to cooperation scores. Since the PRK surgery duration is very short and intraoperative perceived pain is negligible, we expected higher levels of intraoperative cooperation than LASIK. However, it seems that the patients' experience during the first eye surgery can be effective on the perceived pain in the second eye. Therefore, for the first eye surgery, patients expect to experience pain and prepare for that. Since intraoperative perceived pain is subtle, patients' expectation for pain perception is decreased for the second eye, and they may perceive more pain. Similar to El Rami's results, reported perceived pain was more for the second eye surgery, and cyclotorsion was significantly higher, especially when the second eye was the non-dominant eye. Adatia et al.[15] compared patients' subjective experience during first and second eye cataract surgery. According to their findings, patients had more negative feelings during the second eye surgery. Ursea[16] justifies these results by the fact that patients' anxiety decreases before second eye surgery, and a subtle increase in pain perception happens. Although we did not find a significant difference in patients' cooperation and perceived pain during first and second eye PRK, ocular cyclotorsion was higher when operating on the second eye, whether the second eye was the dominant or non-dominant eye. Having pain in the first operated eye and patients' lower ability to maintain fixation or ocular fatigue can lead to higher cyclotorsion in the second eye. Although higher cyclotorsion in the second eye can be problematic when correcting astigmatism, our findings were not clinically significant.

In this study, we evaluated motor dominancy using a sighting test. Determination of ocular dominancy using a sensory dominancy test may result in different findings and can provide more information for similar studies. Inter subjects' variability in pain perception, level of stress, and the possible effect of different ranges of refractive errors and duration of surgery on cooperation and pain perception in larger populations may result in more reliable findings.

In summary, this study showed that the patients' cooperation and perceived pain is unrelated to eye dominancy and laterality during PRK. More studies should be performed in this field in order to confirm these findings.

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