

# Comparison the post operative refractive errors in same size corneal transplantation through deep lamellar keratoplasty and penetrating keratoplasty methods after sutures removing in keratoconus patients

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## Abstract

**Background:** Corneal transplantation is a surgery in which cornea is replaced by a donated one and can be completely penetrating keratoplasty (PK) or included a part of cornea deep lamellar keratoplasty (DLK). Although the functional results are limited by some complications, it is considered as one of the most successful surgeries. This study aimed to compare the refractive errors after same size corneal transplantation through DLK and PK methods in keratoconus patients over 20 years.

**Materials and Methods:** This descriptive, analytical study was conducted in Feiz Hospital, Sadra and Persian Clinics of Isfahan in 2013–2014. In this study, 35 patients underwent corneal transplantation by PK and 35 patients by DLK, after removing the sutures, the patients were compared in terms of best corrected visual acuity (BCVA) and refractive errors. Data were analyzed using Chi-square and t Student tests by SPSS software.

**Results:** The BCVA mean in DLK and PK groups was  $6/10 \pm 2/10$  and  $5/10 \pm 2/10$ , respectively, with no significant difference ( $P = 0.4$ ). The results showed 9 cases of DLK and 6 cases of PK had normal ( $8/10 \leq$  BCVA) visual acuity (25.7% vs. 17.1%), 24 cases of DLK and 27 cases of PK had mild vision impairment (68.6% vs. 77.1%) and 2 cases of the DLK group and 2 cases of PK had moderate vision impairment, (5.7% vs. 5.7%), there was no significant difference in “BCVA” ( $P = 0.83$ ).

**Conclusions:** Both methods were acceptably effective in improving BCVA, but according to previous articles (5,9,10) the DLK method due to fewer complications and less risk of rejection was superior to another method and in the absence of any prohibition this method is recommended.

**Key words:** BCVA, corneal transplantation, deep lamellar keratoplasty, penetrating keratoplasty

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**Received:** 09.04.2014, **Accepted:** 10.08.2014

## INTRODUCTION

Blindness due to corneal problem including corneal infection, dystrophy and other pathologies is an important health issue around the world.<sup>[1]</sup> Corneal

transplantation has been developed rapidly in the past decades. Penetrating keratoplasty (PK) is a method which replaces all layers of corneal, while in

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**How to cite this article:** Razmjoo H, Ghoreishi SM, Ashtari A, Ghafouri I, Mamousi B. Comparison the post operative refractive errors in same size corneal transplantation through deep lamellar keratoplasty and penetrating keratoplasty methods after sutures removing in keratoconus patients. *Adv Biomed Res* 2016;5:39.

Access this article online	
Quick Response Code:	Website: <a href="http://www.advbiores.net">www.advbiores.net</a>
	DOI: 10.4103/2277-9175.178784

layer keratoplasty only a part of cornea is replaced and it is mostly used in disorders in which stromal layers of the cornea are involved.<sup>[2]</sup> Indications for corneal transplantation include the following cases: Optical eyesight improvement: The most common diseases that fall into this classification include Keratoconus, pseudophakic and Bullous keratopathy. Reconstruction: To preserve corneal anatomy and integrity in patients with corneal stromal thinning and descemetocele therapy: To reduce inflammation of the cornea that is resistant to treatment with antiviral and antibiotics. Cosmetic: To improve the appearance of corneal ulcers patients with white or opaque corneas.<sup>[3]</sup>

In PK method via using trephines a round area of corneal was isolated and with the help of another trephine the same size or a bit larger than that was isolated from the donor cornea then was placed and fixed by the help of suture in its place. In lamellar keratoplasty method, some parts of patients corneal are replaced with healthy tissue segments and safe segments remain intact and accordingly are divided into different categories.<sup>[4]</sup> The advantages of this method are maintaining own tissue and reducing the risk of rejection. Its disadvantages include the technical problems that the layer with thickness of 500 microns should be placed in location and vision problems are more than replacing the entire cornea. The subgroups of this method include deep anterior lamellar keratoplasty and endothelial keratoplasty which in first method, the anterior layers of the cornea is replaced with donor tissue and endothelium and Descemet's membrane cells stay in their own places. This method is used in cases which the anterior layer of cornea is being infected with opacities and scarring and diseases such as keratoconus. In the second method the endothelium layer would be replaced with posterior stroma, Descemet's stripping endothelial keratoplasty (DSEK) or Descemet membrane endothelial keratoplasty (DMEK).<sup>[5,6]</sup>

The risks of corneal transplantation are similar to the eye surgeries; in addition, not well-placed transplant layer as well as infection exists, since the cornea does not have any feeding vessel, so the recovery rate is lower than other parts of the body and within this period, there exists the possibility of being infected with various microorganisms which can be reduced by the use of antibiotic eye drops.<sup>[7]</sup> Although many studies have been done on comparing different techniques of corneal transplantation,<sup>[8-11]</sup> but despite the fact that this surgery is being performed through the mentioned methods in Iran, until now a comprehensive study has not been done on comparing these two methods. Thus, the present study was carried out to compare the postoperative refractive errors in same size corneal transplantation by DLK

and PK methods after removing the sutures in keratoconus patients over 20 years in Feiz hospital, Sadra and Persian clinics.

## MATERIALS AND METHODS

This descriptive-analytical study was conducted in Feiz hospital, Sadra and Persian clinics in 2013–2014. The population included keratoconus patients with the age higher than 20 years and had done corneal transplant by one of DLK and PK methods. Inclusion criteria included age of over 20 years, being affected by keratoconus, having corneal transplantation, agreeing to participate in the study, the absence of amblyopia in transplanted eye, the lack of any kind of damage such as trauma or infection in the eye. Also, patients who had a surgery to correct their refractive error (PRK, etc.) after corneal transplant surgery; patients who had still corneal suture at the study (at least after 6 months from the last cornea suture pulling patients could be enrolled in the study) and patients who had rejected the transplant were excluded from the study. All of the patients were operated by one surgeon and corneal graft suture was also similar (separate vs. continues).

The required sample size was estimated to be 33 for each group using the sample size estimation formula for the comparison of proportions with taking into account the 95% significance level, 80% test power, 0.5 the incidence of post-transplant complications due to the lack of an internal investigation and the least significant difference between the two methods was considered as 30%, but in order to ensure high reliability 35 patients in each group were studied. Procedure was as follows, first of all the records of patients who had cornea transplantation in this center from 2006 to 2013 were investigated and the patients who met the inclusion criteria were recalled; examinations were performed with a slit lamp and patient with exclusion criteria were excluded from the study then automatic refractometry and “best corrected visual acuity” measure were performed.

The surgery type (DLK, PK) was specified for the patients and it was registered along with demographic data and also the results of auto refractometer and BCVA in a special questionnaire which was designed for this purpose. The sphere equivalent of patient was calculated and recorded via (Sphere + astigmat/2) equation. Table 1 shows the severity of visual and refractive outcomes, including myopia, hyperopia and astigmatism were determined as follows based on literature studies.<sup>[12-16]</sup> Finally, the obtained data were analyzed by SPSS version 22 using *t*-test and Chi-square test.

**Table 1: The severity of visual and refractive outcomes based on literature studies**

	Visual acuity	Myopia	Hyperopia	Astigmatism
Normal vision	8/10≤ VA	Mild ≤ -3.0	Mild ≤ +2.0	Mild ≤ -1.0
Mild vision impairment	3/10≤ VA <8/10	Moderate -3.01 to -6	Moderate +2.01 to +4	Moderate -1.01 to -2
Moderate vision impairment	1/10≤ VA <3/10	Sever -6.01 to -9	Sever +4.01 to +6	Sever -2.01 to -3
Severe vision impairment	VA <1/10	Extreme ≥9.01	Extreme ≥ +6.01	Extreme ≥ -3.01

VA: Visual acuity

**Table 2: Distribution of demographic variables between the two groups**

Variable	Group level	DLK	PK	P value
Age	Year	1.29±7.6	6.30±8.5	0.31
Sex	Male	22 (%9.62)	22 (%9.62)	1
	Female	13 (%1.37)	13 (%1.37)	
Operated eye	Right	13 (%1.37)	20 (%1.57)	0.09
	Left	22 (%9.62)	15 (%9.42)	

DLK: Deep lamellar keratoplasty, PK: Penetrating keratoplasty

## RESULTS

In this research, 35 patients with DLK corneal transplant and 35 patients with PK were studied. The mean ages of the patients in DLK and PK groups were 29.1 ± 6.7 and 30.6 ± 5.8 years, respectively and based on *t*-test there was no significant different between these two groups (*P* = 0.31). The sex ratio (female/male) in both DKL and PK groups were 22.13 and 22.13 and based on the Chi-square test there was no significant difference in sex distribution between the two groups (*P* = 1). There were 13 patients in the DLK group and 20 patients in the PK group who had surgery on their right eye and the rest of them had surgery on their left eye which based on chi-square test the frequency of operated eye in these two groups was not significant (*P* = 0.09). The distribution of demographic variables between the two groups is shown in Table 2.

The mean of postoperative refraction degree in DLK and PK groups were -0.54 ± 3.9 and -1.07 ± 3.6, respectively and according to the *t*-test, the difference between these two groups was not significant (*P* = 0.49). The frequency of postoperative refractive errors of these two methods is shown in Table 3. According to this table in DLK and PK methods, 45.7% and 40% had myopia, respectively, and rest of them had hyperopia; one patient in the PK group had not spherical refractory error. According to the Chi-square test there was no significant difference between two groups (*P* = 0.63). The frequency percentage of refractive error type in two study groups are shown in Figure 1 which based on that the types of refractive errors in the two groups was almost identical. Fisher's exact test showed no significant difference between two groups (*P* = 0.7).

The mean degree of astigmatism in DLK and PK groups were -2.33 ± 0.73 and -2.79 ± 0.91,

respectively and based on *t*-test the difference between the two groups was significant (*P* = 0.021). According to the obtained results, 15 patients of the DLK group and 13 patients of the PK group had moderate astigmatism (42.9% vs. 37.1%) and of these two groups 20 and 22 people, respectively suffered from severe astigmatism (57.1% vs. 62.9%) and no patient with mild astigmatism was in any of the groups. The Chi-square test showed that there was no significant difference between frequency distribution of astigmatism severity in both groups (*P* = 0.63) [Figure 2]. The mean of BCVA in DLK and PK groups was respectively, 6/10 ± 2/10 and 5/10 ± 2/10, and no significant differences were observed between the two methods (*P* = 0.4). Also, based on these results, 9 patients of DLK group and 6 patients of PK group had normal BCVA (17.1% vs. 25.7%), 24 patients of DLK group and 27 patients of PK had mild vision impairment (68.6% vs. 77.1%) and 2 patients of DLK and 2 patients of the group PK had moderate vision impairment, respectively (5.7% vs. 5.7%) and based on Chi-square test, 'best corrected visual acuity' in both groups had no significant difference (*P* = 0.83) [Figure 3]. The variation process of three parameters of refraction degree, astigmatism degree and the best corrected 'best corrected visual acuity' of in patients under study has been shown in Figure 4.

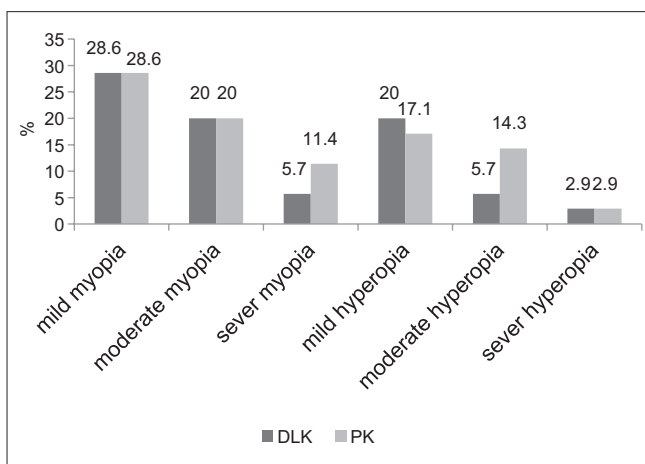
The mean of SE index in DLK and PK groups was respectively, -2.78 ± 4.19 and -3.86 ± 3.72, and based on *t*-test no significant differences were observed between the two methods (*P* = 0.26). The frequency distribution of refractive errors severity based on spherical equivalent in two study groups has been shown in Table 4. According to this table, SE index of 9 patients in DLK group and 8 patients in PK had mild myopia (22.9% vs. 25.7%). Also in these two groups, 10 and 12 patients had moderate myopia (34.3% vs. 28.6%), 5 and 6 patients suffered from severe myopia (17.1% vs. 14.3%) and 2 and 3 patients were suffering from very severe myopia (8.6% vs. 5.7%), respectively.

Hyperopia distribution in these two groups was in a way that one patient of DLK group and 3 patients of PK group had mild hyperopia (8.6% vs. 2.9%). Also, 7 and 3 patients respectively had moderate hyperopia (8.6%

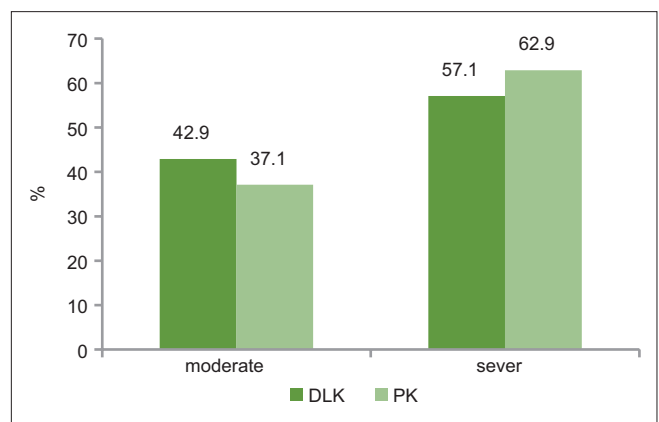
**Table 3: Frequency distribution of refractive errors in two groups**

Refractive error	Method Severity	DLK		PK		P
		Number	Percentage	Number	Percentage	
Myopia	Mild	10	6.28	10	6.28	0.62
	Moderate	7	20	7	20	
	Severe	2	5.7	4	4.11	
Hyperopia	Mild	8	20	6	1.17	
	Moderate	2	7.5	5	3.14	
	Severe	6	1.17	2	7.5	
Astigmat	Mild	0	0	0	0	0.83
	Moderate	15	9.42	13	1.37	
	Severe	20	1.57	22	9.62	
BCVA	Normal	9	7.25	6	1.17	0.83
	Mild vision impairment	24	6.68	27	1.77	
	Moderate vision impairment	2	7.5	2	7.5	

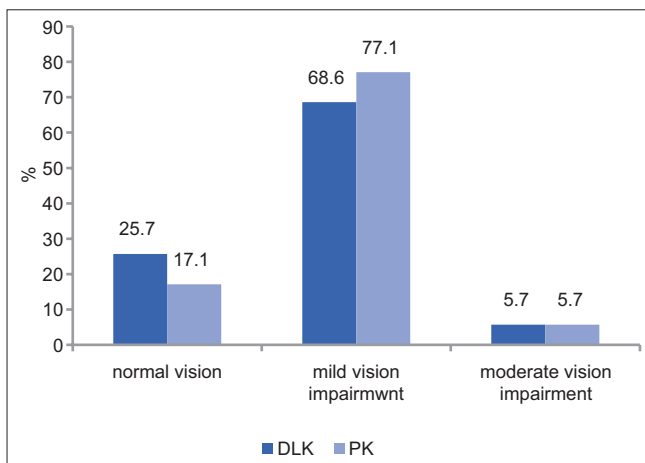
DLK: Deep lamellar keratoplasty, PK: Penetrating keratoplasty, BCVA: Best corrected visual acuity



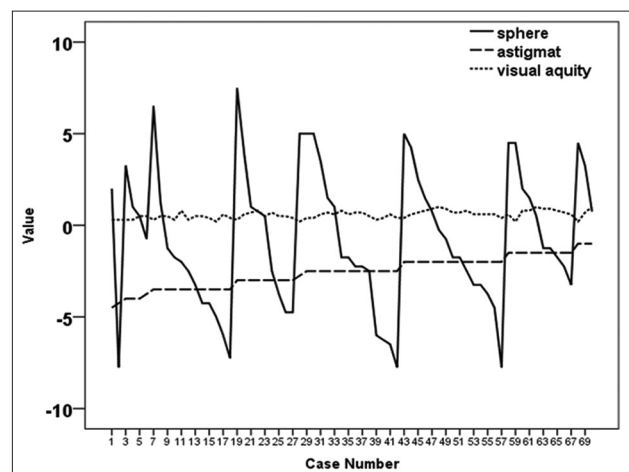
**Figure 1:** Frequency percentage of refractive errors' frequency in both groups.  $P = 0.71$



**Figure 2:** Frequency percentage of astigmatism severity in both groups.  $P = 0.71$



**Figure 3:** Frequency percentage of BCVA in both groups.  $P = 0.71$



**Figure 4:** Sphere, astigmatism and VA values in patients.  $P = 0.71$

vs. 20%) and finally one patient of the DLK group had severe hyperopia (2.9%). There was no patient with very severe hyperopia in any of the groups and in conducting Fisher exact test there was no significant difference between two groups ( $P = 0.71$ ).

## DISCUSSION

The aim of this study was to determine the effect of DLK and PK methods in correcting refractive errors of patients with keratoconus. In this study, two groups of 35 patients with keratoconus had corneal



**Table 4: Frequency distribution of refractive errors severity based on spherical equivalent in two groups**

SE	Method Severity	DLK	PK	Values	
		Number	Percentage	Number	Percentage
Myopia	Mild	9	25/7	8	22/9
	Moderate	10	28/6	12	34/3
	Severe	5	14/3	6	17/1
	Very severe	2	5/7	3	8/6
Hyperopia	Mild	1	2/9	3	8/6
	Moderate	7	20	3	8/6
	Severe	1	2/9	0	0
	Very severe	0	0	0	0

DLK: Deep lamellar keratoplasty, PK: Penetrating keratoplasty, SE: Spherical equivalent

transplantation with two mentioned methods. None of the patients had postoperative complications such as graft rejection or early complications e.g. infection in surgical site and glaucoma. The age and sex distribution of patients in two groups were similar and they didn't suffer from any underlying disease and the confounding effect of above factors in this study was banned through the exclusion condition from the study and the obtained results were most likely related to the type of method used.

According to the obtained results of this study, the severity of postoperative refractive errors between two groups was the same, but according to *t*-test the mean degree of astigmatism was different in the patients of both groups as it was in Funnell *et al.* study, in which the severity of astigmatism in DLK method was less than PK.<sup>[9]</sup> According to the results of our study, the postoperative BCVA between two groups was not different; however, the patients with DLK had better BCVA than the ones who had the surgery with PK.

In a similar study conducted in 2011 by the Razmjoo *et al.* in Isfahan University of Medical Sciences, two groups of 15 patients with keratoconus had corneal transplant with these two methods, in which there was no significant difference between astigmatism severity and improved refractive errors in the mentioned methods.<sup>[10]</sup>

Yong-ming *et al.* studied 75 eyes of 64 patients who had received Deep Anterior Lamellar Keratoplasty (DALK) and 52 eyes of 51 patients who had received PK. In this study, the BCVA of 0.5 or better was achieved in 90.7% after DALK and in 92.3% after PK and DLK was introduced as a healthier ways for the corneal transplant.<sup>[5]</sup> William *et al.* studied 982 keratoconus patients (481with DLK and 501with PK), BCVA between two groups were not significant, also there was no significant difference in postoperative Sphero Equivalent Refraction and astigmatism.<sup>[6]</sup> Khalidmahmood *et al.* studied 67 keratoplasty patients

with corneal transplant of DLK, in which postoperative BCVA was between 6.12 and 6.6 in 34 eyes, 6.18 and 6.24 in 19 eyes and 6.36 nad 6.60 in 7 eyes.<sup>[7]</sup>

In Touzeau's study which was conducted in Australia 70 patients with keratoconus had gone under corneal transplant operation with PK, the postoperative BCVA in 43% of transplant recipients was at 6.12 and above and in 52% was at 6.18 and above and in 20% was less than 6.60.<sup>[8]</sup> Also, in Watson *et al.* study on 47 patients with keratoconus (25 patients with DLK and 22 patients with PK) BCVA at the DLK group was 6.9 and in the PK group was 6.6 and there was no significant difference between two groups.<sup>[11]</sup>

## CONCLUSION

Thus, considering the above-mentioned results, the "best corrected visual acuity" (BCVA) of patients after surgery in both groups was similar, but DLK method is better due to preserving the whole endothelial tissue which has essential role in preventing the rejection of graft preserved. On the other hand, the incidence of other postoperative complications is also less in DLK method.<sup>[17,18]</sup> Therefore, the overall conclusion that can be derived from this study is that both methods are effectively acceptable in improving BCVA but according to previous articles (5,9,10) DLK method because of fewer complications and lower risk of graft rejection is superior to the PK and in the absence of any prohibition this method is recommended for the patient.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

## REFERENCES

- Zare M, Javadi MA, Einollahi B, Karimian F, Rafie AR, Feizi S, *et al.* Changing indications and surgical techniques for corneal transplantation between 2004 and 2009 at a tertiary referral center. *Middle East Afr J Ophthalmol* 2012;19:323-9.
- Barclay L, Lie D. Recent advances in corneal transplantation reviewed. *Medscape Education Clinical Briefs*. Available at: <http://www.medscape.org/viewarticle/764456>. [Last accessed on 2013 May 24].
- Oh BL, Kim MK, Wee WR. Comparison of clinical outcomes of same-size grafting between deep anterior lamellar keratoplasty and penetrating keratoplasty for keratoconus. *Korean J Ophthalmol*. 2013;27:322-30.
- Kang PC, Klintworth GK, Kim T, Carlson AN, Adelman R, Stinnett S, *et al.* Trends in the indications for penetrating keratoplasty, 1980-2001. *Cornea* 2005;24:801-3.
- Zhang YM, WU SQ, Yao YF. Long-term comparison of full-bed deep anterior lamellar keratoplasty and penetrating keratoplasty in treating keratoconus. *J Zhejiang Univ Sci B* 2013;14:438-50.
- Reinhart WJ, Musch DC, Jacobs DS, Lee WB, Kaufman SC, Shtein RM. Deep anterior lamellar keratoplasty as an alternative to penetrating

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- keratoplasty a report by the american academy of ophthalmology. *Ophthalmology* 2011;118:1432-1457.
7. Mahmood K, Tariqu Khan M, Iqbal Chaudary W, Sahi AS, Aqil Qazi ZU. Visual outcome after deep lamellar keratoplasty in keratoconus. *Pak J Ophthalmol* 2010;26:210-5.
  8. Touzeau O, Borderie VM, Allouch C, Scheer S, Laroche L. Effects of penetrating keratoplasty suture removal on corneal topography and refraction. *Cornea* 1999;18:638-44.
  9. Funnell CL, Ball J, Noble BA. Comparative cohort study of the outcomes of deep lamellar keratoplasty and penetrating keratoplasty for keratoconus. *Eye (Lond)* 2006;20:527-32.
  10. Razmjoo H, Shams M, Abtahi MA, Abtah SH. Comparison of deep lamellar keratoplasty and penetrating keratoplasty in patients with keratoconus: A clinical trial study. *J Isfahan Med* 2011;29:798-802.
  11. Watson SL, Ramsay A, Dart JK, Bunce C, Craig E. Comparison of deep lamellar keratoplasty and penetrating keratoplasty in patients with keratoconus. *Ophthalmology* 2004;111:1676-82.
  12. Haddad MA, Sampaio MW, Oltrogge EW, Kara-José N, Betinjane AJ. Visual impairment secondary to congenital glaucoma in children: Visual responses, optical correction and use of low vision AIDS. *Clinics (Sao Paulo)* 2009;64:725-30.
  13. Colenbrander A. Visual standards, aspects and ranges of vision loss with emphasis on population surveys. San Francisco: International Council of Ophthalmology; 2002. p. 22.
  14. Beitman Laser Eye Institute, Understanding Refractive Disorders. Available from: <http://www.beitman.com/lasik.htm>. [Last accessed on 24 Mar 2014].
  15. Manhattan Lasik Surgery. Types of vision problems. Available from: <http://manhattanlasiksurgeons.com/services/manhattan-lasik-surgeon>. [Last accessed on 04 Feb 2014].
  16. Stuart R. Myopia, Astigmatism and Hyperopia. Available from: [http://www.seewinthrop.com/pages\\_tech/refr\\_errors.html](http://www.seewinthrop.com/pages_tech/refr_errors.html). [Last accessed on 18 Jun 2014].
  17. Anwar M, Teichmann KD. Deep lamellar keratoplasty: Surgical techniques for anterior lamellar keratoplasty with and without baring of Descemet's membrane. *Cornea* 2002;21:374-83.
  18. Han DC, Mehta JS, Por YM, Htoon HM, Tan DT. Comparison of outcomes of lamellar keratoplasty and penetrating keratoplasty in keratoconus. *Am J Ophthalmol* 2009;148:744-51.