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Research Article

Dry Eye Severity in Patients Undergoing Cataract Surgery with M-SICS Vs Phacoemulsification

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Abstract

Purpose: To determine the degree of dry eye in cataract patients operated using manual small incision cataract surgery (M-SICS) versus those treated by phacoemulsification.

Setting: Sala uno Ophthalmology Clinic, Cataract and refractive surgery department, Mexico City, Mexico.

Methods: In this observational, analytical, cross-sectional, and prospective study, 44 eyes of 39 patients were analyzed. They were divided into two groups based on the surgical technique: the M-SICS group and the phacoemulsification group. We assessed tear meniscus height, redness, corneal staining, tear breakup time using the Keratograph device both preoperatively and one month postoperatively.

Results: Of the 44 eyes analyzed, 27 (61%) were male, and 17 (39%) were female, with an average age of 68 years. Preoperatively, 36% of the patients had dry eye. The preoperative non-invasive keratograph tear breakup time (NIK-BUT) was 7.12 seconds, and postoperatively, it was 5.42 ± 1.56 seconds for the M-SICS group and 6.42 ± 1.26 and 5.21 ± 1.22 seconds pre and postoperatively, respectively, for the phacoemulsification group. One month after surgery, patients exhibited a mild degree of dry eye according to the ocular surface disease index (OSDI) test, with 57% in the M-SICS group and 44% in the phacoemulsification group. Dry eye presence was determined by surgical group, finding that 95% of those operated on with M-SICS had dry eye, while 83% of those treated with phacoemulsification did. However, this observed difference in the proportion of patients by surgical technique was not statistically significant ($\chi^2 = 1.862$, df = 1, $p > 0.05$)

Conclusion: It was observed that there was no statistically significant disparity between M-SICS and phacoemulsification concerning the incidence and symptomatic presentation of postoperative dry eye at the one-month mark. Consequently, one might infer that the occurrence of dry eye is associated with the surgical intervention itself and not exclusively linked to the chosen technique.

Keywords: Cataract; Cataract Complication; Dry Eye; Keratograph; M-SICS; Phacoemulsification; Post-Surgical Dry Eye

Abbreviations

M-SICS: Manual Small Incision Cataract Surgery; NIK-BUT: Non-invasive Keratograph Tear Breakup Time; OSDI: Ocular Surface Disease Index

Introduction

Cataract is one of the most common ophthalmological conditions in elderly patients and accounts for 50 to 90% of cases in developing countries like Mexico [1-3]. In practice, cataract extraction is also the most commonly performed ophthalmic surgery [3], and among the post-surgical complications frequently described is dry eye [4-7], a condition that by itself affects 10 to 20% of the general population [8,9].

This eye condition has a significant impact on the quality of life of affected individuals due to discomfort and visual impairment [8,10,11]. Moreover, it can compromise the outcomes of corneal, refractive, and cataract surgery [7,9,10,11].

The symptoms of post-cataract surgery dry eye can be temporary [7]; however, those that persist beyond the normal postoperative period of 3 months can be observed in approximately one-third of individuals, being one of the primary reasons for patient dissatisfaction after cataract extraction [10-12].

Various factors are believed to be responsible for the development of dry eye after cataract surgery since the ocular surface is exposed to multiple types of disruption during and after the procedure [4,14], including: incision architecture depending on the surgical technique, which causes corneal nerve damage; type of ophthalmic solution and intraoperative medication, which may have toxic effects on the corneal surface; exposure to microscope light leading to photothermal and phototoxic mechanisms; the amount of cumulative dissipated energy (CDE) and surgery time resulting in the destabilization of the surface due to surgically induced ocular inflammation [4-7,13-15].

As previously mentioned, although dry eye symptoms may be transient, they affect the patient's quality of life. Therefore, this study was conducted with the objective of assessing the presence of dry eye syndrome among patients undergoing M-SICS and phacoemulsification surgery at an ophthalmic care center in Mexico City.

Materials and Methods

Units of analysis and observation

The universe includes patients with cataracts who were operated on at the Ophthalmology Clinic "Sala uno" between October 2020 and February 2021, and a non-probabilistic quota sample was taken.

Type of study and design

Observational, analytical, cross-sectional, prospective.

Selection criteria

Inclusion criteria

- Patients aged over 60 years.
- Patients with cataracts.
- Patients who underwent cataract surgery using the phacoemulsification and M-SICS techniques.
- Patients willing to participate in the study and provide informed consent.

Exclusion criteria

- Patients with severe pre-surgical dry eye.
- Patients with associated eye diseases.
- Patients with rheumatological systemic diseases and diabetes mellitus.
- Users of ocular lubricants.
- Patients with a history of previous eye surgeries.

Elimination criteria

- Patients who do not attend follow-up appointments.
- Patients who no longer wish to participate in the study and withdraw their informed consent.
- Patients who develop post-surgical complications.

Method

The principal investigator measured the results of tear film tests as reported through the Keratograph device, both preoperatively and one month after the surgery.

Results and Discussion

Results

General characteristics of the sample

A total of 44 eyes from 39 patients who underwent cataract surgery using M-SICS and phacoemulsification techniques were studied. Nearly six out of every ten patients were male.

The average age of the patient group was 68 years, with an age range from 20 to 89 years. While half of them were 71 years or younger, when classified by age in decades, 49% were in the 70-79 age group, 18% were in the 60-69 group, and only 3% were in the 20-29 age group.

Therefore, 70.5% of the observed eyes were right eyes. Additionally, 52% of the eyes were operated on using phacoemulsification (Table 1).

Ophthalmological evaluation of patients

To determine the presence and degree of dry eye in patients, an evaluation was conducted based on various parameters, including tear meniscus height, redness, corneal staining, tear breakup time, and OSDI. These parameters were evaluated in the patient group, comparing them according to the surgical technique used for cataract extraction, based on preoperative measurements and one month postoperatively, to determine changes over time by surgical technique. The results were as follows:

Parameter	N(%)
Sex	
Male	61%
Female	39%
Age (y)	
20-29	3%
40-49	8%
50-59	13%
60-69	18%
70-79	41%
80 or more	18%
Laterality	
Right	70.50%
Left	29.50%
Surgery	
Phaco	52%
M-SICS	48%

Table 1: Demographic characteristics of patients.

Tear meniscus height

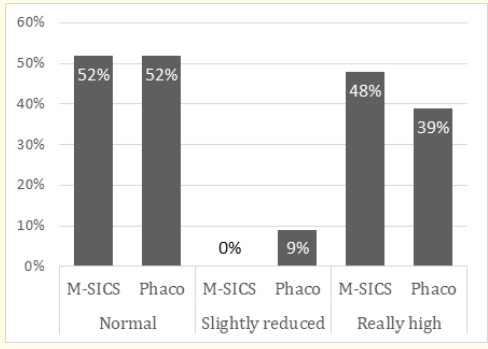
This was evaluated in both preoperative and postoperative measurements according to the surgical technique used, resulting in the following observations:

Preoperative measurement: At this evaluation point, in both treatment groups, 52% of patients had normal tear meniscus height. In the M-SICS group, 48% had a very high tear meniscus, while in the phacoemulsification group, 39% had a very high tear meniscus (Graphic 1).

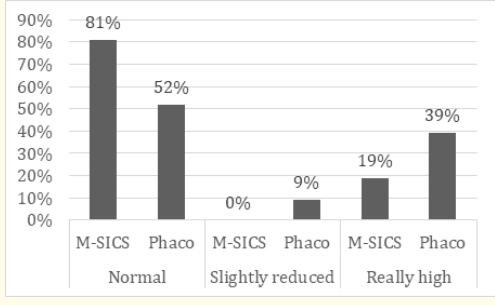
Postoperative measurement: As mentioned earlier, one month after surgery in patients treated with M-SICS there was a reduction, with 81% having a normal tear meniscus height, and only 19% having a very high tear meniscus. In the phacoemulsification group, the tear meniscus height remained constant, with the percentage distribution of tear meniscus height in patients being the same as in the preoperative assessment (Graphic 2).

Redness

This was evaluated based on the degree of redness in patients in different measurements according to the surgical technique, resulting in the following observations:

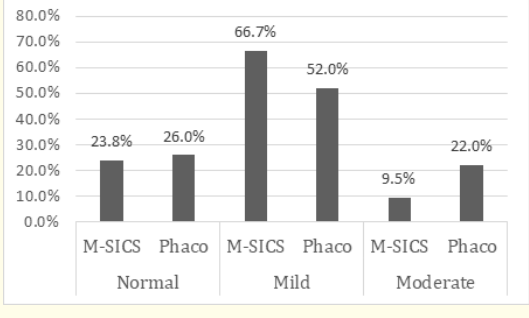


Graphic 1: Preoperative tear meniscus height by surgical technique.



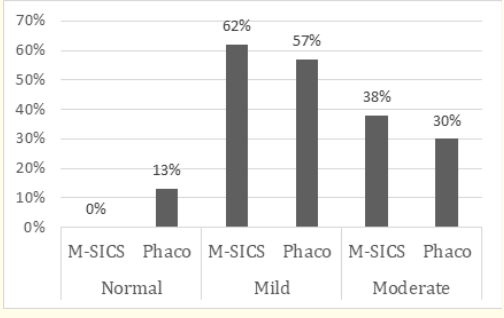
Graphic 2: Postoperative tear meniscus height by surgical technique.

Preoperative measurement: In the M-SICS group, 66.7% of patients had mild redness preoperatively, and 23.8% had normal redness. In the group to be operated by phacoemulsification, 52% of them had mild redness, and 26% had normal redness (Graphic 3).



Graphic 3: Preoperative ocular redness by surgical technique

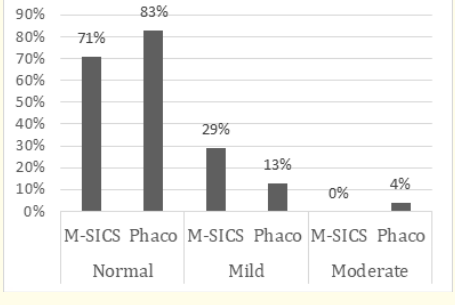
Postoperative measurement: In this evaluation, it was observed that 62% of eyes operated on using M-SICS had mild redness, and 38% had moderate redness. In the group operated by phacoemulsification, 57% had mild redness, and 30% had moderate redness. It is also important to note that there were no cases of normal redness in the M-SICS group at this assessment (Graphic 4).



Graphic 4: Postoperative ocular redness by surgical technique.

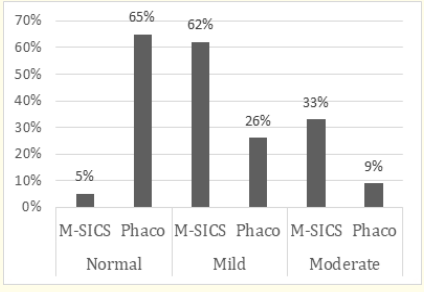
Corneal staining

Preoperative measurement: In the M-SICS group, 71% of patients had normal corneal staining, as did 83% of patients in the phacoemulsification g6oup. It's worth noting that in the M-SICS group, there were no cases of moderate staining, and this degree was observed in only 4% of patients assigned to phacoemulsification (Graphic 5).



Graphic 5: Preoperative corneal staining by surgical technique.

Postoperative measurement: One month after the intervention, it was observed that 62% of patients operated on using M-SICS had mild corneal staining, and only 5% had normal staining. In those treated with phacoemulsification, 65% had normal staining, and 9% had moderate corneal staining (Graphic 6).



Graphic 6: Postoperative corneal staining by surgical technique.

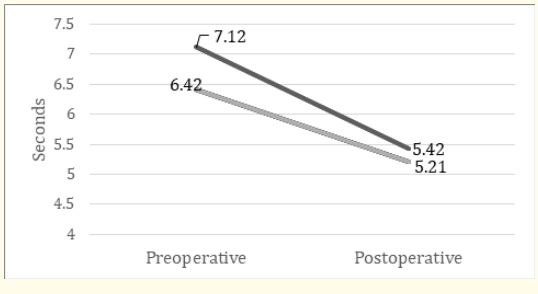
Non-invasive keratograph tear breakup time (NIK- BUT)

Preoperative Measurement: The average value of non-invasive keratograph tear breakup time (NIK-BUT) in the preoperative period for patients in the M-SICS group was 7.12 ± 1.71, while in the group to be operated using phacoemulsification, this parameter had an average value of 6.42 ± 1.26, with a difference of 0.70 between the groups (table 2).

Evaluation	M-SICS	Phaco	Difference
Preoperative	7.12	6.42	0.7
Postoperative	5.42	5.21	0.21

Table 2: Average NIK-BUT difference by surgical technique.

Postoperative Measurement: For this evaluation in both groups, there was a trend of decreased NIK-BUT. In the group operated on using M-SICS the average value was 5.42 ± 1.56, and in the phacoemulsification group, it was 5.21 ± 1.22, with a difference of 0.21 between the two groups (Graphic 7).



Graphic 7: Average NIK-BUT by surgical technique.

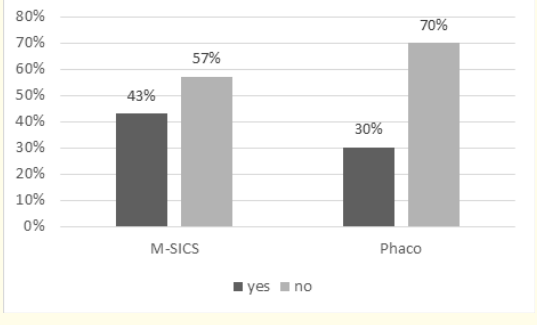
This is exemplified in the following graph and table, where you can see the average values of NIK-BUT and their difference over time by surgical technique.

Dry eye

Based on the previously mentioned evaluations, the presence and degree of dry eye in patients by surgical group were determined, resulting in the following:

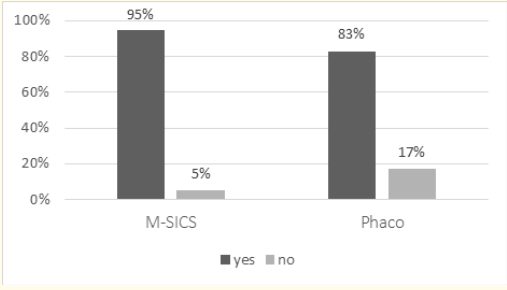
Presence of dry eye

Preoperative Evaluation: 36% of patients had dry eye in the preoperative period. Among these, 44% were in the M-SICS group, and 56% were in the phacoemulsification group. Thus, 43% of those assigned to the M-SICS group had dry eye, as did 30% of those assigned to phacoemulsification (Graphic 8). Based on this, and upon observing the proportional difference of patients with preoperative dry eye by treatment group, a Chi-squared test was conducted, finding that this difference is not statistically significant, meaning it is not a factor that could alter the observation results ($X^2 = 0.732$, df = 1, $p > 0.05$).



Graphic 8: Distribution by assigned treatment group according to the presence of preoperative dry eye.

Postoperative Evaluation: After the surgical intervention, the patients were evaluated again, and it was found that 89% had dry eye. Of these, 51% were operated on using phacoemulsification. The presence of dry eye by surgical group was determined, revealing that 95% of those operated on with M-SICS had dry eye, and 83% of those treated with phacoemulsification had dry eye (Graphic 9). However, this observed difference in the proportion of patients by surgical technique is not statistically significant ($X^2 = 1.862$, df = 1, $p > 0.05$), meaning it does not depend on the type of surgery performed.



Graphic 9: Distribution by assigned treatment group according to the presence of postoperative dry eye

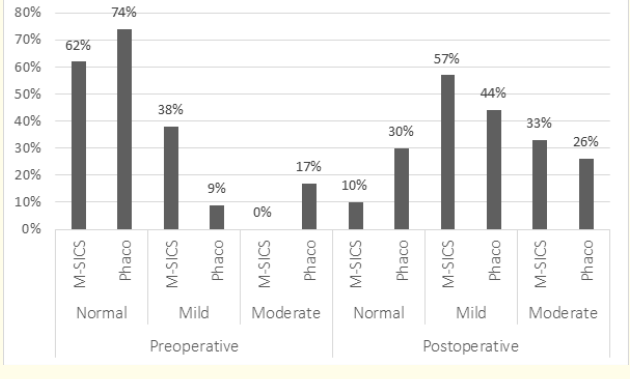
Degree of dry eye

This was calculated from the OSDI and the tests conducted on the patients by surgical group, resulting in the following:

Degree of dry eye according to OSDI

Preoperative Evaluation: For this measurement, 62% of patients assigned to the M-SICS group had a normal degree, and 38% had a mild degree. As for the patients to be operated on using phacoemulsification, 74% had a normal degree, and 17% had a moderate degree.

Postoperative Evaluation: After the surgery, 57% of patients operated on with M-SICS had a mild degree of dry eye according to OSDI, and only 10% had a normal degree. Similarly, 44% of those operated on with phacoemulsification had a mild degree, and 30% had a normal degree (Graphic 10).



Graphic 10: OSDI grade by treatment group pre and postoperative.

Discussion

This study aimed to assess the presence of preoperative dry eye and the worsening of dry eye in the postoperative state through two cataract surgery techniques: phacoemulsification and M-SICS. It was found that almost a third of the patients had at least a mild degree of preoperative dry eye, and we confirmed that changes in the ocular surface occur after cataract surgery, as 89% of the patients had postoperative dry eye.

We analyzed 44 eyes of 39 patients and found that the average age was 68 years, which coincides with the findings reported by Ishrat and Pragati. Unlike other studies where the majority of patients are women, 61% of our patients were men. This difference could be attributed to the fact that most of them were patients from campaigns where the difference in surgical coverage rates could be related to gender-defined social roles, as mentioned by Lewallen and Courtright.

It is well-documented that dry eye syndrome has multifactorial causes. In addition to factors such as advanced age, female gender, postmenopausal estrogen therapy, autoimmune diseases, vitamin deficiencies, smoking, contact lens use, ocular allergy, and diabetes mellitus, external factors like environmental pollution can also have an impact, as described by Donghui Yu and colleagues. In our study, we confirmed this impact because our patients, who were residents of Mexico City and did not have autoimmune diseases, diabetes mellitus, or concomitant ocular diseases preoperatively, found that 36% had a degree of dry eye.

This condition is a complex disease that cannot be categorized by a single sign or symptom, and changes in the ocular surface can also occur in the absence of symptoms, as was the case in this study, where 59.32% of patients had redness, 22% had corneal staining, and an average NIK-BUT of 6.75 seconds, with symptoms in only 31% of patients.

In the postoperative assessment of ocular redness, both groups showed changes reported before and after surgery, but these changes were more significant in patients operated on with the M-SICS technique. This may be due to the conjunctivoscleral manipulation involved in this technique compared to phacoemulsification, which has a corneal approach. Exposure to microscope light has also been reported as a contributing factor to red eyes and dry eyes, as it reduces the density of goblet cells, which is relatively greater in M-SICS surgery since it requires more time to perform.

When comparing corneal staining, there was an equal distribution between both groups preoperatively. However, in the assessment one month after surgery, a significant increase in the proportion of patients with the M-SICS technique presenting mild to moderate corneal staining was detected, which is indicative of ocular dryness. This pattern was also reported by Bipin Bista and colleagues in postoperative M-SICS patients. Although to a lesser extent, an increase in patients who underwent phacoemulsification was also found. Sahu and colleagues reported a peak in corneal staining values in patients operated on with phacoemulsification in the first month, with recovery thereafter.

The tear breakup time was found at the preoperative moment with an average of 7.12 seconds for M-SICS patients and 6.42 seconds for phacoemulsification patients. It's important to mention that an individual's tear breakup time can vary depending on the region, environmental factors, and race. In the study conducted by Fermon and colleagues in 2010 in Mexico, 747 healthy patients were analyzed, reporting an average value of 7.60 seconds, which is consistent with this study where we found initial values below the international literature's reported average. Although, on average, the patients selected for phacoemulsification surgery had a shorter NIK-BUT at the preoperative moment, a greater decrease in time was observed in M-SICS patients (1.7 seconds vs. 1.2 seconds). This can be attributed to the inflammatory changes caused by the mechanical trauma of the surgery, leading to the release of free radicals, cyclooxygenase, and proteolytic enzymes.

In both groups, when the OSDI test was performed, a similar proportion of patients with dry eye presence was found, which was not statistically significant ($X^2 = 0.732$, df = 1, $p > 0.05$). Postoperatively, there was an increase in the number of patients reporting dry eye in both groups, 95% in patients operated with M-SICS and 83% in phacoemulsification patients. However, when analyzed, it was not statistically significant ($X^2 = 1.862$, df = 1, $p > 0.05$). Therefore, the occurrence of dry eye in these patients could be attributed to the surgery itself and not the type of surgical technique. This is consistent with the findings reported by Dasgupta and colleagues in 2016, who analyzed 100 cataract patients postoperatively (50 M-SICS and 50 phacoemulsification), reporting the presence of dry eye in both techniques with similar values up to the 12th week of follow-up.

Limitations

This is a study from a single high-volume reference center in Mexico, which has a bias in patient selection because they are recruited from campaigns for low-income populations. There was no randomization in patient selection, and not all confounding variables were considered. Surgeries were performed by different doctors with varying years of experience.

However, this is the first study in Mexico that analyzes the presence of dry eye and compares it according to two different surgical techniques.

Conclusion

It was observed that there was no statistically significant disparity between M-SICS and phacoemulsification concerning the incidence and symptomatic presentation of postoperative dry eye at the one-month mark. Consequently, one might infer that the occurrence of dry eye is associated with the surgical intervention itself and not exclusively linked to the chosen technique.

Recommendations

It is necessary to conduct a study with a larger sample size, assessing comorbidities, and employing an extended follow-up period, during which each patient undergoes a distinct technique on each eye, all performed by the same surgeon.

Conflict of Interest

Authors have no conflict of interest or any financial interest to declare.

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