



A CLINICAL STUDY ON DRY EYE AFTER CATARACT SURGERY.

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ABSTRACT **Introduction:** Dry eye as defined by the International Dry eye workshop is a multifactorial disease of the tears and ocular surfaces. Cataract surgery can cause dry eye as surgery can damage ocular surface. **Aims:** To find out various factors responsible for dry eye after cataract surgery in presenile patients and the incidence of dry eye cases after cataract surgery. **Methods:** It was a prospective study on 100 patients Complete ocular examination and dry eye tests were done preoperatively and postoperatively. **Results:** patients who had longest tunnel incision, longer period of microscopic light exposure, vigorous irrigation, and eyedrops with preservatives had developed dry eye disease. **Conclusion:** As dry eye may develop after cataract surgery, so by decreasing incision size of tunnel, minimizing microscopic light exposure and vigorous irrigation, using preservative free drops can decrease dry eye symptoms post operatively.

KEYWORDS : Dry eye, cataract surgery, Incision, Eyedrops.

INTRODUCTION:

Dry eye as defined by the International Dry eye workshop is a multifactorial disease of the tears and ocular surfaces. It is a disorder of the tear film due to tear deficiency or excessive tear evaporation which causes damage to interpalpebral ocular surface and is associated with the symptoms of ocular discomfort.¹

Dry eye state is a form of noninfectious ocular surface disorder due to deficiency or absence of tear fluid. The ocular surfaces rub against each other with each blink. For smooth functioning, it is provided with lubricating fluid. The lubricating fluid is known as tears.²

Normal tear film is a trilaminar structure comprising of superficial lipid layer, an intermediate aqueous phase, and underlying mucous layer. Tears cleanse, lubricate, and nourish the surface of the eye, also provide physical and immune protection against infection. It forms smooth refractive surface for vision.

Cataract operation is the most common ocular surgery. It can cause ocular surface damage which can lead to dry eye disease. The symptoms of dry eye are ocular discomfort, photophobia, sensation of dryness, foreign body sensation such as grittiness and fatigue, burning, redness, blurred or fluctuating vision, pain, headache, tired eyes, itching, stringy mucoid discharge, soreness, pseudoeptiphora. It has been noticed that some patients during postoperative period present with dry eye symptoms.

Dry eye disease can impair the ability of patients to perform daily activities which will affect the quality and mental health of the patient.

MATERIALS AND METHODS:

This prospective study was conducted in a tertiary care hospital. A total of 100 patients aged between 30 years & 50 years of any gender, scheduled for elective cataract surgeries were included in this study, as these patients are categorized to presenile group. The study was conducted over a period of one year July 2020 June 2021. A detailed history and thorough ocular examination including Tear breakup time (TMH), Schirmer test (ST), Tear meniscal height (TMH) were done pre-operatively, post operatively at 7 days, 30 days, 90 days. All data was collected as per a predefined proforma.

Inclusion Criteria:

1. Patients aged between 30 years and 50 years scheduled for elective cataract surgeries without dry eye symptoms.

Exclusion Criteria Were:

1. pre-existing dry eye,
2. Pre-existing ocular disease like glaucoma, Uveitis, Disorders of the lid and nasolacrimal pathway, Ocular allergies, Pterygium, Blepharitis.
3. Patients on chronic ocular medications,
4. History of ocular trauma, burn,
5. Systemic diseases like Sjogren syndrome, Rheumatoid arthritis, Systemic

lupus erythematosus, Diabetes mellitus.

These factors could have an influence on the dry eye test results.

Before cataract surgery, Moxifloxacin eyedrop was instilled 4 times daily for 2 days. 2.5% phenylephrine and tropicamide drops were used to dilate pupil at 15 minutes interval for 1 hour before surgery. Post operatively combination of Moxifloxacin and Dexamethasone eye drop was used 1 drop 6 times daily for 2 weeks and 1 drop 4 times daily for another 4 weeks in the operated eye. Nepafenac eye drops were also given for 6 weeks (1 drop 4 times daily).

This prospective study was approved by institutional Ethical committee and it adheres to the declaration of Helsinki. Patients were verbally explained about the procedure and an informed consent was obtained from all patients who were enrolled in this study.

All selected cases underwent SICS procedure by a single surgeon with sufficient experience in cataract surgery. The surgeries were performed under peribulbar anesthesia. A foldable acrylic hydrophobic PCIOL was implanted in the capsular bag of each patient. The lens from the same company with same design was used in each case.

Clinical Data Collection And Analysis

A complete general and ophthalmic history was elicited. It was followed by a thorough ocular and systemic examination, Slit lamp examination, tear meniscus floaters, conjunctival xerosis, coneal xerosis, mucous strands and filaments. Dry eye tests including schirmer's, TMH, Tear breakup time has been done.

RESULTS AND OBSERVATIONS:

The case selection, documentation were done as per materials and methodologies of the study. Total duration of the study was one year (from July 2020 to June 2021). The study was conducted on 100 patients aged between 30 years and 50 years of both sexes, who were scheduled for elective cataract surgeries.

Table 1- Showing Incision Size And Percentage Of Dry Eye Cases After 90 Days Follow Up

FAC TOR	INCISION SIZE IN mm											
	5.5mm			6mm			6.5 mm			7 mm		
	Pos t op 7 th day	Post op 30 th day	Post op 90 th day	Pos t op 7 th day	Post op 30 th day	Post op 90 th day	Pos t op 7 th day	Post op 30 th day	Post op 90 th day	Pos t op 7 th day	Post op 30 th day	Post op 90 th day
TBU T(s)	8	10	10	8	11	13	6	8	10	4	5	5
ST (mm)	14	18	15	14	16	15	9	12	15	7	9	12
TMH (mm)	0.2	0.26	0.22	0.18	0.20	0.22	0.16	0.18	0.20	0.13	0.18	0.20

No. of patients with dry eye cases	27	13	1	12	4	1	9	5	1	9	7	3
Percentage of dry eye cases	10%			14%			20%			40%		

Table shows that the highest number of dry eye cases in 7 mm incision-40%, followed by 6.5mm -20% , 6 mm -14%, 5.5 mm- 10%.

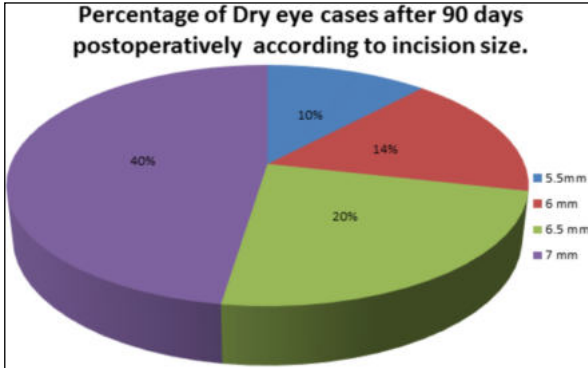


Table 2. Microscopic Light Exposure And Dry Eye Test Value

FACTOR	MICROSCOPIC LIGHT EXPOSURE											
	10-15 minutes			16-20 minutes			21-25 minutes			26-30 minutes		
POST OP DAYS	Post op 7 th day	Post op 30 th day	Post op 90 th day	Post op 7 th day	Post op 30 th day	Post op 90 th day	Post op 7 th day	Post op 30 th day	Post op 90 th day	Post op 7 th day	Post op 30 th day	Post op 90 th day
TBUT (s)	10	16	12	10	12	10	8	11	12	5	7	8
ST (mm)	12	16	10	10	14	10	9	14	16	4	6	8
TMH (mm)	0.26	0.28	0.28	0.24	0.28	0.28	0.17	0.28	0.34	0.14	0.22	0.34
NUMBER OF PATIENTS WITH DRY EYE	38	15	1	18	8	1	6	4	2	6	5	3
PERCENTAGE OF PATIENTS WITH DRY EYE	10%			45%			50%			70%		

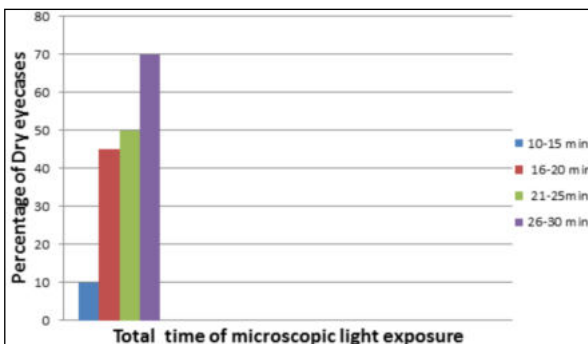


Table shows microscopic light exposure and percentage of dry eye cases. Those who had exposed to longer period of light showed more percentage of dry eye cases. 26- 30 minutes (70%), 21-25 minutes (50%), 16-20 minutes (45%), 10-15 minutes (10%).

Bar diagram showing Percentage of dry eye cases and Microscopic light exposure.

Table 3: Intraocular Irrigation And Dry Eye Cases

FACTOR	INTRA OCULAR IRRIGATION								
	5 minutes			10 minutes			15 minutes		
POST OP DAYS	Post op 7 th day	Post op 30 th day	Post op 90 th day	Post op 7 th day	Post op 30 th day	Post op 90 th day	Post op 7 th day	Post op 30 th day	Post op 90 th day
TBUT (s)	8	9	9	8	9	8	5	8	9
ST (mm)	7	8	9	8	8	9	6	8	9
TMH (mm)	0.24	0.28	0.29	0.13	0.14	0.23	0.12	0.16	0.20
NUMBER OF PATIENTS WITH DRY EYE	36	15	6	12	6	3	14	9	7
PERCENTAGE OF PATIENTS WITH DRY EYE	4%			50%			80%		

Table shows vigorous intraocular irrigation can cause dry eye. 15 minutes irrigation showed 80 % cases of dry eye after 90 days of follow up, 10 minutes showed 50% of cases, 5 minutes irrigation showed 4% cases of dry eye.

Bar diagram showing Percentage of dry eye cases with Total time of Irrigation done.

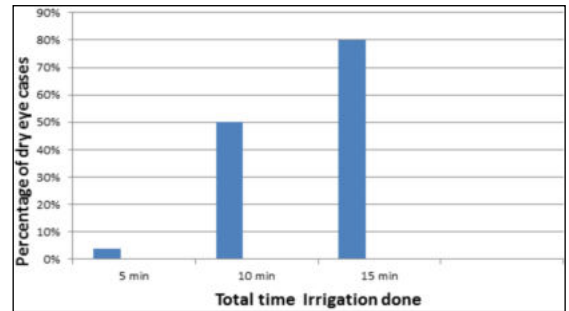
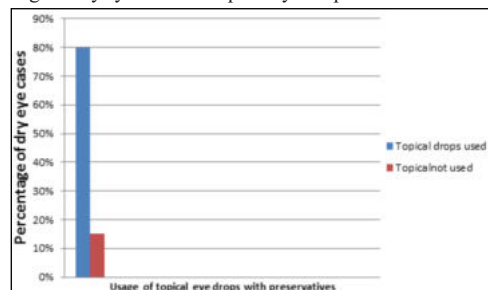


Table 4. Usage Of Topical Eyedrops And Percentage Of Dry Eye Case

FACTOR	TOPICAL EYE DROPS USED WITH PRESEVATIVES			TOPICAL EYE DROPS PRESEVATIVES FREE		
	Post op 7 th day	Post op 30 th day	Post op 90 th day	Post op 7 th day	Post op 30 th day	Post op 90 th day
TBUT(s)	5	7	9	9	9	9
ST (mm)	6	8	9	9	9	8
TMH (mm)	0.13	0.16	0.18	0.20	0.24	0.28
NUMBER OF PATIENTS WITH DRY EYE	52	37	30	18	8	1
PERCENTAGE OF PATIENTS WITH DRY EYE	80%			15%		

Table shows those patients who used topical eyedrops with preservatives developed dry eye disease. Dry eye cases were found to be quite high in patients who used preservatives containing topical drops -80 %. Patients who used preservative free topical drops showed less cases 15%.

Percentage of dry eye cases in Topical eye drops users and non users:



In this prospective study it was observed that dry eye symptoms due to

ocular surface damages may occur after surgery of presenile cataract. When cataract develops before the age of 50 it is defined as Presenile cataract³. Cataract surgery can induce dry eye in patients with healthy ocular surface prior to surgery. Affected patients may experience foreign body sensation, grittiness, burning sensation and watery eyes post operatively .Dry eye test values were affected in early postoperative days but a decrease in test values were found in further postoperative follow up .

In the present study we made a detailed assessment of various risk factors that can potentially cause dry eye disease after cataract surgery in presenile patients.

We evaluated the effect of sclero-corneal tunnel incision, usage of preservative containing eyedrops, microscopic light exposure and repeated irrigation and drying intra operatively.

1. Incisional Corneal Nerve Damage

Cornea is one of the most sensitive tissues of the body, as it is densely innervated with sensory nerve fibers via ophthalmic division of trigeminal nerve by way of 70-80 long ciliary nerves. The corneal nerves are important in the self regulation of tears since they provide the sensation in the feedback loop that signals tear production. When we block or decrease the function of these nerves ,we can significantly limit the eye's ability to create a proper tear film ,which can lead to decreased vision and symptomatic patients.

The surgical procedure that cause corneal denervation can cause epithelial injury and hinderence in wound healing, epithelial permeability is also increased. This will in turn affects metabolic activity of corneal epithelium and cause structural damage. Corneal sensation is a function of the long ciliary nerves of the ophthalmic division of fifth cranial nerve that is Trigeminal nerve.

In this study it was observed that as the size of corneo -scleral tunnel increases , bigger part of the cornea gets denervated and neural regeneration is also prolonged which in turn leads to persistent foreign body sensation and other symptoms of dry eye disease. This study showed similar results with other studies where size of the incision correlates with occurrence and duration of dry eye.

Yang et al. observed aggravation of dry eye symptoms in their study .They conducted their study on 70 eyes of 35 patients.They noted no difference in dry eye test values based on incision location but test values can get affected with increase in depth of incision.⁴

A study conducted by Lyne showed complete loss of corneal sensitivity in patients who had undergone cataract surgery, only 2 of 9 patients recovered after two years of follow up.⁵ Similar results were observed in another study by John, on 60 patients.⁶

Kim et al. conducted a similar study in which they assessed all parameters at 1 week, 1 month and 3 months after surgery and observed decreased corneal sensitivity post operatively.⁷

Similar studies were also conducted on change in corneal sensitivity and dry eye disease after small incision cataract surgery and suggested sclero- corneal tunnel incision which made during surgery can be the reason for that.

2. Application Of Topical Eye Drops

As a part of routine treatment regime topical eyedrops including antibiotic drops, non steroidal eyedrops, steroidal eyedrops were prescribed to the patients after cataract surgery. Topical eyedrops usually contain preservatives. Preservatives are used to decrease contamination , to provide anti microbial activity,to prevent secondary mycotic, amoebal, bacterial ocular infections,and prolong the half-life of the drug by preventing biodegradation and maintaining drug potency. Some of the examples are Benzalkonium chloride(BAC), chlorobutanol,methyl paraben,sodium perborate ,stabilized thimerosal .The most commonly used preservative in ocular preparations is Benzalkonium chloride.

In this study it was observed that those patients who used topical eyedrops with preservatives developed dry eye disease. Percentage of dry eye disease post operatively after 90 days follow up was high among them. Toxicity of preservatives may cause ocular surface damage and exacerbate dry eye symptoms. Similar study conducted by Jee et al. on 80 patients also noted same findings.⁸

Xue- Min et al. also noted occurrence of dry eye after cataract surgery postoperatively⁹.A total of 50 eyes of 37 patients were examined in their study. Many authors have raised the possibility of toxicity of preservatives added in topical eyedrops on ocular surface.^{10,11,12} Benzalkonium chloride (BAK)exacerbate dry eye symptoms, interfere with the integrity of the external lipid layer of the pre-corneal tear film ,reduction of tear film break up time.

BAK toxicity is dose dependent.BAK at low concentration can cause cell arrest by apoptosis and high concentration can cause necrosis. Various in vivo vitro studies has been proved toxicity of BAK on corneal and conjunctival epithelial cells experimentally.^{13,14}

3. Phototoxicity

Phototoxicity caused by prolonged microscopic light exposure can be one of the possible factors causing dry eye post operatively.In the present study it was found that patients who had prolonged exposure to microscopic light intraoperatively developed dry eye disease.

Similar study by Yang et al. observed same findings of our study.⁴ They noticed worsening of dry eye test values post operatively. Oh et al. in his study on 48 eyes demonstrated longer the microscopic light exposure higher the chances of developing dry eye diseases. He observed decrease in goblet cell density which had not recovered at three months after surgery.¹⁵

Excessive light exposure can cause possible damage to the ocular surface and tear film stability. Hyung et al.demonstrated this in his study on 30 rabbits.¹⁶ Light exposed group showed decreased aqueous production, decreased conjunctival goblet cell density,squamous metaplasia of conjunctival epithelial cells,ultrastructural cellular damage to corneal and conjunctival tissues.

Ipek et al. conducted in vitro study on porcine fibroblast and documented fibroblastic cell damage and delayed wound healing on prolonged light exposure.¹⁷

4. Repeated Intra-ocular Drying And Irrigation

Repeated irrigation and drying is done intra operatively during cataract surgery in order to maintain optical clarity. In our study it has been noticed patients who had undergone vigorous irrigation for a prolonged time developed dry eye symptoms post operatively. Vigorous irrigation and drying can cause ocular surface trauma by damaging conjunctival and corneal epithelial cells ,also reduces goblet cell density.

Our study was in accordance with similar study by Moon et al. He observed aggravated dry eye parameters during early post operative period.¹⁸

Saurabh et al. also concluded that one of the factors contributing dry eye is Repeated irrigation and drying their study on 100 patients. Dry eye assessment had done preoperatively, at 7 th day , 21 st day and 90 th day post operatively and they observed dry eye test values was affected till three months after surgery.¹⁹

In the present study the incidence of dry eye disease after cataract surgery in presenile patients was found to be 60%.Many studies has been conducted on dry eye disease postoperatively in senile patients. Venugopal et al.in their study documented 62.2%of the patients had dry eyes after cataract surgery.²⁰ Cho and kim also reported aggravation of dry eye symptoms in their study during follow up period after cataract surgery. A total of 98 eyes were included in the study.⁴

CONCLUSION

Cataract surgery is capable of causing dry eye disease and affecting dry eye test values. Factors responsible are sclera corneal incision, microscopic light exposure, repeated irrigation, topical eyedrops containing preservatives. Even after successful cataract surgery patients may be dissatisfied due to dry eye symptoms. Therefore proper counselling should be done before surgery about the possible occurrence of dry eye symptoms after surgery. By decreasing incision size of tunnel, minimizing microscopic light exposure and vigorous irrigation, using preservative free drops can decrease dry eye symptoms post operatively.

REFERENCES:

1. Lemp MA. Report of the National Eye Institute/Industry workshop on Clinical Trials in Dry Eyes. CLAO J. 1995 Oct;21(4):221-32. PMID: 8565190.
2. Dry eye disease ,The clinician's guide to Diagnosis and Treatment,Penny A.

- Asbell, Michael A. Lemp
3. Parsons □ Diseases of the Eye. 22nd edition.
 4. Cho YK and Kim MS. Dry eye after cataract surgery and associated intraoperative risk factors. *Korean J Ophthalmol* 2009; 3(2): 65–73.
 5. 14. Lyne A. Corneal sensitivity after surgery *Ophthalmol Soc U K* 1982; 102(pt. 2): 302–305
 6. John T. Corneal sensation after small incision, sutureless, one-handed phacoemulsification. *J Cataract Refract Surg.* 1995 Jul;21(4):425-8. doi: 10.1016/s0886-3350(13)80533-0. PMID: 8523287.
 7. Kim J H, Chung J L, Kang S Y, et al. Change in corneal sensitivity and corneal nerve after cataract surgery. *Cornea* 2009; 28(11): S20–25.
 8. Jee D, Park M, Lee H J, et al. Comparison of treatment with preservative-free versus preserved sodium hyaluronate 0.1% and fluorometholone 0.1% eyedrops after cataract surgery in patients with preexisting dry-eye syndrome. *J Cataract Refract Surg* 2015; 41: 756–776.
 9. Li X M 1, Hu L, Hu J, et al. Investigation of dry eye disease and analysis of the pathogenic factors in patients after cataract surgery. *Cornea* 2007; 26(9 Suppl. 1): S16–S20
 10. Debbasch C, Brignole F, Pisella P.J., et al. Quaternary ammoniums and other preservatives' contribution in oxidative stress and apoptosis on Chang conjunctival cells. *Invest. Ophthalmol. Vis. Sci.* 2001; 42: 642–652
 11. Van Horn D.L, Edelhauser H.F, Prodanovich G., et al. Effect of the ophthalmic preservative thimerosal on rabbit and human corneal endothelium. *Invest. Ophthalmol. Vis. Sci.* 1977; 16: 273–280. –.
 12. Noecker R, Herrygers L, Anwaruddin R. Corneal and conjunctival changes caused by commonly used glaucoma medications. *Cornea.* 2004; 23: 490–496.
 13. Lazarus H.M, Imperia P.S, Botti R.E., et al. An in vitro method which assesses corneal epithelial toxicity due to antineoplastic, preservative and antimicrobial agents. *Lens Eye Toxic. Res.* 1989; 6: 59–85. – para 4 lastline
 14. De Saint Jean M, Brignole F, Bringuier A.F., et al. Effects of benzalkonium chloride on growth and survival of Chang conjunctival cells. *Invest. Ophthalmol. Vis. Sci.* 1999; 40: 619–630. Para 4-lastline.
 15. Oh T, Jung Y, Chang D, Kim J, Kim H. Changes in the tear film and ocular surface after cataract surgery. *Jpn J Ophthalmol* 2012; 56: 113–8.
 16. Hwang H B and Kim H S. Phototoxic effects of an operating microscope on the ocular surface and tear film. *Cornea* 2014; 33(1): 82–90
 17. Ipek T, Hanga M P, Hartwig A, et al. Dry eye following cataract surgery: the effect of light exposure using an invitro model. *Cont Lens Ant Eye* 2018; 41(1): 128–131.
 18. Moon H, Yoon J H, Hyun S H, et al. Short-term influence of aspirating speculum use on dry eye after cataract surgery: a prospective study. *Cornea* 2014; 33(4):
 19. Saurabh Srivastava, Brijesh Dudhat, Tear film changes after cataract surgery: Manual small incision versus Phacoemulsification. *January 2018 Delta journal of ophthalmology* 19(3): 170.
 20. Venugopal K C, Krishnaraj P A, Chandan N (2012) Evaluation of dry eye after manual small incision cataract surgery with corneoscleral tunnel incision. *Journal of Clinical and Diagnostic Research* 6: 1029-1033.