

## ARTICLE

# The Triple Procedure: Analysis of Structural, Functional & Refractive Outcome

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### ARTICLE INFO

#### Article history

Received: 1 June 2020

Accepted: 24 July 2020

Published Online: 30 July 2020

#### Keywords:

PCR

Viral keratitis

Diagnostic dilemma

### ABSTRACT

To analyse the outcome of Triple procedure(Combined penetrating keratoplasty, cataract extraction and intraocular lens implantation) is a surgical technique for visually disabling corneal conditions with associated cataract. **METHODS:** The medical records of 120 patients who underwent triple procedure between January 2007 and December 2011 in terms of demographic data, past ophthalmic history, indications for surgery were retrospectively reviewed. Salient preoperative data included the initial visual acuity at the time of presentation, slit lamp findings of cornea (scar, haze, vascularisation, stromal folds with bullae), anterior chamber, lens details, intraocular pressure status, posterior segment examination with the help of indirect ophthalmoscope or B scan ultrasonography. **RESULTS:** A total of 120 corneal triple procedures performed were included in this study. Of 120 patients, 25 (20.83%) were male and 95 (79.17%) were female. Mean age of these patients was 42.45 +/-15.85 years (range 9 to 75 years). The mean postoperative follow up was 15.08 +/-12.8 months (range, 1.5 to 49 months). Failed therapeutic grafts (42.5%) - was the common indication found for surgery. Preoperatively, intraocular pressure was increased in 11 (9.16%) patients. Conventional triple procedure in terms of combined penetrating keratoplasty with extracapsular cataract extraction with intraocular lens implantation (PK+ECCE+IOL) was performed in 114 (95%) eyes, 01 (0.83%) eye underwent keratoplasty with phacoemulsification with intraocular lens implantation (PK+PE+IOL), and secondary intraocular lens implantation (PK+IOL) in 05 (4.17%) eyes. **CONCLUSION:** Triple procedure is an effective surgical option in corneal diseases associated with cataract. It provides an optimal visual and refractive outcome especially in high risk grafts situation.

## 1. Introduction

**T**riple procedure(Combined penetrating keratoplasty, cataract extraction and intraocular lens implantation) is a surgical technique for visually disabling corneal conditions with associated cataract. First

described by Katzin and Meltzer in 1966. It offers immediate postoperative visual improvement and precludes the need of another major intraocular surgery for cataract in future that may jeopardize the corneal graft. It is generally indicated in patients with significant cataracts and corneal diseases contributing to vision loss.

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In our study, we analysed the structural, functional and refractive outcomes of triple procedure in terms of graft clarity, postoperative refraction and visual rehabilitation.

## 2. Methods

The medical records of 120 patients who underwent triple procedure between January 2007 and December 2011 in terms of demographic data, past ophthalmic history, indications for surgery were retrospectively reviewed. Salient preoperative data included the initial visual acuity at the time of presentation, slit lamp findings of cornea (scar, haze, vascularisation, stromal folds with bullae), anterior chamber, lens details, intraocular pressure status, posterior segment examination with the help of indirect ophthalmoscope or B scan ultrasonography. Peribulbar block (2% xylocaine, 0.5% bupivacaine) was the most common technique of anaesthesia. Pupil was dilated preoperatively with 0.5% -1% tropicamide and 5% phenylephrine. Super pinkie was applied for a period of 5-10 minutes to have a soft eye prior to surgery after anaesthesia. Donor corneal rims preserved in MC Carey -Kaufman medium were used. Size of donor corneal button oversized the host corneal button by 0.5mm in all cases. Size of donor corneal button ranged between 6-9.5 mm. Most common trephine size was 8.0 mm followed by 7.5 mm. After the excision of host corneal button, anterior capsulotomy was done. The nucleus was delivered by bimanual technique. The rest of the procedure was same as cataract extraction by extracapsular technique. For intraocular lens power calculation, preoperative standard keratometry readings were used as K1= 44.00D @180 and K2=44.00D@ 90 respectively. The axial length for each eye was determined preoperatively and Intraocular lens power calculation was done using Sanders-Retzlaff-Kraaff II formula, SRK-T formula in cases of high (>24mm) and low axial lengths (<20mm). As the intraocular lens was placed in the posterior chamber or in the sulcus, suturing of donor cornea was done with 16 interrupted sutures of 10 -0 nylon monofilament or with a combined 8 interrupted and single continuous 10-0 monofilament nylon suture in some cases. Postoperative medication regime included as topical steroids, topical antibiotics, lubricants, systemic steroids and anti glaucoma medications to all patients as applicable. Any additional procedure done during surgery, intraoperative, early and late postoperative complications were noted. Patients have been followed up in initial 2-3 weeks, 6 weeks (glass appointment), 3-6 months and then at 1 year. Suture removal depended upon the looseness of sutures and the amount of astigmatism. The final outcome was assessed in terms of graft clarity, final visual acuity, refraction at the last available visit. Clarity/Successful graft taken as clear

grafts with compact stroma and sharply visible anterior segment details.

## 3. Results

A total of 120 corneal triple procedures performed were included in this study. Of 120 patients, 25 (20.83%) were male and 95 (79.17%) were female. Mean age of these patients was 42.45 +/-15.85 years (range 9 to 75 years). The mean postoperative follow up was 15.08 +/-12.8 months (range, 1.5 to 49 months). Failed therapeutic grafts (42.5%) - was the common indication found for surgery. Preoperatively, intraocular pressure was increased in 11 (9.16%) patients. Conventional triple procedure in terms of combined penetrating keratoplasty with extracapsular cataract extraction with intraocular lens implantation (PK+ECCE+IOL) was performed in 114 (95%) eyes, 01 (0.83%) eye underwent keratoplasty with phacoemulsification with intraocular lens implantation (PK+PE+IOL), and secondary intraocular lens implantation (PK+IOL) in 05 (4.17%) eyes.

Various indications for procedure were listed as follows:

**Table 1.** Indications for Triple Procedure

S.no.	Indications	Frequency(n=120)
1	Regrafts	51 (42.5%)
2	Corneal scars	34 (28.33%)
3	Adherent leukomas	26 (21.67%)
4	Others	09 (7.5%)

### Others include:

S.no.		(n=9)
1	Fuchs dystrophy	05 (55.5%)
2	Keratoconus	01 (11.11%)
3	Chemical injury	02 (22.22%)
4	Buphthalmos	01 (11.11%)

**Table 2.** Type of Triple Procedure

S.no.	Type of surgery	Frequency(n=120)
1	PK +ECCE +IOL	114 (95%)
2	PK+PE+IOL	01 (0.83%)
3	PK+ IOL	05 (4.17%)

### 3.1 Visual and Anatomical Outcome

76 out of 120 (63.33 %) grafts were clear and 44 out of 120 (36.67%) grafts were failed. Out of which 12 eyes developed graft infection, 10 eyes had uncontrolled rise in intraocular pressure, 21 eyes had immunological rejection, 01 was primary graft failure. The initial (preoperative) visual acuity was perception of light /upto counting fingers 1 meter in maximum cases (99.16%), in 01 eye (indication -keratoconus) only preoperative visual acuity was 6/36

(logmar-0.778). Postoperative visual acuity in terms of Snellens chart noted as below.

**Table 3.** Visual acuity at last follow up

S.no.	Visual acuity	No.of eyes/patients
1	<1/60	42(34.2%)
2	1/60 to 5/60 (logmar=1.778to1.07)	11(9.2%)
3	6/60to 6/18 (logmar =1 to 0.477)	46(38.33%)
4	6/12 to 6/6 (logmar=0.30to 0)	21(18.33%)

Definite cause of decreased vision was noted in 10 patients, all these were clear grafts. 06 eyes were damaged due to glaucomatous optic atrophy, 02 eyes were amblyopic, 01 clear graft with scarred Choroidal neovascular membrane and 01 was a primary graft failure. Combined penetrating keratoplasty and cataract extraction was performed in 7(5.833%) eyes of monocular patients with a potential for visual recovery. The BCVA in these cases at presentation was CF 1 meter. Postoperatively, 06 patients had clear crafts with improvement in vision, 01 graft failed due to glaucomatous damage.

**Table 4.** Profile of failed grafts at last followup

S.no.	Primary indication for failed grafts	Frequency(n=44)
1	Regrafts	26(59%)
2	Adherent leucoma	06(13.6%)
3	Corneal scars	07(15.9%)
4	Others	05(11.36%)

Others include: buphthalmos=01, trauma=01, trachoma=01, fuchs dystrophy=01, chemical injury=01 Corneal scars=07 (viral=04)

**Table 5.** Causes of graft failure

S.no.	Causes	Frequency (n=44)
1	Graft infection	12(27.27%)
2	Rise in intraocular pressure	10(22.73%)
3	Immunological graft rejection	21(47.72%)
4	Primary graft failure	01(2.27%)

### 3.2 Refractive Details

Refractive details(in form of manifest refraction) were available in 73 patients. All post-operative refractions were transposed to negative cylinders for analysis. Mean spherical equivalent at available followup was 0.229+/-2.48D. 41% of all eyes had postop refractive errors (spherical equivalents)within +/-2.0D of emmetropia. Postoperative refraction was targeted towards emmetropia in 61.12%, and towards -1.0 D myopia in 38.94% cases. Mean keratometric cylinder was available for only 30 patients so extrapolation of data was not possible.

**Table 6.** Parameters

S.no.	Parameters	
1	Mean axial length	23.64+/-1.85mm
2	Mean intraocular lens power implanted	19.95 +/-4.71D
3	Mean spherical equivalent	0.229+/-2.48D
4	Mean refractive cylinder	-4.21+/-2.39D
5	Range of spherical equivalent	-6.50 to +6.0D
6	Range of refractive cylinder	-1.0D to -16.00D

### 3.3 Complications

Vitreous upthrust was seen in 05 (4.16%) eyes during surgery for which anterior vitrectomy was done. The common early postoperative complications included increased intraocular pressure in 22 (18.33%) eyes, increased AC reaction in 63 (52.5%) and wound leak in 03 (2.5%), managed with appropriate measures. Other complications noted as posterior capsular opacification in 18(15%) cases, managed well with Nd: YAG capsulotomy and persistent epithelial defect in 05 (4.16%) eyes, out of which 04 (80%) grafts failed due to secondary infection, 01 (20%) survived.

### 4. Discussion

Fuchs dystrophy was the most common indication for triple procedure in 31.3-77%<sup>[2]</sup> of patients. Corneal scarring (including adherent leukoma)-66.4%with associated cataract was the most common indication in other study<sup>[1]</sup>. In our study, therapeutic failed grafts (42.5%), followed by corneal scarring associated with cataract was found to be the most common indication(28.33%). The proportion of corneal scars is very less in our study and found to be statistically significant (Z test for proportion, p - value < 0.001)

Taylor<sup>[11]</sup> et al. reported 77%clear grafts and 57%with visual acuity 20/40 or better; Lee<sup>[12]</sup> and Dohlman reported 73%clear grafts and visual acuity 20/50 or better in 47%of their patients. Various other series have reported a graft clarity of 90-100%<sup>[4-6]</sup>. Sridhar etal found 72%grafts clear after a mean follow up of 23.7+/-17.6 months<sup>[1]</sup>. As compared to other reports, graft clarity rate was found to be 63.33% with a visual acuity of 20/40 or better in 18.33% eyes in our study at a mean follow of 15.08+/-12.8 months(range=1.5 to 49 months), probably because we encountered more of failed grafts (after infectious keratitis) as a major indication, which are in themselves high risk grafts and in which the surgical success is in any way is less compared to other indications.

Postoperative glaucoma as a major complication seen in 24% eyes in a series of 104 eyes, and endothelial rejection in 16.2% by Meyer etal (14); Sridhar etal reported secondary glaucoma in 13.5%, graft infiltrate in 5.8%, 18.3% secondary graft failures. In our study we had

Graft rejection as a major cause for secondary graft failure(47.72%), secondary glaucoma in 22.73%, graft infection in 27.27%.

Various Studies have shown that Intra ocular Lens power calculation with regression formulas in cataract surgery results in postoperative refractive errors within 2 diopters (D) of emmetropia in more than 90% of cases [8,9]. In contrast, when a cataract and corneal opacity coexist, regression formulas are not as accurate because the ultimate corneal curvature is less predictable [10].

Binder et al analysed in a study of 43 consecutive triple procedures, a mean refractive error of 1.79D and 70% of eyes achieved 20/40 or better corrected visual acuity,

48.8% achieved refractive errors within 2 diopters of emmetropia [6].

41% of our patients had refractive errors within +/-2.0 diopters of emmetropia, with 18.33% eyes achieved visual acuity of 20/40 or better with a mean spherical equivalent of 0.229+/-2.48D with a range of refractive error between -6.50 to 6.0D. Sridhar(1) et al studied 58.8% eyes within +/-2D of predicted refraction in 104 patients. Shimmura et al (15) studied 26-68% final refraction within +/-2.0D of target, with the range of refractive error between -14.7 to +8.0D.

**Table 7.** Previous studies related to triple procedure for comparison

S.no.	Study	Design	No. Of eyes	Mean follow up(months)	Eyes +/-2.0Dof target/emmetropia(%)	MSE (D)	Mean cylinder	BCVA./=6/12(%)	Graft survival (%)
1	Nguyen et al	Retro	499	12	47	1.20	4.16	61	97
2	Gruenauer et al	Retros	53	20.5	47	-2.06	-4.00		100
3	Pinneros et al	retro	93		42		3.90	65	
4	Present study	retro	120	15.08	41	0.229	-4.212	18.33	63.33
	P value			<0.001	0.0169	<0.001	0.334	<0.0001	<0.0001

Note:

One proportion Z test → Eyes +/-2.0Dof target/emmetropia, BCVA./=6/12 and Graft survival; One sample Z test → Mean follow up(months), MSE(D) and Mean cylinder

## 5. Conclusion

Triple procedure is an effective surgical option in corneal diseases associated with cataract. It provides an optimal visual and refractive outcome especially in high risk grafts situation.

## References

- [1] M.S Sridhar et al. Corneal Triple Procedure: Indications, Complications and Outcomes. A Developing country scenario. *Cornea*, 2000, 19(3): 333-5.
- [2] Pamel GJ, Taylor Dm. Combined procedures. In: Brightbill FS, ed. *Corneal surgery. Theory, technique and tissue*, 2nd edition. St Louis: Mosby, 1993: 177-83.
- [3] Hunkeler JD, Hyde LL. The triple procedure. Combined penetrating keratoplasty, extracapsular cataract extraction and lens implantation. An expanded experience. *Am Intraocular Implant Soc J* 1983, 9: 20-4.
- [4] Crawford GJ, Stulting RD, Waring GO 3d, Van Meter WS, Wilson LA. The triple procedure analysis of outcome, refraction, and intraocular lens power calculation. *Ophthalmology*, 1986, 93: 817-24.
- [5] Katz HR, Forster RK. Intraocular lens calculation in combined penetrating keratoplasty, cataract extraction and intraocular lens implantation. *Ophthalmology* 1985, 92: 1203-7.
- [6] Perry S. Binder. Intraocular lens powers used in the triple procedure. Effect on visual acuity and refractive error. *Ophthalmology* 1985, 92(11): 1561-1566.
- [7] DQ Nguyen, LL Mumford, MNA Jones. The visual and refractive outcomes of combined and sequential penetrating keratoplasty, cataract extraction and intraocular lens insertion. *Eye*, 2009, 23: 1295-1301
- [8] Hoffer KJ. Accuracy of ultrasound in intraocular lens calculation. *Arch Ophthalmol*, 1981, 99: 1819-23.
- [9] Sanders D R, Retzlaff J, Kraff MC. Comparison of empirically derived and theoretical aphakic refraction formulas. *Arch Ophthalmol*, 1983; 101:965-7.
- [10] Perl T, Charlton KH, Binder PS. Disparate diameter grafting. Astigmatism, intraocular pressure, and visual acuity. *Ophthalmology*, 1981, 88: 774-80.
- [11] Taylor Dm, Khaliq A, Maxwell R. Keratoplasty and intraocular lenses: current status. *Ophthalmology*, 1979, 86: 242-54
- [12] Lee JR, Dohlman CH. Intraocular lens implantation in combination with keratoplasty. *Ann Ophthalmol*, 1977, 9: 513-813.
- [13] Buxton JN, Jaffe MS. Combined keratoplasty, cataract extraction and intraocular lens implantation. *Am Intraocul Implant Soc J.*, 1978, 4: 11.
- [14] Roger FM, David CM. Assessment of success and complications of triple procedure surgery. *Trans. Am. Ophth. Soc.* vol. LXXXV, 1987
- [15] Shigeto S, Yoshie O, Hiroki S, Jun S, Kazuo T. Corneal opacity and cataract. Triple procedure versus secondary approach. *Cornea*, 2003, 22(3).