**Original Article**

# Post-Keratoplasty Glaucoma in Secondary Trans-Scleral Fixation of Posterior Chamber Intra-Ocular Lens Implant

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*Pak J Ophthalmol 2011, Vol. 27 No. 4*

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Resubmission of paper
August' 2011

Acceptance for publication
September' 2011

**Purpose:** Purpose of this study was to observe the incidence of post-keratoplasty glaucoma in secondary scleral fixation of IOL in patients of aphakia and pseudophakic bullous keratopathy (Group I). These patients were compared, with clinically matched patients, undergoing penetrating keratoplasty with posterior chamber IOL in the presence of capsular support (Group II).

**Material and Methods:** 25 consecutive patients of bullous keratopathy in aphakic eyes without capsular support or in pseudophakic eyes with AC IOLs were included in this prospective study. Penetrating keratoplasty was performed by suturing 0.25 mm larger donor corneal graft with interrupted 10/0 nylon monofilament sutures, after fixing the IOL to the sclera with 10/0 prolene suture. The statistical analysis was performed using Fisher's exact test and chi-square test 2x2 table. The finding was considered significant at P value < 0.05.

**Results:** The post-operative visual acuity, in the study population as whole, ranged from < 0.05 to 0.33 Snellen's fraction (i.e. hand movement to 6/18 Snellen's VA). A statistically significant improvement was noted (p-value < 0.05 using Fisher's exact test and chi-square analysis), when post-operative visual acuity was compared with pre-operative visual acuity in each group. However, comparing the study groups, there was no statistically significant difference in the post-operative visual acuity (p-value> 0.05).

The incidence of post-operative glaucoma was 32% incidence of glaucoma in group I was 40% (10/25 patients) and in group II was 24% (6/25 patients). The difference between the two groups in the post-operative incidence of glaucoma was statistically significant (p value<0.05). Comparing the difference between pre-operative and post-operative incidence of glaucoma, it was statistically significant within the group I (p value<0.05) as a whole (p value < 0.05).

**Conclusion:** While Trans-scleral fixation of posterior chamber intra-ocular lens has a place in eyes lacking capsular support it does lead to higher frequency of post-keratoplasty glaucoma.

Raised intra-ocular pressure, contributes to loss of corneal endothelial cells as well as to progressive optic nerve damage, and is a well known complication of penetrating keratoplasty. The incidence of post – keratoplasty glaucoma in aphakic eyes ranges from 42% to 89%[1-2]. Corneal edema and bullous keratopathy in aphakic and pseudophakic eyes continue to remain the leading indication of penetrating keratoplasty[3-7]. In eyes without capsular support, scleral fixation of posterior chamber IOL is

preferred because the posterior chamber IOL fixed to sclera are more physiological, is closer to nodal point of eye and acts as a barrier against the vitreous movements. Scleral fixation PC IOLs play a definitive role in preventing cystoids macular edema and graft endothelial damage[8-12]. In addition, the penetrating keratoplasty procedures combined with closed loop anterior chamber IOL failed in 60% of the patients in one study[13].

## PURPOSE

Purpose of this study was to observe the frequency of glaucoma (raised IOP) after scleral fixation and scleral fixation in patients with aphakic and pseudophakic corneal edema and bullous keratopathy (Group I). These patients were compared with clinically matched patients undergoing penetrating keratoplasty with posterior chamber IOL in the presence of capsular support (Group II).

## MATERIAL AND METHODS

25 consecutive patients of corneal oedema and bullous keratopathy in aphakic eyes without capsular support or in pseudophakic eyes with AC IOLs were included in this prospective study. A complete ophthalmic and medical history was taken, and ophthalmological examination, including recording of VA, measuring IOP with applanation tonometer, and B-scan were performed (Table 1-2).

In group I, after removal of oedematous corneal button, adequate anterior vitrectomy was performed removing the vitreous from the anterior chamber and from behind the iris. A posterior chamber IOL was fixed to sclera in an oblique plane, using 10/0 prolene suture with a small 8.0 mm needle, passed through the dilated pupil behind the iris emerging in an area of lamellar scleral flap 1.5 mm from the limbus and tied under the flap. Penetrating keratoplasty was completed by suturing 0.25 mm larger donor corneal graft with interrupted 10/0 nylon monofilament sutures.

In group II, after removal of edematous corneal button, extra capsular cataract extraction was performed and posterior chamber IOL was implanted either in the capsular bag or in the sulcus. Penetrating keratoplasty was completed by suturing 0.25 mm larger donor corneal button in a fashion similar to the group I.

Post-operatively, a combination of Tobramycin and Dexamethasone eye drops was prescribed, to be used 2 hourly for 2 weeks and 4 hourly for 2 months. Topical and oral anti-glaucoma medicines were added when required.

All patients were followed for at least six months, and the post-operative visual acuity and IOP were recorded and compared with pre-operative findings, not only within the group, but also with each other. The post-keratoplasty glaucoma was defined as IOP more than 21 mm Hg, when associated with non-inflammatory corneal graft edema and/or optic nerve damage. The characteristic visual field changes and the glaucomatous optic neuropathy may not be evident due to corneal edema and visual distortion related to higher astigmatism. The statistical analysis was performed using Fisher's exact test and chi-square test 2x2 table. The finding was considered significant at P value < 0.05.

## RESULTS

Group I: Twenty five eyes of 24 patients of aphakic or pseudophakic bullous keratopathy were studied. One patient had sequential bilateral surgery. The male patients were more than the females with a ratio of 3:1. Average age of patients was 45.4 years, with a range of 9 years to 68 years.

Group II: Twenty five eyes of 25 clinically matched patients undergoing penetrating keratoplasty with posterior chamber IOL in the presence of capsular support were included. The male patients were more than the females with a ratio of 2:1. Average age of patients was 58.8 years, with a range of 23 years to 86 years. Both groups of patients were studied and compared primarily in respect of pre-operative and post-operative visual acuity and incidence of post-operative glaucoma. The comparison, between the groups, was performed using Fisher's exact test and chi-square analysis. A finding was considered significance at P value< 0.05.

**The improvement in the visual acuity:** The pre-operative visual acuity in both the groups ranged from perception of light to finger counting at one meter distance. Comparing the study groups, there was no significant difference in the pre-operative visual acuity (p-value> 0.05).

The post-operative visual acuity, in the study population as a whole, ranged from < 0.05 to 0.33 Snellen's fraction (i.e. hand movement to 6/18 Snellen's VA). Comparing the study groups, there was no significant difference in the post-operative visual acuity (p-value> 0.05 (Table 3). However the

**Table 1:** (Group I)

| No | ID | Age/Sex | Eye | Visual Acuity | | IOP mmHg | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | Pre-op | Post-op | Pre-op | Post-op | |
| 1 | RAR | 57/M | R.E | FC | 6/12c | 12 | 16 | No Glaucoma |
| 2 | MK | 58/M | L.E | FC | 6/18c | 21* | 32* | Uncontrolled glaucoma Required Trab. MMC |
| 3 | MP | 26/M | L.E | HM | 6/18 | 22* | 21* | Controlled with topical R |
| 4 | AI | 25/M | L.E | HM | 6/18 | 20 | 39* | Uncontrolled glaucoma Required Trab. MMC |
| 5 | MA | 31/M | L.E | FC | 6/18c | 12 | 16 | No Glaucoma |
| 6 | HA | 68/M | R.E | HM | 6/36 | 13 | 14 | No Glaucoma |
| 7 | SM | 57/M | R.E | HM | 6/60 | 15 | 15 | No Glaucoma |
| 8 | JB | 56/F | L.E | PL | 3/60 | 18 | 23 | No Glaucoma |
| 9 | PA | 35/M | R.E | FC | 6/12c | 23* | 21* | Controlled with topical R |
| 10 | BB | 35/F | R.E | HM | 6/36 | 10 | 09 | No Glaucoma |
| 11 | FK | 23/M | L.E | HM | 6/18 | 18 | 23* | Controlled with topical R Ret.Det. 6 Month Post-op. |
| 12 | MR | 46/M | L.E | FC | 6/12c | 15 | 17 | No Glaucoma |
| 13 | H | 32/M | R.E | HM | 6/18 | 17 | 27* | Uncontrolled glaucoma Required Trab. MMC |
| 14 | RB | 57/F | L.E | PL | 3/60 | 24* | 14* | Controlled with topical R |
| 15 | BB | 35/F | L.E | HM | 6/60 | 14 | 16 | No Glaucoma |
| 16 | SM | 56/M | L.E | HM | 6/36 | 24 | 14* | Controlled with topical R |
| 17 | MS | 64/M | L.E | HM | 6/36 | 14 | 12 | No Glaucoma |
| 18 | UF | 32/M | L.E | FC | 6/60 | 23* | 28* | Uncontrolled glaucoma Required Trab. MMC |
| 19 | NI | 09/M | R.E | PL | 6/60 | 12 | 13 | Ret.Det. 2 Month Post-op. |
| 20 | BB | 57/F | R.E | HM | 6/36 | 15 | 14 | No Glaucoma |
| 21 | RB | 62/F | L.E | FC | 6/18 | 18* | 20* | Controlled with topical R |
| 22 | Q | 52/M | R.E | FC | 6/18 | 12 | 13 | No Glaucoma |
| 23 | IA | 42/M | L.E | FC | 6/36 | 20 | 21 | No glaucoma |
| 24 | NS | 55/M | L.E | HM | 6/36 | 15 | 14 | No Glaucoma |
| 25 | KD | 65/M | R.E | HM | 6/36 | 15 | 14 | No Glaucoma |

*Table 2:* ***(Group II)***

| Sr. N | ID | Age/Sex | Eye | Visual Acuity | | IOP mmHg | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | Pre-op | Post-op | Pre-op | Post-op | |
| 1 | AG | M/55 | L.E | HM | 6/36 | 21 | 17* | Post-op. Glaucoma-Controlled with topical R |
| 2 | JD | M/86 | R.E | FC | 6/24 | 18 | 16* | Post-op. Glaucoma-Controlled with topical R |
| 3 | AR | F/60 | L.E | 1/60 | 6/12 | 14 | 13 | No Glaucoma |
| 4 | MRA | M/70 | R.E | FC | 6/18 | 14 | 15 | No Glaucoma |
| 5 | M | F/65 | L.E | 1/60 | 6/24 | 20 | 17 | No Glaucoma |
| 6 | AR | F/60 | R.E | 1/60 | 6/18 | 16 | 17 | No Glaucoma |
| 7 | BD | M/65 | R.E | HM | 6/36 | 12 | 13 | No Glaucoma |
| 8 | MI | F/60 | L.E | HM | 6/24 | 14 | 16 | No Glaucoma |
| 9 | HA | M/56 | R.E | PL | 6/24 | 15 | 15 | No Glaucoma |
| 10 | MU | M/65 | R.E | PL | HM | 12 | 11 | No Glaucoma |
| 11 | MS | M/65 | R.E | CF | 6/36 | 15 | 17 | No Glaucoma |
| 12 | MNB | M/27 | R.E | 5/60 | 6/36 | 10 | 11 | No Glaucoma |
| 13 | RG | M/53 | L.E | 3/60 | 6/36 | 12 | 11 | No Glaucoma |
| 14 | RT | F/25 | R.E | 2/60 | 6/24 | 12 | 12 | No Glaucoma |
| 15 | GS | M/80 | L.E | CF | 6/36 | 15* | 16* | Pre-and Post-op. Glaucoma-Controlled with topical R |
| 16 | KZ | M/57 | L.E | 4/60 | 6/6p | 12 | 13 | No Glaucoma |
| 17 | MA | M/58 | L.E | HM | 6/18 | 13 | 13 | No Glaucoma |
| 18 | M | F/50 | L.E | FC | 6/12 | 12 | 13 | No Glaucoma |
| 19 | RB | 62/F | R.E | FC | 6/18 | 16* | 20* | Pre-and Post-op. Glaucoma-Controlled with topical R |
| 20 | MTB | 66/M | L.E | 1/60 | 6/9 | 14* | 16* | Pre-and Post-op. Glaucoma-Controlled with topical R |
| 21 | KY | 70/M | L.E | 1/60 | 6/9 | 13 | 12 | No Glaucoma |
| 22 | SN | 23/F | L.E | PL | 6/9 | 23* | 14* | Pre-and Post-op. Glaucoma-Controlled with topical R |
| 23 | MA | 55/M | L.E | FC | 6/24 | 14 | 15 | No Glaucoma |
| 24 | HB | 72/F | R.E | HM | 6/18 | 12 | 13 | No Glaucoma |
| 25 | RSA | 47/M | L.E | FC | 6/24 | 13 | 12 | No Glaucoma |

*IOP with topical anti-glaucoma therapy.

improvement in the visual acuity in each study group, was statistically significant (p-value< 0.05), when post-operative visual acuity compared with pre-operative visual acuity.

The incidence of post-keratoplasty glaucoma: (Table 4).

**Table 3:** Post-operative visual acuity

| Visual Acuity Snellen's Chart/ Snellen's fraction | Group I (N=25) (%) | Group II (N=25) (%) | Total (N=50) (%) |
|---|---|---|---|
| From 6/18 to 6/6 | 11/25 | 11/25 | 22/50 |
| From 6/18 to 6/60 | 12/25 | 13/25 | 25/50 |
| Less than 6/60 | 02/25 | 01/25 | 03/50 |

**Table 4:** Incidence of pre and post-operative elevated IOP

| Group | Incidence | |
|---|---|---|
| | Pre-operative Patients n (%) | Post-operative Patients n (%) |
| PKP with scleral fixation of IOL (Group I N=25) | 6/25 (24) | 10/25 (40) |
| PKP with ECCE with IOL in the bag /sulcus (Group II N=25) | 4/25 (16) | 6/25 (24) |
| Total | 10/50 (20) | 16/50 (32) |

The pre-operative frequency of glaucoma in group I, was 24% (i.e.6/25 patients) and in group II, was 16% (i.e.4/25 patients), the total frequency of glaucoma being 20%. The difference between the two groups in the pre-operative incidence of glaucoma was not statistically significant (p value>0.05).

The post-operative incidence of glaucoma in group I, was 40% (i.e.10/25 patients) and in group II, was 24% (i.e.6/25 patients), the total incidence of post-operative glaucoma being 32%. There difference between the two groups in the post-operative incidence of glaucoma was statistically significant (p value<0.05). Comparing the difference between pre-operative and post-operative incidence of glaucoma, it was statistically significant within the group I (p value<0.05), and as a whole (p value<0.05), but not within the group II (p value>0.05).

## DISCUSSION

Raised intra-ocular pressure contributes to loss of corneal endothelial cells as well as to progressive optic nerve damage and is a well known complication of penetrating keratoplasty. The incidence of post-keratoplasty glaucoma in aphakic eyes ranges from 42% to 89%[1-2]. The other risk factors for post-keratoplasty glaucoma are pre-existing glaucoma, previous graft, and incorrect surgical technique of keratoplasty. In this study pre-existing glaucoma (6/25 patients, 24%) in group I, contributed to the incidence of glaucoma. These patients had pre-operative AC IOL related gross angle distortion which causes secondary glaucoma and also increases the severity of bullous keratopathy. Post-operatively 4 additional patients developed glaucoma, in addition to the existing cases. Many investigators reported increased frequency of post-operative glaucoma after intra-capsular cataract extraction or after extracapsular cataract extraction with loss of posterior capsular support. Zimmerman and co-workers[14] postulated that the absence of crystalline lens and the zonules results in loss of support of the trabecular meshwork, resulting in raised IOP. The increased number of post-operative glaucoma, in patients undergoing vitrectomy and scleral fixation of IOL may be due the loss of support of trabecular meshwork, in addition to the factors related to the surgical procedure of keratoplasty like tight sutures, smaller or equal size of donor cornea etc.

Johnson et al[15] and Heidmann et al[16], in two separate series of patients undergoing combined penetrating keratoplasty with trans-scleral fixation of IOL for pseudophakic bullous keratopathy, reported a post-operative visual acuity of 20/40 or greater in 27% and 31% of eyes, with 11 to 13 months follow up, respectively. Clear grafts were noted in 89% to 93% of cases. Cystoid macular edema was seen in 31% and 36% of cases, which adversely affect the visual outcome.

**Table 5:** Incidence of post-keratoplasty elevated IOP: comparison with the reported studies

| | Richard C. Troutman and others | Lyle WA and Jin JC | T L Vander Shaft and others | Holland EJ and others | Present study |
|---|---|---|---|---|---|
| Incidence | 34% | 39% | 46% | 56% | 40% |

Troutman and co-workers[17] reported 34% (15 out of 44 patients) incidence of post operative glaucoma in a series of patients undergoing combined penetrating keratoplasty with trans-scleral fixation IOL. These required anti-glaucoma medications except two, who required filtration procedures.

Lyle and Jin[18] reported 39% incidence of post operative glaucoma in patients undergoing combined penetrating keratoplasty with IOL exchange for pseudophakic bullous keratopathy.

Similarly Shaft and co-workers[19] reported 46% incidence of post operative glaucoma in patients undergoing combined penetrating keratoplasty with exchange of original intra-ocular lens with a tripod posterior chamber IOL sutured to the iris for pseudophakic bullous keratopathy.

Holland et al[20] reported 30% (20 out of 66 patients) incidence of new onset of post operative glaucoma in patients undergoing combined penetrating keratoplasty with trans-scleral fixation IOL for pseudophakic bullous keratopathy, while 39 out of 105 patients had pre-op glaucoma. So the total incidence of post operative glaucoma reported in this study was 56% (59 out of 105 patients).

In the present study, the incidence of post-keratoplasty glaucoma is comparable with reported studies (Table 5). The variable incidence of post-operative glaucoma in the above mentioned reported studies and the present study as well, may be due to the fact that pre-operative factors responsible for the glaucoma may vary in different studies[22]. Per operative factors like varying surgical techniques by different surgeons or in-accurate surgical technique, like relatively smaller or equal size of donor cornealbutton[23] may also have played a role as well as post-operative factors, like inflammatory sequelae, suturing technique, and drug induced elevation of IOP may be responsible[23].

## CONCLUSION

Trans-scleral fixation of posterior chamber intra-ocular lens is suitable in cases lacking capsular support specially when combined with penetrating keratoplasty. In this study the frequency of the post-keratoplasty glaucoma in bullous keratoplathy is significantly higher in those patients who had undergone scleral fixation of IOL.

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