

Outcomes of Deep Lamellar Keratoplasty by Big Bubble Method with using Shifting Bubble Sign in Patients with Keratoconus or Corneal Opacity

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Abstract

Purpose: To investigate the results of deep lamellar keratoplasty (DLK) by big bubble method with using shifting bubble sign in patients suffering from keratoconus or corneal opacity

Methods: In this prospective interventional clinical trial, 20 eyes of 18 patients (10 males and 8 females) who underwent DLK by big bubble method using shifting bubble sign were investigated. Mean age of cases were 26.94 years old (19 to 66 years). Keratoplasty was done as a treatment of keratoconus in 18 cases (90%) and corneal opacity due to trachoma in 2 cases (10%).

Results: In this study, 20 eyes of 18 patients who underwent DLK by big bubble method using shifting bubble sign were investigated. Best corrected visual acuity (BCVA) of 14 cases (70%) were equal or lower than $20/200$ and in 6 cases (30%) were between $20/200$ and $20/50$. Mean uncorrected visual acuity of all cases in the first, third, sixth and twelfth months of follow-ups were $20/160$, $20/120$, $20/120$ and $20/80$ respectively. Mean of BCVA of cases after one year was $20/35$ ($20/20$ to $20/120$). Micro perforation occurred in 3 cases (15%) during the procedure, but DLK were not converted to penetrating keratoplasty (PK) in any of the cases. Vascularization and corneal opacity was occurred in 2 cases (10%) at the junction of donor and recipient cornea.

Conclusion: DLK by big bubble method is an effective way to treat the keratoconus or corneal opacity and using shifting bubble sign will confirm formation of the big bubble. The results of this study are comparable with similar previous studies on the same subject.

Keywords: Deep Lamellar Keratoplasty, Big Bubble, Shifting Bubble Sign

Iranian Journal of Ophthalmology 2009;21(2):41-45 © 2009 by the Iranian Society of Ophthalmology

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Received: June 28, 2008

Accepted: December 25, 2008

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Introduction

Deep lamellar keratoplasty (DLK) can be done whenever recipient has a normal and healthy endothelium and descemet membrane has the ability to restore corneal clarity after the keratoplasty.¹⁻⁴

In deep anterior lamellar keratoplasty (DALK), external layers of the cornea are completely removed while descemet membrane and the endothelium is remain untouched and normal.^{1,2}

Keeping the corneal endothelial cells untouched by the above method will prevent endothelial rejection, one of the most important side effects of penetrating keratoplasty (PK) mainly done by endothelium antigens. It also increases graft survival, since no endothelial cell is lost.^{1,2} In addition other complications such as endophthalmitis, choroidal hemorrhage, cataract and glaucoma will be prevented by DLK.^{1,2,5,6}

Different methods such as using air, liquid, microkeratome and excimer laser are suggested to separate the anterior stromal layers from the descemet membrane with different outcomes.^{2,11}

Big bubble method was performed by Anwar and Teichaman in 2002 to separate the anterior stromal layers. Other studies have been done to estimate the success rate, complications and outcomes of this method.⁵⁻¹¹

This study is to investigate the results of DLK by big bubble method and using shifting bubble sign by injecting small air bubble into the anterior chamber to confirm big bubble formation.

Methods

This prospective interventional clinical trial was performed during 12 months (March 2005 to March 2006) enrolling 20 eyes of 18 patients (10 males and 8 females). All patients who were admitted in ophthalmology clinic of Rassoul-Akram hospital. They had moderate to severe keratoconus without noticeable corneal scar in which the visual acuity could not be corrected completely or hard contact lens was not tolerable. Also, we enrolled those who had corneal opacities due to trachoma but their descemet and endothelium were normal.

Complete ocular examinations such as corrected and uncorrected vision evaluation

by using E-chart, slit-lamp examination, applanation tonometry, fundoscopy and lacrimal system check up were done for all cases by the anterior segment fellowships. All data were recorded.

The patients with history of previous ocular surgery, glaucoma, deep corneal scar, Fuch's dystrophy, dry eye, ocular trauma or retinal problems were excluded from the study.

The procedure was started under general anesthesia for all patients. After preparation and rinsing the eye, horizontal and vertical diameters of the cornea were distinguished and its center was marked; then about 312 μ m of corneal thickness was trephined by using Hessburg-Barron suction trephine size 7.75 or 8.

A paracentral dissection was done using a 15° knife and air was injected deeply in stroma using a 27 gauge needle attached to a 5 ml syringe to create the big bubble.

Anterior layers were removed carefully by a crescent knife, and then 0.2 ml air was injected into anterior chamber paracentrally; in which situation the air was located circumferentially in anterior chamber due to formation of the big bubble (Figure 1).

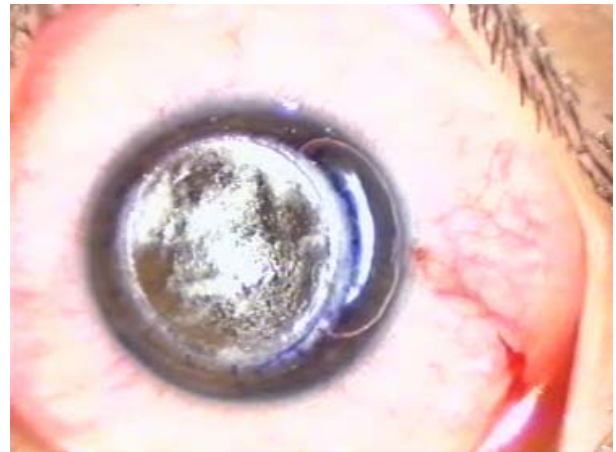


Figure 1. Air bubble located circumferentially in anterior chamber due to presence of the big bubble

A tiny hole was made at the middle of the big bubble by the 15° knife. As the air exited from the big bubble, the 0.2 ml injected air in the anterior chamber, shifted and centralized from the circumference confirming the big bubble formation (Figures 2 and 3).



Figure 2. Making a tiny hole at the middle of the big bubble by the 15° knife



Figure 3. Centralized air from the circumference after punctuation with 15° knife, confirms formation of the big bubble

The remained stroma was separated from the descemet by a thin spatula and cut from the cornea.

The donor cornea was punched by punch no. 8 or no. 8.25 (0.25 mm more than trephine) and located over the recipient corneal bed after removing its descemet and sutured by sixteen 10/0 nylon sutures to the recipient cornea. The eye was dressed at the end of the procedure.

On the first day postoperative, the eye was examined after removing the dressing. In case of any epithelial deficit, the dressing was continued until the complete epithelial repair occurred.

In cases that formation of pseudo chamber (space between the recipient descemet and donor stroma) resulted in sever stromal

edema, the patient was returned to theatre and 0.2 ml mixture of SF6 gas and the air (1/3 SF6 gas plus 2/3 air) was injected and the intraocular pressure (IOP) was being checked every 2 hours.

The follow-up visits were done at the end of 1st, 3rd, 6th and 12th months postoperation. Best uncorrected and corrected vision by obstacles, corneal clarity, IOP, keratometry and refraction were examined in each follow-up session and the results were recorded. All results were analyzed by computer using the SPSS (ver. 15).

Results

In this prospective interventional clinical trial, 20 eyes of 18 patients (10 males and 8 females) were enrolled. Mean age of cases was 26.94 years old (19 to 66). DLK indication was keratoconus in 18 eyes (90%) and corneal opacity in 2 remain cases (10%). Preoperative uncorrected vision was less than $20/200$ in 18 cases (90%) and between $20/200$ and $20/80$ in the other 2 cases (10%). Uncorrected vision more than $20/80$ was not found in any of the cases.

Preoperative best corrected vision of 14 cases (70%) was $20/200$ or less and in 6 cases (30%) it was between $20/200$ and $20/50$. Preoperative corrected vision more than $20/50$ was not detected in any of the cases.

Mean uncorrected vision after DLK and in 1st, 3rd and 6th month postoperative was $20/160$, $20/120$ and $20/120$ respectively and it was $20/80$ ($20/120$ to $20/20$) at the 12th month.

Mean postoperative best corrected vision at the 1st, 3rd and 6th month was $20/60$, $20/40$ and $20/50$ respectively. Vision of $20/40$ or better in 14 cases (70%) and $20/20$ in 3 cases (25%) were detected after the 12 months follow-up.

In 3 cases (25%) micro perforation was occurred during the suturing (in 1 case) and while the remained stroma was being separated from the descemet membrane by iris spatula (in 2 other cases). Since no or very low aqueous leakage was detected after occurring the micro perforation in all 3 cases above, the DLK procedure was continued without converting to PK and at the end of the procedure 0.2 ml air was injected paracentrally into the anterior chamber. One day after surgery the grafted had grade 3-4 edema in all 3 cases and pseudo chamber was formed between the descemet membrane

and the stroma. These 3 cases returned to theatre and 0.2 ml mixture of SF6 gas and air (1/3 SF6 and 2/3 air) was injected into the anterior chamber. Their IOP was measured every 2 hours during the first 24 hours after the injection. In one case of the complicated 3 cases, IOP was elevated to 50 mmHg. Since the pressure was not controlled by anti glaucoma medications, the patient was sent to theatre and 1.10 ml of his aqueous was extracted. In less than 5 days the gas was absorbed in all 3 cases and the cornea recovered its clarity by adhesion of the stroma. In other 17 remained cases (85%) the procedure was finished without any complications.

Depends on the topography and keratometry findings, the sutures were removed selectively and gradually and all sutures were removed after 12 months.

One to 3 loose sutures was detected in 4 eyes (20%) during the first 6 months postoperative. Resuturing was not done since no dehiscence in donor and recipient stroma was seen and there was not any noticeable topographic changes.

Epithelial and anterior stromal corneal opacity was occurred in 1 case on the third month postoperative in which clarity was recovered after starting the steroids based on diagnosis of stromal rejection.

Fibro-vascular tissue growth was seen between the contact surface of the donor and the recipient cornea in 2 cases (10%) after 6 months postoperative fed by a medium size vessel superiorly. Subconjunctival Avastin was injected two times at the entrance of the vessel to the cornea, resulted in regression of most fibro-vascular tissue, but it could not remove it completely. No endothelial rejection was seen in this study.

Discussion

With no endothelial rejection, lamellar keratoplasty (LK) has been usually considered by the ophthalmic surgeons; but because of technical complications and poorer visual results than PK, it is not performed routinely.¹

From 1980, developing of refractive surgery techniques have shifted attentions to LK again resulted in arising a method called DLK.¹⁰ Various techniques with various outcomes have been performed since then to

separate the anterior layers of stroma from the descemet membrane to reach better results.²⁻⁷

Amayem et al,³ reported functional success rate of %91.6 in performing DLK by BSS fluid injected into the 4 quadrants of the stroma after trephining; and separating of the stroma at the end.

In another study, Senoo et al⁴ used BSS fluid in a different technique with %91 success rate in which at first a stromal flap was prepared, then Hydrodelamination was performed by BSS and visco-elastic was injected into the pseudo chamber and trephine was done at the end. In their study micro perforation was occurred in %23 of cases of which %9 were underwent PK.⁴

Using big bubble method in performing DALK was suggested in 2002 by Anwar and Teicham for the first time.² In this method 60-80% of corneal thickness is trephined at first and then air is injected deep into the stroma by a 27-30 G needle attached to a 1-3 ml syringe forming the big bubble.

Following various studies performed to evaluate using big bubble method and measuring its success rate,⁶⁻¹⁰ Vaj Payes RB et al used this technique for 10 cases suffering from corneal opacity and reported 100% success rates⁶ without any complications.

Vincent et al⁷ compared the outcomes of using microkeratom with using big bubble method in performing DLK and reported better results was achieved by the big bubble method.

In the Michieletto et al study¹⁰ affecting factors in failure of the big bubble method was evaluated and revealed that very thin cornea is one of the factors resulted in failure of the DLK performed by the big bubble method.

In our study we used the big bubble method in addition to using shifting bubble sign to confirm the big bubble formation during the procedure. With the positive shifting bubble sign, the cornea can be punctured in middle of the bubble by a 15° knife, but if formation of the bubble is in doubt any intervention or puncturing the middle of the cornea can result in perforation and aqueous fluid leak in which performing PK instead of LK is inevitable.¹²

Francis et al has performed a similar study on 3 cases and called it small bubble.⁹

Our study was done on 20 cases with 100% success rates in performing DLK by the big bubble method. Micro perforation was occurred in 3 cases (15%) which is more than Anwar's et al study (9%)² but less than Michieletto's et al study in which the micro perforation was reported in 20% of the cases,¹⁰ but none of our procedures were converted to PK. The micro perforations and pseudo chamber formation were controlled by injecting a mixture of SF6 gas and air.

Another interesting matter which revealed from our study is, because of rapid absorption of the air, injecting only air into the anterior chamber due to micro perforations, is not effective and leads to pseudo chamber formation. So in case micro perforation occurred while continuing DLK is intended, combination of SF6 gas with air (1/3 SF6 gas with 2/3 air) is suggested to be injected to prevent sending the patient to theatre again and more costs.

Best corrected vision in our study was ²⁰/₄₀ or better in %70 of cases 12 months after the operation which is less than Vaj Pae RB's study (100%) because of senile cataract in 2 of our cases affected their vision.

Fibro-vascular tissue growth has not been reported in previous studies while it occurred in 2 cases (10%) in our study for whom subconjunctival Avastin was injected at the vascularisation site.

Corneal endothelial graft rejection was not detected in any cases of our study as well as previous studies.

Stromal rejection was suspected in one case who was cured with topical steroid administration.

Conclusion

Outcomes of our study in performing DLK by the big bubble method using shifting bubble sign are comparable with other studies. Utilizing the shifting bubble sign can confirm formation of the big bubble and supports the DLK procedure.

In case of occurrence of micro perforation and aqueous leak, while continuing of DLK procedure is intended, injecting a mixture of SF6 gas with air (1/3 SF6 gas with 2/3 air) into the anterior chamber can prevent formation of pseudo chamber.

References

1. A Caporossi, A Balestrazzi, C Simi, et al. Manual deep lamellar keratoplasty: alternative methods and air-guided technique. *Am J Ophthalmol* 2005;(37):2697-701.
2. Anwar M, Teichmann KD. Big-bubble technique to bare descemet's membrane in anterior lamellar keratoplasty. *J Cataract Refract Surg* 2008;(28):398-403.
3. Amayem AF, Anwar M. Fluid lamellar keratoplasty in keratoconus ophthalmology 2000;107:76-80.
4. T Senoo, K Chiba, O Terada, et al. Deep lamellar keratoplasty by deep paranchyma detachment from the corneal limbs. *Br J Ophthalmol* 2005;89:1597-600.
5. Fonata L, Parento G, Tassinari G. Clinical outcomes after deep anterior lamellar keratoplasty using the big-bubble technique in patients with keratoconus. *Am J Ophthalmol* 2007;143(1):117-24.
6. Vajpayee RB, Tyagi J, Sharman N, et al. Deep anterior lamellar keratoplasty by big bubble technique for treatment corneal stromal opacities. *Am J Ophthalmol* 2007;143(6):954-6.
7. Borderie VM, Werthel AL, Touzeau O, et al. Comparison of techniques used for removing the recipient stroma in anterior lamellar keratoplasty. *Arch Ophthalmol* 2008;126(1):31-7.
8. Danasoury A, Hashem A. Deep lamellar keratoplasty with baring of descemet membrane: The big bubble technique. *Tech Ophthalmol* 2007;5(2):56-62.
9. Francis W, Price Jr. Small bubble technique helps big bubble technique. *Br J Ophthalmol* 2007;91:1260-1.
10. Michieletto P, Balestrazzi A, Balestrazzi A, et al. Factors predicting unsuccessful big bubble. Deep lamellar anterior keratoplasty. *Ophthalmologica* 2006;220:379-82.
11. Funell CL, Ball J, Noble BA. Comparative cohort study of the outcomes of deep lamellar keratoplasty and penetrating keratoplasty for keratoconus. *Eye* 2006;20:527-32.
12. Foroutan AR, Dastjerdi MH. Shifting-bubble sign in big-bubble technique in deep anterior lamellar keratoplasty. *Cornea* 2007;26(1):117-8.