



Original research

Excimer laser refractive surgery rate in Iran: 2010–2014

Hassan Hashemi ^{a,b}, Abbasali Yekta ^c, Marzieh Nojomi ^d, Saman Mohazzab-Torabi ^b,
Bardia Behnia ^e, Mehdi Khabazkhoob ^{f,*}

^a Noor Research Center for Ophthalmic Epidemiology, Noor Eye Hospital, Tehran, Iran

^b Noor Ophthalmology Research Center, Noor Eye Hospital, Tehran, Iran

^c Refractive Errors Research Center, Mashhad University of Medical Sciences, Mashhad, Iran

^d Faculty of Medicine, Iran University of Medical Sciences, Tehran, Iran

^e Faculty of Medicine, Tehran University of Medical Sciences, Tehran, Iran

^f Department of Medical Surgical Nursing, School of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Received 11 February 2017; revised 7 May 2017; accepted 14 May 2017

Available online 1 June 2017

Abstract

Purpose: To determine the rate of excimer laser refractive surgery in Iran and its trend during 2010–2014, and the number of surgeries per ophthalmologist.

Methods: Twelve provinces were considered for the study; 4 major referral provinces of Tehran, Fars, Isfahan, and Khorasan, and 8 others which were selected randomly. Then a number of excimer laser centers were chosen from each province. In the timeframe between 2010 and 2014, one week per season was randomly selected for each center, and the number of surgeries conducted in these 20 weeks was determined by trained personnel.

Results: In the 12 surveyed provinces, 28 of the 57 active surgical centers were selected. The rate of excimer laser refractive surgery in 2010 in Iran was 2764 per million population which reached 3744 per million by 2012 and took a slightly decreasing trend to 3582 until 2014. Based on the number of ophthalmologists and the number of surgeries in 2014, the average number of surgeries per ophthalmologist was 103 surgeries.

Conclusion: This is the first study to report the rate of excimer laser refractive surgery in Iran.

Copyright © 2017, Iranian Society of Ophthalmology. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Keywords: Laser refractive surgery; Iran; Trend; Ophthalmologist

Introduction

Visual impairment is one of the most important public health issues with a huge burden on communities. Based on recent reports by the World Health Organization, 285 million people around the world have a vision disorder, and 39 million

are blind.¹ Uncorrected refractive errors are responsible for 43% of the global visual impairment, followed by cataract which is accountable for 33% of this burden.¹ According to the report in 2010, 6.8 million people were blind, and 101.2 million were visually impaired due to refractive errors which points to a respective 7.9% and 15% increase since 1990.²

Refractive correction can be achieved with glasses, contact lenses, intraocular lens implantation, and laser refractive procedures. The method is chosen based on factors such as refractive status, socio-economic status, age, and corneal properties, and thus, certain methods may be contraindicated for certain cases.³ Glasses are the simplest method, but studies shows that a high percentage of people with refractive errors do not even have glasses.⁴

Conflict of interest: No conflicting relationship exists for any author.

Financial Support: This project was supported by Iran National Science Foundation.

* Corresponding author.

E-mail address: Khabazkhoob@yahoo.com (M. Khabazkhoob).

Peer review under responsibility of the Iranian Society of Ophthalmology.

<http://dx.doi.org/10.1016/j.joco.2017.05.006>

2452-2325/Copyright © 2017, Iranian Society of Ophthalmology. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Intraocular lens implants have been used as a method for refractive correction for years. The application of excimer laser began during the last two decades of the 20th century.⁵ In addition, these surgical methods come with advantages such as reduced hospitalization time after surgery and use of topical anesthetics which have made them a popular option for improving vision.^{6–9} Laser refractive surgery procedures correct the curvature of the cornea by ablating the surface of the cornea using excimer laser and changing the corneal shape depending on the type of refractive error.

There is little epidemiological information regarding these surgical procedures, and unlike cataract surgery, rates of excimer laser refractive surgery around the world are unknown. In light of the high prevalence of refractive errors and the high demand for these surgical options, knowledge of the rates and appropriate planning to provide necessary facilities can help reduce the global visual impairment caused by refractive errors.

The purpose of this study is to determine the rate of excimer laser refractive surgery in Iran and its trend during 2010–2014, and determine the number of excimer laser refractive surgeries per ophthalmologist.

Methods

The present study was conducted as a cross-sectional study in 2015 to review excimer laser refractive surgeries during 2010–2014 in Iran.

For this study, 4 provinces of Tehran, Fars, Isfahan, and Khorasan, which are known as referral centers for excimer laser refractive surgery in different parts of Iran, were selected non-randomly. In addition, 8 other provinces were randomly selected. For this purpose, all provinces where refractive surgery is available were listed in Excel software, and the 4 provinces of Tehran, Fars, Isfahan, and Khorasan were excluded from this list. The RANDBETWEEN command was run with the remaining provinces to choose a province, and this was repeated after excluding the selected province until sampling was complete. In the next step, a list of surgical centers in each city was compiled. For cities with more than one center, a number of centers were randomly selected in proportion to the population of the province using simple random sampling. Table 1 provides the number of excimer laser refractive surgery centers in the 12 selected provinces and the number of sampled centers. Once the centers were identified, data collection technicians were trained for two days. For each center, one week per season was randomly selected for the 5 year frame of this study. Therefore, data from 20 weeks from 2010 to 2014 was collected for each center, and the number excimer laser refractive surgeries performed during these weeks was recorded.

Statistical analysis

To determine the rate of excimer laser refractive surgery, first the number surgeries in all selected centers around the country was calculated because the numerator was a given

Table 1

Number of excimer laser refractive surgery centers and the number of sampled centers in the 12 surveyed provinces of this study.

Province name	Number of selected centers	Number of active centers	Sampling weight
West Azerbaijan	1	1	1
Isfahan	5	7	1.4
Khuzestan	1	3	3
East Azerbaijan	3	3	1
Tehran	8	24	3
Gilan	1	1	1
Sistan and Baluchistan	2	2	1
Fars	2	7	3.5
Qazvin	1	1	1
Qom	1	2	2
Kermanshah	1	1	1
Khorasan Razavi	2	5	2.5

event over a given time, and the denominator was the total population.

To calculate the total number of surgeries at the selected surgical centers in each year, given that 4 weeks were selected for each year, the number of surgeries counted in these 4 weeks was multiplied by 12.5 because 2 of the 52 weeks of the year are Norooz (Persian New Year) holidays when no surgeries are conducted. Then to determine the total number of surgeries in the country, the number of surgeries in each center was calculated based on the weight of each center in the province. The weights assigned to each center are provided in Table 1. To calculate weights, the number of active centers in each province was divided by the number of selected centers (Table 1). Finally, the national rate of excimer laser refractive surgeries was calculated by dividing the number of surgeries performed in the 12 selected provinces to the total population of these 12 provinces.

Ethical issues

The Ethics Committee of Iran National Science Foundation approved the study protocol, which was conducted in accord with the tenets of the Declaration of Helsinki.

Results

In the 12 surveyed provinces, 28 of the 57 active surgical centers were selected. Table 2 summarizes the number of excimer laser refractive surgeries, the population in the 12 studied provinces, and the surgical rate from 2010 to 2014. The surgical rate in 2010 was 2764 per million population which increased to 3744 per million population in 2012 and then showed a slight downward trend to 3582 per million in 2014. (The Cochran–Armitage test for trend: $P < 0.001$) Based on the total number of ophthalmologists and the number of surgeries in 2014, there was 103 surgeries per ophthalmologist during this year.

Discussion

Cataract and refractive errors are the leading causes of visual impairment and blindness globally, and treatment

Table 2
Number and rate of excimer laser refractive surgery in Iran from 2010 to 2014.

	2010	2011	2012	2013	2014
Number of excimer laser refractive surgery surgeries	131,856	169,940	182,925	181,038	178,990
Population (million)	47,701,000	45,599,204	48,853,000	49,407,000	49,968,000
Excimer laser refractive surgery rate*	2764	3727	3744	3664	3582
95% Confidence Interval/low	2749	3709	3727	3647	3566
95% Confidence Interval/high	2779	3745	3762	3681	3599

Excimer laser refractive surgery rate = (Number of excimer laser refractive surgery surgeries*1000,000)/Population (million).

*The Cochran–Armitage test for trend: $P < 0.001$.

methods for these two vision disorders have received increased attention during the past decade.¹⁰ Cataract surgical rates have been discussed in several reports previously, and two studies have examined cataract surgical rates in Iran.^{11,12}

This is the first study to examine the rate of excimer laser refractive surgery in Iran, and to the best of our knowledge, no similar study has been conducted in any other country either, although there are studies that show the status of these surgeries in certain countries. According to the latest report concerning the status of cataract surgery in Iran, the surgical rate ranges between 4 and 5 thousand surgeries per million population.¹¹ Of course this rate cannot be compared with laser refractive surgery rates because the two surgeries have different target groups, and cataract surgery is the only treatment method for the condition. Results of the present study can be helpful for health planners to assess the proportion of refractive errors being corrected using such surgical procedures and to allocate resources to regions lacking facilities.

Overall, the surgical rate in 2010 was 2764 per million population and 3582 per million in 2014. Based on the findings of our study, the number of excimer laser refractive surgeries in Iran increased from 131,856 in 2010 to 178,990 in 2014; however, the increase occurred between 2010 and 2012 and took a slightly downward slope afterwards. Compared to a report in the United States, the number of LASIK surgeries in 2011 was 11 million which is significantly higher than in our study.¹³

A study in China showed that about 950,000 eyes underwent laser refractive surgery in 2012, and they estimated a three-fold increase for the next 10 years. In other words, they estimated that by 2023, the number of surgeries would reach 2.89 million eyes per year.¹⁴

Lack of studies with a similar methodology makes it difficult to make a judgment regarding the status of refractive surgery in Iran. In addition, it should be noted that the distribution of refractive errors in each country, the age structure, and especially the economic status of populations can be very important factors in terms of the rate of excimer laser refractive surgery. The status of excimer laser refractive surgery in Iran can also be assessed from a different point of view in regard to the age group of the candidates and the distribution of refractive errors. According to previous studies,¹⁵ most people seeking excimer laser refractive surgery are in the age range of 20–50 years, although the 17–78 year age range has also been reported. Based on the latest census, approximately 51% of the Iranian population is in the 20–50 year age group.^{15–17}

By taking this percentage into account as the denominator, the rate of laser refractive surgery comes to about 7000 per million population. Previous studies in Iran indicate that at least 30% of the 20–50 year old population has refractive errors.^{18–20} The Tehran Eye Study found that 12–16% of 16–55-year-olds needed glasses.²¹ If we take the percentage in need of glasses as base, there are more than 3 million people in Iran who have this need, while the number of refractive surgeries is less than 200 thousand. Although refractive surgeries will cumulatively reduce the number of cases of refractive error, the numbers increase as teens and adolescents get older. Overall, comparison of these results show that about 7% of cases in need of refractive correction receive excimer laser refractive surgery, although it must be noted that surgery is contraindicated for a certain percentage of cases due to conditions such as corneal ectasia, but we know from previous studies that this percentage is not high. Nonetheless, results indicate that the demand for refractive surgery is very low in Iran compared to the existing number of cases with refractive errors, and at least 25% remain uncorrected in most age groups. It seems that the issue of surgical cost should not be ignored, and perhaps the most important reason for the low service uptake is the cost which is often not covered by insurance policies.

The present study has strengths and weaknesses that should be pointed out. Lack of sufficient information on the extent of use of refractive surgery in Iran and the world makes our study findings a valuable resource for estimates in Iran and even the Middle East. On the other hand, including the 4 non-random provinces is a limitation of the study. Given that these 4 provinces have high numbers of surgical centers where large volumes of patients receive surgery, excluding them from the study would have lead to serious underestimation, while we might have overestimated surgical rates in the current situation. It should be noted that refractive surgery is not available in certain provinces, and those seeking such services travel to nearby provinces.

In this report, we demonstrated, for the first time, the rate of excimer laser refractive surgery in a 5-year period from 2010 to 2014 in Iran. Given the large population of cases with refractive errors, and compared to other studies, the surgical rate does not seem to be sufficiently high. Further studies for identifying the determinants of the surgical rate and providing necessary facilities can be helpful towards reducing the burden in the long-term.

References

1. Pascolini D, Mariotti SP. Global estimates of visual impairment: 2010. *Br J Ophthalmol*. 2012;96(5):614–618.
2. Naidoo KS, Leasher J, Bourne RR, et al. Global vision impairment and blindness due to uncorrected refractive error, 1990–2010. *Optom Vis Sci*. 2016;93(3):227–234.
3. Murray A, Jones L, Milne A, Fraser C, Lourenço T, Burr J. *A Systematic Review of the Safety and Efficacy of Elective Photorefractive Surgery for the Correction of Refractive Error*. Review Body Report submitted to the Interventional Procedures Programme. National Institute for Health and Clinical Excellence; 2005.
4. Aldebasi Y. Young Public's awareness to refractive error deficiency. *Int J health Sci*. 2011;5(1):9–15.
5. Oladiwura D, Oki E, Stanford M. The evolution of corneal refractive surgery. *J Surg*. 2004;2(1):34–37.
6. Levenger S, Nemet P, Hirsh A, Kremer I, Nemet A. Refractive eye surgery in treating functional amblyopia in children. *Binocul Vis strabismus Q*. 2006;21(4):231–234.
7. Panday VA, Reilly CD. Refractive surgery in the United States air force. *Curr Opin Ophthalmol*. 2009;20(4):242–246.
8. Stanley PF, Tanzer DJ, Schallhorn SC. Laser refractive surgery in the United States Navy. *Curr Opin Ophthalmol*. 2008;19(4):321–324.
9. Yoon SC, Jung JW, Sohn HJ, Shyn KH. Cataract and refractive surgery in ; a survey of KSCRS members from 1995~2006. *Korean J Ophthalmol KJO*. 2009;23(3):142–147.
10. Bourne RR, Stevens GA, White RA, et al. Causes of vision loss worldwide, 1990–2010: a systematic analysis. *Lancet Glob health*. 2013;1(6):e339–e349.
11. Hashemi H, Fotouhi A, Rezvan F, et al. Cataract surgical rate in Iran: 2006 to 2010. *Optom Vis Sci*. 2014;91(11):1355–1359.
12. Hashemi H, Alipour F, Mehravaran S, Rezvan F, Fotouhi A, Alaedini F. Five year cataract surgical rate in Iran. *Optom Vis Sci*. 2009;86(7):890–894.
13. Corcoran KJ. Macroeconomic landscape of refractive surgery in the United States. *Curr Opin Ophthalmol*. 2015;26(4):249–254.
14. Kezirian G, Fatnani L, Opoku E, Lyons M. *Forecast of laser refractive surgery in china 2013-2023*. Kellogg northwestern school of management; 2013.
15. Torricelli AA, Bechara SJ, Wilson SE. Screening of refractive surgery candidates for LASIK and PRK. *Cornea*. 2014;33(10):1051–1055.
16. Gupta N, Naroo SA. Factors influencing patient choice of refractive surgery or contact lenses and choice of centre. *Contact Lens Anterior Eye J Br Contact Lens Assoc*. 2006;29(1):17–23.
17. Hashemi H, Khabazkhoob M, Pakzad R, Yekta A, Nojomi M, Nabovati P. The characteristics of excimer laser refractive surgery candidates. *Eye contact Lens*. 2017 Jan 17. <http://dx.doi.org/10.1097/ICL.0000000000000360> [Epub ahead of print].
18. Hashemi H, Fotouhi A, Mohammad K. The age- and gender-specific prevalences of refractive errors in Tehran: the Tehran Eye Study. *Ophthalmic Epidemiol*. 2004;11(3):213–225.
19. Ostadimoghaddam H, Fotouhi A, Hashemi H, et al. Prevalence of the refractive errors by age and gender: the Mashhad eye study of Iran. *Clin Exp Ophthalmol*. 2011;39(8):743–751.
20. Mousavi MN. The prevalence of refractive errors among iranian university student. *Iran J Ophthalmol*. 2014;26(3):1–7.
21. Fotouhi A, Hashemi H, Raissi B, Mohammad K. Uncorrected refractive errors and spectacle utilisation rate in Tehran: the unmet need. *Br J Ophthalmol*. 2006;90(5):534–537.