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Original Article

Comparison of omega-3 nutraceutical dietary supplement verses topical eye drops for the treatment of dry eye after phacoemulsification

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ABSTRACT

Objective*: To compare the effect of omega-3 dietary supplement vs topical conventional eye drops for the treatment of dry eye disease induced after un-complicated phacoemulsification*

Methods*: The study involved 42 cataract patients over 40 who developed dry eye after phacoemulsification surgery. Participants were divided into two groups: the treatment group received omega-3 fish oil supplementation (1000 mg) along with standard postoperative care, while the control group was given conventional eye drops (artificial tears) for 3 months. Objective assessments (Schirmer test and TBUT) and subjective OSDI questionnaires were used to evaluate dry eye symptoms at 1 week, 1 month, 2 months, and 3 months post-surgery. Patients with pre-existing dry eye, ocular diseases, or systemic conditions like diabetes or hyperlipidemia were excluded.*

Results*: The mean pre-treatment values of all three tests improved significantly in both groups after 3 months. After 3 months of treatment the control group exhibited a mean OSDI score of 24.55(SD=1.92), compared to 19.20 (SD = 1.91) in the treatment group, though this difference was not statistically significant (t = -1.972, p = 0.923). This trend continued throughout for other two objective tests Schirmer test (t = 1.149, p = 0.289) and TBUT (t = 0.901, p = 1.032), where t-tests consistently yielded p-values above 0.05, suggesting no statistically significant divergence in tear production between groups.*

Conclusion: *In conclusion, topical conventional eye drops and omega-3 dietary supplements (fish oil) both appear promising for the management of dry eye illness after unfussy phacoemulsification surgery.*

Keywords*: Tear break up time, Ocular surface disease index, Dry eye disease***,** *Schirmer test 1, polyunsaturated fatty acids*

1. INTRODUCTION

Dry eye is a prevalent form involving multiple factors that affect the precorneal tear film, also known as keratoconjunctivitis sicca, the disease causing dry eyes occur when either eyes don't produce enough quantity of tears or the tears don't have the proper composition to keep eyes lubricated with various degree of ocular surface epitheliopathy, neurosensory abnormalities and inflammation.[1] Chronic inflammation of ocular surface indorses ocular surface changes that starts with hyperosmolarity of the tear production and thus, enhance the severity of disease.[2]

The generation of a functioning of layer causing tears is essential for the eye surface system's operation. Tear stability and osmolarity can be negatively impacted by disturbances to the homeostasis, which can result in tissue injury via osmotic, mechanical, and inflammatory mechanisms. Any element that throws off this delicate balance has the potential to harm eyesight and vision. [3]

Different factors can alter prevalence of dry eye during operate such as, type of incision, certain intraocular lenses types, microscope light exposure time and the duration of the surgery. In post-operative care period use of antibiotics, steroids which contain preservatives can enhance dry eye sign and symptoms postoperatively.[4] The cause by which dry eye occurs after phacoemulsification is lower if we compare it with that after manually done SICS. [5]

The causes of DED are different from those of DED brought on by cataract surgery. Although preoperative DED can worsen postoperative DED, the dry eye disease (DED) ranges from 5% to 50% if we look at the global prevalence of this disease.[6] Currently, the recommended approach to treating cataracts is phacoemulsification in conjunction with intraocular lens implantation. On the other hand, this process might result in decreasing the density of goblet cells, which could lower vision quality by weakening the lipid layer in tears, creating instability in tears, and influencing the function of the eye. [7]

Throughout the procedure involved in the surgery of cataract—before, during, as well as after surgery can impact function and metabolism of conjunctival goblet cells. Postoperative ocular surface injury can promote increased production of arachidonic acid, while cyclooxygenases mediate a rise in proinflammatory prostaglandin A. Although postoperative dry eye is typically transient, the resulting inflammatory reactions stimulate the production of neurotrophic factors that aid in corneal nerve regeneration. [8, 9]

The most reported complaint after uncomplicated phacoemulsification is dry eye. Thus, quality of life compromises, daily life activities like reading, driving, computer use also affect.[10] Formerly dry eye symptoms are managed by increasing the tears production and quality, subsiding ocular surface inflammation, management of underlying eyelid pathologies with diet modification and routine life. Use of anti-inflammatory medications and eye drops used for lubrication of eyes post-surgery can mitigate symptoms caused by dry eye that is a conventional to treat dry eye to relief symptoms but only for short period of time. Artificial tears don’t treat the underlaying inflammation.[11]

Corticosteroids treat this ocular surface inflammation but can’t be used for long period of time due to their adverse side effects.[12] Alternative solution of this problem is to use eye drops containing fatty acids which have omega-3 involved in it or oral intake of essential dietary supplements as recommended by many clinicians because they have no significant side effects. Omega-3 can be 1st

line treatment for mild dry eye as American academy of optometry's preferred practice pattern mentioned in its major dry algorithm.[13]

A key area of interest and therapeutic significance is the comparative study of conventional topical eye drops versus dietary supplements containing omega 3 in treatment of disease of dry eye following simple phacoemulsification. To develop optimal treatment plans, it's essential to understand the complex interactions among the different parts of eye ocular system as well as mechanisms driving this disease. Potential treatment options, including conventional drops used for eyes and omega-3 dietary supplements, each address different aspects of health of eye and tear film stabilization. In the end, this study will enhance patient outcomes in ophthalmic practice by highlighting the roles in controlling dry eye disease following phacoemulsification.

2. METHODOLOGY

This randomized controlled trial was conducted at Al Ehsan Trust Hospital, Lahore, with 42 cataract patients over 40 years old who developed dry eye following uncomplicated phacoemulsification surgery. Using non-probability convenient sampling, patients were divided into two groups of 21. Group A received omega-3 fish oil supplementation (1000 mg per dose) alongside postoperative antibiotics and anti-inflammatory eye drops for three months. Group B received standard dry eye treatment, consisting of artificial tears, antibiotics, and anti-inflammatory eye drops, also administered for three months. Patients were diagnosed with dry eye based on objective measures (Schirmer test without anesthesia and tear film breakup time (TBUT) with fluorescein) and subjective assessment via the Ocular Surface Disease Index (OSDI) questionnaire. Assessments were conducted preoperatively and then postoperatively at 1 week, 1 month, 2 months, and 3 months.

The Schirmer test involved placing strips in the conjunctival sac for 5 minutes in dim light; results showing wetting below 10 mm indicated dry eye. TBUT testing was performed using fluorescein strips under slit lamp examination, with dry spots appearing in less than 5 seconds considered as dry eye. The OSDI questionnaire assessed the impact of dry eye on quality of life, scoring from zero (normal) to one hundred (severe dry eye). Exclusion criteria included any pre-existing dry eye, ocular surface disease, eyelid abnormalities, ocular hypertension, rheumatoid arthritis, trauma, chemical burns, excessive contact lens use, and previous surgeries impacting tear stability or production. Additionally, all participants were screened for hyperlipidemia and diabetes before enrollment. Written informed consent was obtained from all participants, ensuring confidentiality and anonymity.

3. RESULTS

The control group, comprising 21 individuals, had a mean age of 56.67 years (SD = 2.278) with an age range spanning from 41 to 75 years. In contrast, the treatment group, also consisting of 21 individuals, had a higher mean age of 60.81 years (SD = 2.402), and a broader age range from 40 to 80 years. Regarding gender distribution, the control group had 12 females and 9 males, while the treatment group had 11 females and 10 males, indicating a relatively balanced sex ratio across both groups.

The Schirmer test results were analyzed over multiple time points between a control group (N=21) and a treatment group (N=21), with corresponding t-test results and p-values provided for each comparison. Initially, at

baseline, both groups showed similar mean tear production levels (10.11 mm for control vs. 10.50 mm for treatment; p = 0.735), indicating no significant difference. This trend continued throughout subsequent evaluations at 1st week, 1st month, and 3rd month, where t-tests consistently yielded p-values above 0.05, suggesting no statistically significant divergence in tear production between groups. Notably, by the 2nd month, a borderline significance (p = 0.076) emerged, hinting at a potential trend towards increased tear production in the treatment group (8.67 mm) compared to the control (7.60 mm). These findings imply that while the treatment did not show significant efficacy over the entire study period, the observed trend at the 2nd month warrants further investigation to assess its clinical relevance and potential benefits in enhancing tear production.

Table 1: Comparison between control and treatment group according to Schirmer Test

Schirmer Test	Control Group (N=21)	Treatment Group (N=21)	T test	P-Value
Baseline				
Mean±SD	10.11±0.56	10.50±0.531	0.507	0.735
Range	7-18.50	5-13.5		
1st Week				
Mean±SD	5.45±0.47	5.55±0.52	0.135	0.354
Range	2-9	1-9		
1st Month				
Mean±SD	6.65±0.51	6.94±0.59	0.374	0.280
Range	4-13	2-12		
2nd Months				
Mean±SD	7.60±0.51	8.67±0.76	1.165	0.076
Range	4-14.50	4-18.50		
3rd Month				
Mean±SD	8.95±0.46	9.74±0.51	1.149	0.289
Range	6-15	5-13		

The mean pre-treatment Schirmer Test improved significantly in both groups after treatment. However, the Schirmer Test drift was significantly higher in the treatment group in comparison with the control group at the final visit postoperatively (9.74±0.51 and 8.95±0.46), respectively.

Figure 1: Schirmer Test Score Reported at Follow-Up Intervals

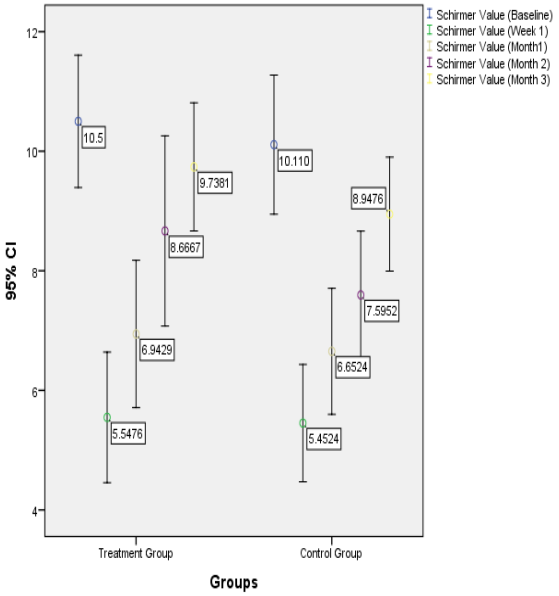


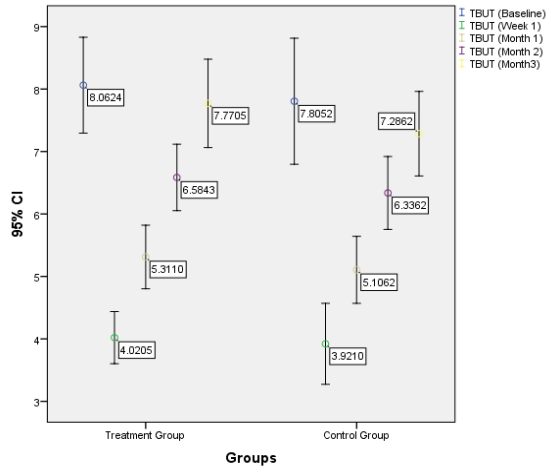
Table 2: Comparison between control and treatment group according to Tear Break up Time

TBUT	Control Group (N=21)	Treatment Group (N=21)	T test	P-Value
Baseline				
Mean±SD	7.81±0.48	8.06±0.37	0.423	0.329
Range	4.87-13.46	5.15-11.23		
1st Week				
Mean±SD	3.92±0.31	4.02±0.20	0.269	0.048
Range	1.30-7.11	2.32-6.31		
1st Month				
Mean±SD	5.11±0.26	5.31±0.24	0.577	0.877
Range	2.11-7.31	3.43-7.54		
2nd Months				
Mean±SD	6.34±0.28	6.58±0.26	0.656	0.642
Range	4.08-8.56	4.41-8.67		
3rd Month				
Mean±SD	7.29±0.32	7.77±0.34	0.901	1.032
Range	4.96-10.11	5.12-10.91		

The table presents TBUT measurements for both the control and treatment groups across multiple time points, with corresponding t-test results and p-values to assess differences between the groups. Initially, at baseline, both groups exhibited similar TBUT values, with means of 7.81 seconds (SD = 0.48)

for the control group and 8.06 seconds (SD = 0.37) for the treatment group, showing no statistically significant difference (p = 0.329). Notably, at the 1st week assessment, the treatment group demonstrated a significantly longer TBUT (mean 4.02 seconds, SD = 0.20) compared to the control group (mean 3.92 seconds, SD = 0.31), with a p-value of 0.048. However, this significant difference was not sustained in subsequent months, as evidenced by non-significant p-values at 1st month (p = 0.877), 2nd month (p = 0.642), and 3rd month (p = 1.032). These findings suggest a transient improvement in tear film stability early in the treatment phase.

Figure 2: Tear Break Up Time Score Reported at Follow-Up Intervals



The mean pre-treatment TBUT improved significantly in both groups after treatment. However, the TBUT drift was drastically greater in the treatment group in contrast with the control group at the final visit postoperatively (7.29±0.32 and 7.77±0.34), respectively.

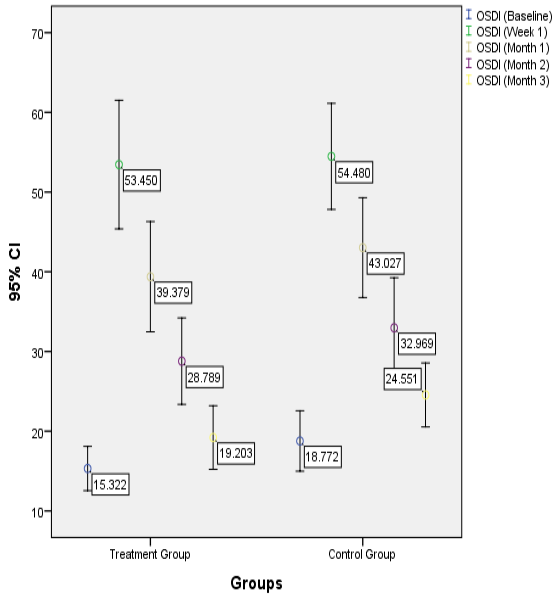
The OSDI scores were analyzed across various time points for both the monitor and treatment groups, with accompanying t-test results to determine statistical significance. At baseline, the control group exhibited a mean OSDI score of 18.77 (SD = 1.82), compared to 15.32 (SD = 1.33) in the treatment group, though this difference was not statistically significant (t = -1.532, p = 0.203). Similar findings persisted throughout subsequent assessments at 1st week, 1st month, 2nd month, and 3rd month, where t-tests consistently yielded p-values above 0.05, indicating no significant divergence in OSDI scores between groups. Despite generally lower OSDI scores observed in the treatment group across all time points, these differences did not reach statistical significance, suggesting that while the treatment may have had some impact on reducing ocular surface disease symptoms, the study may have been underpowered to detect smaller differences.

Table 3: Comparison between control and treatment group according to Ocular Surface Disease Index

OSDI	Control Group (N=21)	Treatment Group (N=21)	T test	P-Value
Baseline				
Mean±SD	18.77±1.82	15.32±1.33	-1.532	0.203
Range	9.09-41.70	7.50-31.30		
1st Week				
Mean±SD	54.48±3.19	53.45±3.87	-0.206	0.203
Range	33.87-87.50	31.30-83.30		
1st Month				
Mean±SD	43.03±3.00	39.38±3.31	-0.816	0.502
Range	17.34-69.40	17.90-69.40		
2nd Months				
Mean±SD	32.97±3.01	28.79±2.60	-1.051	0.549
Range	9.44-62.50	11.40-55.60		
3rd Month				
Mean±SD	24.55±1.92	19.20±1.91	-1.972	0.923
Range	11.40-44.44	8.33-41.70		

The mean pre-treatment OSDI increased extensively in two groups after treatment. However, the OSDI was drastically greater in the control group in comparison with the treatment group at the final postoperative visit (24.55±1.92 and 19.20±1.91), respectively.

Figure 3: Ocular surface Disease Index Score Reported at Follow-Up Intervals



4. DISCUSSION

In the aftermath of ocular surgery, dry eye can seriously impair a person's quality of life by causing burning, itching, redness, irritation, sensitivity to light, and even momentary blurriness of vision (14). The inflammation that follows surgery is a major contributor in post-surgical dry eye (15). Topical ocular drops and dietary supplements containing omega-3 nutraceuticals are two popular methods. Since the body is unable to create them, omega-3 dietary supplements are essential nutrients that must be included in the diet. These long-chain fatty acids support both the reduction of inflammatory responses and the regulation of inflammation (16).

In line prior with our study, our study revealed that there was improvement in both the groups with regard to treatment for Schirmer test, TBUT and OSDI. According to a study by Kesba et al. (17), there was a considerable improvement in the control and treatment groups for the Ocular Surface Disease Index (OSDI) and Tear Break-Up Time (TBUT). Nonetheless, there was a noticeably bigger improvement in the treatment group that took supplements containing omega-3 polyunsaturated fatty acids (PUFAs). This implies that an omega-3 PUFA-rich diet can improve tear film integrity and lessen symptoms of dry eyes following phacoemulsification. Schirmer test findings showed no statistically significant difference between the groups. In a similar vein, following cataract surgery, 61 eyes from 48 patients with newly developed dry eye complaints were assessed by Mohammadpour et al. (18) Their results corroborated those of Kesba et al. (17), showing both groups' OSDI and TBUT to have significantly improved. Notably, the therapy group displayed a higher improvement in OSDI (P=0.026) and a more pronounced improvement in TBUT (P=0.038) compared to the control group. The Schirmer test results, however, did not show a significant difference between the treatment and control groups (P=0.155).

According to a study by Miljanović et al., there is a strong link relating women's lower incidence of dry eye symptoms and their higher nutritional consumption of omega-3 fatty acids. (19). There is, however, no data explicitly assessing the effectiveness of omega-3 fatty acids for dry eyes pursuing phacoemulsification. Promising outcomes in reducing sensations of dryness were observed in a cross-sectional study evaluating the effects of oral linolenic acid, an omega-3 fatty acid, on cataract patients following surgery. (20) Our study findings revealed the same outcomes that use of Omega-3 FAs in treatment group reduced the dryness symptoms in Schirmer Test, TBUT and OSDI earlier as compared to topical conventional eye drops.

Conventional treatment options for DED include lubricating eye drops, corticosteroids, and immunomodulators, which aim to alleviate symptoms and promote ocular surface healing. These treatments primarily address the symptoms rather than targeting the underlying inflammation. Post-phacoemulsification, topical steroids are commonly prescribed

to manage inflammation and minimize dry eye symptoms caused by surgical trauma (21). A study comparing the ability of omega-3 fatty acids with conventional lubricating eye drops in non-surgical dry eye patients found that omega-3 supplementation was similarly effective in reducing symptoms and improving tear film stability. (22) In the context of post-phacoemulsification dry eye, topical therapies are often preferred due to their direct therapy to the ocular surface. These treatments target localized inflammation and provide immediate relief, which is particularly important in the immediate postoperative period. While omega-3 fatty acids have shown promise in managing dry eye symptoms, their systemic nature means they may not offer the same level of localized effect as topical treatments. Thus, for rapid and targeted relief, especially following cataract surgery, topical therapies remain the go-to choose. However, omega-3 supplementation might still be beneficial as a complementary strategy to address underlying inflammation and support overall ocular surface health.

Managing dry eye disease (DED) after phacoemulsification surgery remains complex and multifaceted. While omega-3 supplements and traditional topical eye drops work through different mechanisms, both may help relieve symptoms and improve ocular surface health. Because they modulate inflammatory pathways, omega-3 fatty acids, well-known for their anti-inflammatory qualities, provide a complete strategy to treating DED. According to preliminary research, taking omega-3 supplements may help lessen the symptoms of dry eyes following surgery. To be exact, further thorough investigation using randomised controlled trials is needed to ascertain the ability of omega-3 supplementation in this particular situation of phacoemulsification-induced DED in order to make firm recommendations. On the other hand, topical conventional eye drops—like lubricants and corticosteroids—remain a clinical practice standard because they treat inflammation directly on the ocular surface and providing immediate symptomatic relief. These treatments are well-supported by existing evidence in managing post-surgical dry eye.

5. CONCLUSION

In conclusion, topical conventional eye drops and omega-3 dietary supplements (fish oil) both appear promising for the managing of dry eye illness after phacoemulsification surgery. Nevertheless, new research indicates that other forms of omega-3 fatty acids are more effective than conventional topical treatments at reducing symptoms and enhancing the health of the ocular surface. Their systemic anti-inflammatory qualities might more successfully target underlying pathophysiological pathways, thereby providing a comprehensive strategy for the management of post-operative dry eye.

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