Changes in the Tear film after Manual Small Incision Cataract Surgery – A Prospective Study

Pallamreddy Sree Lakshmi, C.S. Sandhya, C. Jagannath, K. Madhavi
Department of Ophthalmology, S V Medical College, Tirupati, Andhra Pradesh, India

Background: Manual small incision cataract surgery is a good alternative to phacoemulsification in areas where very high volume surgery with inexpensive instrumentation is required. Dry eye disease is an ocular surface disorder which produces discomfort and reduced vision due to tear film instability. This study is meant to evaluate the changes in tear film following cataract surgery by comparative analysis of various parameters before and after manual small incision cataract surgery. The aim was to evaluate the changes in tear film after manual small incision cataract surgery.

Methods: The prospective study was conducted in 100 eyes of 100 patients. Those included were selected from the patients diagnosed as having unilateral or bilateral age related uncomplicated cataract without dry eye symptoms. All selected patients were studied for any abnormalities in tear film pre and post manual small incision cataract surgery. The various parameters studied were tear meniscus height (TMH), tear film break up time (TBUT), Schirmer test 1 (ST1) and Rose Bengal staining (RB). The tests were performed for all patients 1 day before and 1 day, 1 month, and 3 months after surgery.

Results: The majority of the study participants were aged between 51-60 yrs (51%). 24% of the eyes showed lower TMH at 3 months post operative visit. 8% the eyes recorded lower TBUT values at 3 months post operative follow up, which was statistically significant (P<0.01). There was a statistically significant difference in ocular surface changes with Rose Bengal staining between preoperative and postoperative 1 week, 1 month, and 3 months follow up (P<0.002). The mean postoperative ST1 results were no different from preoperative values.

Conclusion: Patient undergoing SICS without having dry eye preoperatively showed lower values of tear film indices like TMH, TBUT and RB at 1 week and still lower values at 1 month. There was dryness of eyes in many of the patients and majority of them had mild grade dry eye.

Abstract

Dry eye disease is an ocular surface disorder which produces discomfort and reduced vision due to tear film instability. Incidence of dry eye in the US has been estimated to be around 2.7 per year. Incidence of dry eye in India amongst patients attending the outpatient department has been estimated to be around 0.46% with a male: female ratio of 1:1.22.

Cataract is the leading cause of blindness in the world. At the same time, cataract surgery is the most successful and rewarding surgery in the field of ophthalmology. However, after cataract surgery, many patients complain of foreign body sensation, irritation, redness and blurring of vision which are considered as unwanted effects of the surgery. These persist in some patients until they are managed by subsequent effective treatment. Some studies have reported aggravation of dry eye symptoms and signs after cataract surgery (Ram, et al.). Thus, in spite of a perfect cataract surgery and a good Snellen visual acuity, the patients may remain dissatisfied.

In developing countries like ours, the most efficient and the economical means of doing a cataract surgery is manual small incision cataract surgery with a corneo scleral tunnel incision. Now-a-days, even the base camp surgeries which are done under the National Program for Control of Blindness (NPCB) are manual Small Incision Cataract Surgeries (SICS) with corneo scleral tunnel incisions. The procedure is fast and has a low rate of complications and can be performed in dense cataract. Manual SICS is a good alternative to phacoemulsification in areas where very high volume surgery with inexpensive instrumentation is required. In the present study, the aim was to evaluate the changes in tear film following cataract surgery by comparative analysis of tear film indices before and after manual SICS.

Materials and Methods

In the present study 100 eyes of 100 patients who attended the department of Ophthalmology, Sri Venkateswara Medical College, Tirupati were included. All the patients were above 50 yrs and were diagnosed as senile cataract. All patients underwent uneventful manual SICS with either superior or temporal corneoscleral incision. The study was approved by the institutional ethical committee (IEC). Patients with surgical complications, pre-existing dry eyes, Sjogren’s syndrome, rheumatoid arthritis and other autoimmune disorders and patients with pre-existing ocular diseases like glaucoma, uveitis, disorders of the lid or the nasolacrimal pathway, ocular allergies, pterygium and previous ocular surgeries were not included in the study. Patients who lost follow up were excluded.

Clinical examination included comprehensive anterior segment evaluation done under slit lamp biomicroscopy,
to rule out any pre-existing ocular surface disease. TMH, TBUT, ST1, RB staining was done in all patients. The patients were started on systemic and topical antibiotics one day before surgery. On the day of surgery pupils were dilated using 0.8 mg tropicamide and 10% phenylephrine hydrochloride drops 90 minutes before cataract surgery. A manual small incision cataract surgery with either superior or temporal sclero corneal tunnel was performed under peribulbar block. The incision was 6 to 6.5 mm in length and 1.5 to 2 mm from the limbus. A rigid PMMA intraocular lens was implanted in all patients. A standard post-operative regime was followed in all the patients. All patients received steroid antibiotic combination in tapering doses for 8 weeks. Post-operative evaluation was done at 1 week, 1 month and 3 months. At each visit TMH, TBUT, ST1 and RB staining was done.

Tear meniscus height (TMH): Tear meniscus height was recorded as normal or low (under narrow beam of slit lamp). Precorneal tear film was observed for presence of debris (mucous/oil droplets/debris)

Tearfilm break up time measurement (TBUT): The TBUT measures the interval between the last complete blink and the first appearance of dry spot over cornea after application of 2% fluorescein dye. The readings were recorded under slit lamp using cobalt blue filter. Three TBUT readings were taken and average was calculated. TBUT less than 10 seconds was considered as dry eye. [Figure 1]

Schirmer test 1 (ST 1): It was done using 5×35 mm sterile strips of Whatman No.41 filter paper. ST1 was evaluated by inserting a schirmer paper strip in the lower fornix at the junction of middle and lateral third of the lower fornix for 5 minutes. Wetting of 10 mm or less is considered as dry eye.

Rose Bengal stain (RB): It is a measure of assessing ocular surface damage. A sterile, commercially available Rose Bengal strip moistened with 4% xylocaine was applied to the inferior cul de sac. After 15 seconds, the eye was examined for staining of cornea and conjunctiva under red free light or bright light under the slit lamp. VanBijsterveld scoring system was used to grade the staining of cornea and conjunctiva, based on a scale of 0-3 in 3 areas: nasal conjunctiva, temporal conjunctiva, and cornea. An additive score of 4 or more in the eye was considered as positive test. [Figure 2]

Dry eye was defined as having one or more symptoms (often or all the time present), along with one or more positive clinical findings (based on slit lamp examination) and one or more positive clinical tests (TBUT of ≤10 seconds, ST1 score ≤ 10 mm, RB stain score of >4). Asymptomatic patients with positive signs or positive tests were considered as having dry eye and were included in the study. Dry eye was graded as mild, moderate, and severe. Mild dry eye can be defined in patients with ST1 of less than 10 mm in 5 minutes, TBUT less than 10 seconds and less than one quadrant of staining of the cornea by RB. Moderate dry eye is defined as ST1 of 5 to 10 mm in 5 minutes, TBUT of 5 to 10 seconds with punctuate staining of more than one quadrant of the corneal epithelium by RB. Severe dry eye is defined as diffuse punctate or confluent staining (with RB) of the corneal epithelium, often with filaments and diffuse punctate or confluent staining of the conjunctival epithelium with ST1 less than 5 mm in 5 minutes and TBUT less than 5 seconds.

Statistical analysis: Chi-square test was applied for analyzing significance among qualitative variables. Paired t-test was applied for analyzing significance among quantitative variables and to check preoperative and postoperative results. Descriptive statistics was applied for quantitative variables, Mean and SD. The Statistical software SPSS 20.0 was used for analysis of the data and Microsoft word and Excel 2011 was used to generate graphs and tables.

Results

All the patients were followed till 3 months postoperatively and assessed for the development of dry eye on the basis of tear meniscus height (TMH), Schirmer’s test (ST1), tear film breakup time (TBUT) and rose bengal (RB) staining of ocular surface. The results of the study were analyzed as below.

In the present study majority (51%) of the study participants were aged between 51 to 60 (yrs) 43% were aged between
61-70 (yrs). [Table 1]. In the present study 41% of the subjects were males and 59% were females.

| Age (yrs) | Frequency | Percent |
|-----------|-----------|---------|
| 51 – 60   | 51        | 51%     |
| 61 – 70   | 43        | 43%     |
| 71 – 80   | 02        | 02%     |
| 81 – 90   | 04        | 04%     |
| Total     | 100       | 100%    |

Table 1: Distribution of study subjects according to age

TMH analysis showed that pre operatively all subjects had normal TMH values. 23%, 29% and 24% had low TMH at post operative 1 week, 1 month and 3 months respectively which was statistically significant. [Table 2]

The TBUT analysis showed that pre operatively all subjects had normal TBUT values. At post operative 1 week, 1 month and 3 months 6%, 23% and 8% had low TBUT values. 92% of the patients regained normal values in 3 months followup period which was statistically significant. [Table 3]

Table 2: Multiple bar diagram representing, TMH at Pre, Post-op at 1 week, 1 month and 3 months

ST analysis was normal in all patients pre operatively. 0%, 3% and 0% had low ST1 values at post-op 1 week, 1 month and 3 months respectively. After 3 months post operative all patients regained ST1 value of >10 which was statistically significant. [Table 4]

Table 3: Comparison of TBUT at Pre-op, Post-op at 1 week, 1 month and 3 months

Table 4: Comparison of ST at Pre-op, Post-op at 1 week, 1 month and 3 months

Discussion

Dry eye is a multifactorial disease of tearfilm and ocular surface that can be result of aqueous deficiency or be evaporative in nature. Dry eye can develop after various types of ophthalmic surgeries such as photorefractive keretectomy and laser assisted in situ keratomileusis. This study was done to evaluate the dryness of the eyes after manual small incision cataract surgeries with corneoscleral tunnel incisions. Many previous studies comparing the preoperative and postoperative changes in dry eye symptoms and/or dry eye test values showed significant worsening after cataract surgery. A difficulty in assessing dry eye is that there is no gold standard test. As a result various diagnostic tools with different sensitivities and specificities are used to diagnose dry eye. In present study TMH, TBUT, ST1 and ocular surface staining with Rose Bengal was done (RB can easily detect ocular surface inflammation). Cataract surgery can affect or interrupt the neurogenic response of the ocular surface and decrease tear secretion. Like other studies, we also report that dry eye can develop after cataract surgery.
In the present study the TMH values were lowest at 1 month, while it showed slight improvement at 3 months. Cho et al., in their study found that TMH value decreased in all the follow up visits from the preoperative value in the non-dry eye group. Gharaei et al., also showed a decreased TMH value at 3 months follow up visit. The lowest value of TBUT was seen at 1 month and after 3 months there was slight improvement. Chandan C et al. and Mohan S et al., in their study also found lower value of TBUT at 1 month follow up. In the present study none of the patients had ST1 values in the dry eye range pre operatively, whereas 0%, 3% and 0% of patients in the post operative 1 week, 1 month and 3 months respectively had ST1 values in the dry eye range. In a study by Srinivasan R et al., Kavitha et al., Chandan C et al., the schirmer test values decreased in the and postoperative cases of cataract surgery, to a significant levels. In a study by Ram et al., Li et al., Liu Z et al., and Mohan S et al., conducted. Schirmer test values decreased significantly till 4 weeks postoperatively. In the present study none of the patients had abnormality of RB staining preoperatively where as 29%, 51% and 37% of patients in the post operative 1 week, 1 month and 3 months had abnormal RB staining. In a study by Oh et al., RB staining showed a similar pattern.

In the present study dry eye was noticed in 10 cases at post operative 1 month out of which 3 cases had mild dry eye and 7 cases had moderate dry eye. After 3 months the severity of dry eye decreased but never returned to baseline levels. In a study by Saif MYS et al., severity of dry eye significantly increased 1 week after surgery and remained increased up to 4 weeks after surgery. 3 months the severity of dry eye decreased again and returned to near base line. Both Phacoemulsification and SICS patients had more severe dry eye at 1 week post operative which slightly decreased after 4 weeks. In a study by Kasetsuwan et al., concluded that severity of dry eye peaked 7 days post Phacoemulsification. Within 1 month and 3 months both symptoms and signs showed gradual improvement. In the present study RB staining showed that most of the patients had mild dry eye with a peak at 1 month (29%) and decreased again but never returned to normal at 3 months post operative period (23%). In studies by Cho et al., Li et al., Gharaei et al., dry eye appeared at 1 week post operatively and reached a peak at 1 month post operative period. In several studies like Ram et al., Gharaei et al., Cohen et al., Hardten et al., Insler et al., Jones et al., and Roberts et al., there was overwhelming evidence suggesting the aggravation or initiation of dry eye following cataract surgery.

Disruption of the normal corneal innervation or lacrimal functional unit feedback can reduce the tear flow and blink rate and cause instability of the tear hyperosmolarity and tear film. With corneal healing postoperatively, new neurite cells emerge and after 25 days neural growth factor is released to regenerate the sub epithelial corneal axons. Thus, the recovery of the corneal nerves may explain why the dry eye was seen early after surgery and improved thereafter. Even though, in theory, neurogenic inflammation may effect the feedback loop in the contralateral eye, in the present study the other eye did not show significant dryness after surgery. In addition to transection of the corneal nerves and damage to the corneal epithelial cells, exposure to microscopic light, vigorous intraoperative irrigation of the tear film, elevation of inflammatory factors in the tear film due to ocular surface irritation, use of topical eye drops post operatively and its preservatives can cause dry eye after phacoemulsification and SICS. Vigorous irrigation of the tear film and manipulation of the ocular surface intraoperative may reduce the goblet cell density and result in shortened TBUT postoperatively. We believe that the use of light filters, decreased exposure time, appropriate irrigation and gentle handling of the ocular surface tissue may decrease the postoperative dry eye.

### Conclusion

Patients undergoing SICS with normal dry eye indices preoperatively showed lower values of dry eye indices like TMH, TBUT, ST1 and RB staining at 1 week and still lower values at 1 month post operative. The incidence of dry eye was more at post operative 1 month following SICS. 10% of the patients had dry eye of which mild dry eye was seen in 7% and moderate dry eye was seen in 3% at 1 month postoperative. Although mild to moderate dry eye may not interfere with vision, decrease of vision can occur in severe cases. Preoperative assessment should be done properly by using questionnaire about dry eye symptoms, tests for tear film production and its stability. If dry eye is detected preoperatively artificial tears and cyclosporine eye drops can be prescribed post operatively. We conclude that dry eye symptoms can develop immediately after cataract surgery and reach a peak on day 7. Both symptoms and signs of dry eye can improve overtime. However, it is important that ophthalmologists assess dry eye before and after cataract surgery to ensure proper treatment, quality of vision and quality of life for their patients.

| RB   | Pre-op | Post-op at 1 week | Post-op at 1 month | Post-op at 3 month | P - value |
|------|--------|-------------------|--------------------|--------------------|-----------|
| 0=Normal | 100    | 71                | 49                 | 63                 |           |
| 1=Mild   | 0      | 22                | 29                 | 23                 |           |
| 2=Moderate | 0     | 6                 | 15                 | 11                 | P < 0.002 |
| 3=Severe | 0      | 1                 | 7                  | 3                  |           |
| TOTAL   | 100    | 100               | 100                | 100                |           |
References

1. Srinivasan R, Agarwal V, Suchismitha T, Kavitha. Dry eye after phacoemulsification. *AIOC* 2008; 116-8.
2. Cho YK, Man SK. Dry Eye After Cataract Surgery and Associated Intraoperative Risk Factors. *Korean J Ophthalmol* 2009; 23:65-73.
3. Li XM, Hu L, Hu J, Wang W. Investigation of Dry Eye Disease and Analysis of the Pathogenic Factors in Patients after Cataract Surgery. *Cornea* 2007; 26:16-20.
4. Ram J, Sharma A, Pandav SS, Gupta A, Bambery P. Cataract surgery in patients with dry eyes. *J. Cataract Refract Surg*. 1998; 24:1119-24.
5. Ram J, Gupta A, Brar GS, Kaushik S, Gupta A. Outcomes of phacoemulsification in patients with dry eye. *J Cataract Refract Surg*. 2002; 28:1386-9.
6. Stern ME, Beuerman RW, Fox RI, Goa J, Mirchoff AK, Pflugfelder SC. The pathology of the dry eye and the interaction between the ocular surface and the lacrimal glands. *Cornea. St. Louis: Mosby* 1997; 663-86.
7. Fernando Murrilo LSCP, Jay HK, Krahmer MJMEJH. Dry eye. *Cornea. St. Louis: Mosby* 1997; 663-86.
8. Kohlhass M. Corneal sensation after cataract and refractive surgery. *J Cataract Refract Surg* 2002; 28:1399–409.
9. Kasetsuwan N, Satitpitakul V, Changul T, Jariyakosol S. Incidence and Pattern of Dry Eye after Cataract Surgery. *PLoS One* 2013; 8:e78657.
10. Gharaei H, Mousavi MN, Daneshvar R, Hosseini M, Sazande S. Effect of clear corneal incision location on tear film following phacoemulsification surgery. *Iranian Journal of Ophthalmology* 2009; 21:29-34.
11. Kavitha C, et al. Evaluation of dryness of eyes after manual small incision cataract surgery with corneo scleral tunnel incision. *JCDR* 2012; 4461:2304.
12. Chandan C, Udayaditya M, et al. Dry eye disease following MSICS; A study from eastern India. *IIAR* 2016; 6:270-3.
13. Liu Z, Luo L, Zhang Z, Cheng B, Zheng D, et al. Tear film changes after phacoemulsification. *Zhonghua Yan Ke ZaZhi* 2002; 38:274–7.
14. Mohana S, Abhik S, Bithi C. Comparative evaluation of dry eye following cataract surgery; A study from north India. *IOSR-JDMS* 2014; 13:13-8.
15. Oh T, Jung Y, Chang D, et al. Changes in the tear film and ocular surface after cataract surgery. *Ipn J Ophthalmol* 2012; 56:113-8.
16. Saif MYS, et al. Dry eye changes after phacoemulsification and manual small incision cataract surgery Int. *J Ophthalmology Eye Res* 2016; 4:184-91.
17. Liu Xi, Yang-shun Gu, Ye-sheng Xu. Changes of tear film and tear secretion after phacoemulsification in diabetic patients. *J Zhejiang Univ Sci B*. 2008; 9:324–328
18. Cohen KL. Sterile corneal perforation after cataract surgery in Sjogren’s syndrome. *Br J Ophthalmol* 1982; 66:179-182.
19. Hardten DR. Dry eye disease in patients after cataract surgery. *Cornea* 2008; 27:855.
20. Insler MS, Boutros G, Boulware DW. Corneal ulceration following cataract surgery in patients with rheumatoid arthritis. *J.Am. Intraocul. Implant. Soc*. 1985; 11:594-597.
21. Jones RR, Maguire LJ. Corneal complications after cataract surgery in patients with rheumatoid arthritis. *Cornea* 1992; 11:148-150.
22. Roberts CW, Elie ER. Dry eye symptoms following cataract surgery. *Insight* 2007; 32:14-21.