

# Comparison of efficacy of Omega3 fatty acids with Vitamin A and Vitamin C in the treatment of dry eye syndrome

## ABSTRACT

**Background:** Dry eye is one of major ocular surface disorders affecting millions of people. The chronic discomfort in these conditions interferes with the quality of life for a long period of time. A typical clinical symptoms of dry eye are 'burning sensation', 'irritation', and 'ocular fatigue'. Hence the Aim of this research "To compare the efficacy of Omega3 fatty acids with Vitamin A and Vitamin C in the treatment of dry eye syndrome".

**Methods:** The present study titled "Comparison of efficacy of Omega3 fatty acids with Vitamin A and Vitamin C in the treatment of dry eye syndrome" was conducted in VIMS & RC, Whitefield, Bangalore between January 2013 and July 2014 on the subjects who attended the outpatient department of Ophthalmology at VIMS & RC. This was a duration based, observational study of 100 clinically diagnosed cases of dry eye syndrome after informed consent which satisfied the inclusion and exclusion criteria. Dry eye syndrome diagnosis and severity level of diseases was determined with OSDI scoring, TBUT, Schirmer's test 1 & 2, Rose Bengal Test and TMH.

**Results:** Results showed that lesser grade of dry eye is seen in patients with higher education, younger age group and with indoor jobs as compared to patients with outdoor jobs who had higher grade of dry eye in our study groups. Improvement was observed in TBUT, Schirmer'1 & 2, Rose Bengal, OSDI score and grade of dry eye in both 2<sup>nd</sup> study group (CMC + Omega 3 fatty acids) and 3<sup>rd</sup> study group (CMC+ Vitamin A&C) as compared to the control group. (P<0.001) This improvement was more significant in 2<sup>nd</sup> study group as compared to 3<sup>rd</sup> study group.

**Conclusion:** It was observed that dry eye syndrome was more significantly improved in group2 (CMC + Omega 3 fatty acids) & groups 3 (CMC + Vitamin A&C). It was concluded using oral supplementation of omega 3 fatty acids or vitamin A & C would be beneficial for patients suffering from dry eye syndrome.

**Keywords:** Dry eye syndrome, Dry eye grading severity scheme, CMC, Omega 3 fatty acids, Vitamin A & C

## 1. INTRODUCTION

Dry eye is a multifactorial disease of the tears and ocular surface that results in symptoms of discomfort, visual disturbance, and tears film instability with potential damage to the ocular surface. According to the 2007 report of the International Dry Eye Workshop, Dry Eye can be defined as a multifactorial disease of the tears and ocular surface that results in symptoms of discomfort, visual disturbance, and tear film instability with potential damage to the ocular surface. It is accompanied by increased osmolarity of the tear film and inflammation of the ocular surface [1]. Dry eye is recognized as a disturbance of the Lacrimal Functional Unit (LFU) which is an integrated system comprising of the lacrimal glands, ocular surface (cornea, conjunctiva and meibomian glands, lids) and the sensory and motor nerves that connect them [2]. Disease or damage to any component of the lacrimal functional unit (LFU)

27 can destabilize the tear film and lead to ocular surface disease that expresses itself as dry  
28 eye. The risk factors for dry eye are multifactorial [3]. Dry eye syndrome is of two types - tear  
29 deficient and evaporative. It is accompanied by increased osmolarity of the tear film and  
30 inflammation of the ocular surface [1]. Dry eye syndrome affects a significant percentage of  
31 the population. It can affect any race, is more common in women, and is one of the most  
32 frequent reasons for seeking eye care [4]. Despite progress in determining the etiology,  
33 pathogenesis and treatment of dry eye syndrome, current knowledge remains inadequate  
34 .Moreover, the most common therapy for dry eye syndrome—artificial tears—provides only  
35 temporary and incomplete symptomatic relief. Among the various diseases affecting the  
36 ocular surface, dry eye is the mostcommon condition [2]. In standard outpatient clinics, it has  
37 been reported that 15–30% of new patients are affected by dry eye. 2 Although a decrease  
38 in tear production is a common condition in many types of dry eye, the severity of ocular  
39 surface lesions varies greatly from disease to disease [5].  
40 Therefore, identification of modifiable risk factors for dry eye syndrome may suggest  
41 avenues for investigation of novel preventive and treatment measures [6,7,8]. Research has  
42 shown that dietary intake of omega3 fatty acids affects overall amount of inflammatory  
43 activity in the body [9,10]. But efficacy of treatment with Vitamin A and C with Omega3 fatty  
44 acids has not been evaluated adequately. Accordingly this study is designed to compare  
45 efficacy of omega3 fatty acids with Vitamin A and C in treatment of dry eye syndrome.  
46 Hence the Objectives of this research is, To compare the efficacy between omega3 fatty  
47 acids with carboxymethyl cellulose eye drops , Vitamin A and Vitamin C with carboxymethyl  
48 cellulose eye drops and carboxymethyl cellulose eye drops only as a control group in the  
49 treatment of dry eye syndrome.To observe correlation between duration of treatment and  
50 improvement of dry eye syndrome in the study group.

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## 52 **2. MATERIAL AND METHODS**

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54 This is an observational, descriptive & comparative study of patients reporting to the  
55 ophthalmology out - patient department, Vydehi Institute of Medical Sciences And Research  
56 Centre, Whitefield Bangalore.

57 MATERIALS includes following items:

58 Sample size: 100 cases divided in 3 groups

59 **Study Design: interventional and non-observational**

60 TOOLS USED includes following items:

61 1. Informed consent

62 2. Dry eye grading severity scheme

63 The dry eye severity scale proposed by the Delphi Panel Report has proven to

64 Be a practical method of grading the severity of the disease. In the report a severity

65 Scale has been introduced which provides a useful scheme to aid in assessing

66 Severity of dry eye disease.

67 *Grade 1:* mild or episodic discomfort with no or minimal conjunctival/corneal staining or  
68 eye inflammation.

69 *Grade 2:* moderate episodic or chronic discomfort with no or minimal conjunctival/corneal  
70 staining or eye inflammation.

71 *Grade 3:* severe frequent or constant discomfort, with moderate to marked  
72 conjunctival/corneal staining.

73 *Grade 4:* very severe and/or disabling and constant discomfort with marked eye  
74 Inflammation [11].

75 3. Tear meniscus height

76 TMH was measured by a slit-lamp microscope at the center of the lower lid margin. The slit  
77 was positioned horizontal to the lower lid with indirect illumination, to exclude invasive

78 triggers like glaring or heating. The normal average value was taken as 1mm for average  
79 eyes.

80 4. Tear break up time

81 Break-up time has been defined as the interval between a complete blink and the  
82 appearance of the first randomly distributed dry spot on the cornea

83 5. Schirmer's test (1&2)

84 It is the test for tear quantity. It is performed by placing a narrow filter-paper strip in the  
85 inferior cul de sac. Aqueous tear production is measured by the length in millimeters that the  
86 strip wets over a period of 5 minutes. Schirmer test with anaesthesia (Schirmer's 2 test), also  
87 referred as a basic secretion test has been reported to give more variable results than  
88 schirmer without anaesthesia (Schirmer's 1). Here basic secretion is measured and results  
89 considered as follows:  $\geq 15$  mm /9-14 mm /4-8 mm /< 4 mm

90 6. Rose Bengal test

91 Rose Bengal is a vital stain taken up by dead and degenerating cells that have been  
92 damaged by the reduced tear volume 1.5mg/strip Rose Bengal strips are used to stain the  
93 eye

94 7. Ocular surface index questionnaire (OSDIQ – dry eye questionnaire)

95 This questionnaire consists of 12 questions asked to the patient. The OSDI is assessed on a  
96 scale of 0 to 100, with higher scores representing greater disability. The index demonstrates  
97 sensitivity and specificity in distinguishing between normal subjects and patients with dry eye  
98 disease. The OSDI is a valid and reliable instrument for measuring dry eye disease (normal,  
99 mild to moderate and severe) and effect on vision-related function. Values to determine dry  
100 eye severity calculated using the OSDI

101 Formula:  $OSDI = (\text{sum of scores}) \times 25 / (\# \text{ of questions answered})$ .

102 In the following, Patients reporting to the ophthalmology out-patient department diagnosed  
103 with Dry eye syndrome, treatment in one of three groups of our study and followed up every  
104 once a month for 2 months to obtain efficacy of treatment.

105 Treatment for each group was:

106 1st group: Carboxymethyl cellulose 1% eye drops (4times/day)

107 2nd group: Carboxymethyl cellulose 1% eye drops (4times/day) with oral supplementation of  
108 Omega 3 Fatty acids (Eicosapentaenoic Acid 360mg + Docasahexaenoic Acid 240mg/day)

109 3rd group: Carboxymethyl cellulose 1% eye drops (4times/day) with oral supplementation  
110 of Vitamin A (25000IU) and Vitamin C (500mg) twice weekly.

111 Finally, Descriptive and inferential statistical analysis has been carried out in the present  
112 study. Results on continuous measurements are presented on Mean  $\pm$  SD (Min-Max) and  
113 results on categorical measurements are presented in Number (%). Significance is assessed  
114 at 5 % level of significance. One way analysis of variance was performed to find the  
115 significance difference between the TBUT, Schirmer's test 1 & 2, OSDI Score and TMH with  
116 the treatments. Assumed equal variance in each group, done the bonferroni correction for to  
117 assess the pair wise comparison between the group1 with group2 and group3. Chi-square/  
118 Fisher Exact test has been used to find the significance of study parameters on categorical  
119 scale between two or more groups.

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### 122 3. RESULTS

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124 The Statistical software namely SAS 9.2, SPSS 15.0, STATA 11.1, MedCalc 9.0.1 , Systat  
125 12.0 and R environment ver.2.11.1 were used for the analysis of the data and Microsoft word  
126 and Excel have been used to generate tables [12-15].

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**Table 1: Gender distribution of patients studied according to age groups**

Age in years	Gender		Total	P-Value
	Female	Male		
21-30	18(33.3%)	13(28%)	31(31%)	0.759
31-40	20(37.3%)	15(33%)	35(35%)	
41-50	12(22%)	14(30%)	26(26%)	
51-60	4(7.4%)	3(7%)	7(7%)	
>60	0(0%)	1(2%)	1(1%)	
Total	54(100%)	46(100%)	100(100%)	

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In total number of 100 patients included in this study, in the group 21-30 years of age among 31 patients, 18 were female and 13 were male. In the group of 31-40 years among 35 patients 20 were female and 15 were male. In the group of 41-50 years of age among 26 patients 12 were female and 14 were male. In the group of 51-60 years of age among 7 patients 4 were female and 3 were male and in the group of more than 60 years, 1 patient was male.(table1)

**Table 2: Age distribution of patients studied according to grade of dry eye**

Age Years	Grade of Dry Eye			
	Grade 1	Grade 2	Grade 3	Total
21-30	21(42%)	10(22.2%)	0(0%)	31(31%)
31-40	19(38%)	14(31.1%)	2(4%)	35(35%)
41-50	8(16%)	16(35.6%)	2(4%)	26(26%)
51-60	2(4%)	4(8.9%)	1(2%)	7(7%)
> 60	0(0%)	1(2.2%)	0(0%)	1(1%)
Total	50(100%)	45(100%)	5(100%)	100(100%)

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P=0.053+, Significant, Fisher Exact test

In total number of 50 patients with grade 1 dry eye, 21(42%) were in 21-30 years age group , 19(38%) in 31-40, 8(16%) in 41-50 and 2 patients (4%) were in 51-60 years age group. In total number of 45 patients with grade 2 dry eye, 10(22.2%) were in 21-30 years age group,

144 14(31.1%) in 31-40, 16(35.6%) in 41-50, 4(8.9%) in 51-60 and 1 patient was in >60 years  
 145 age group. In total number of 5 patients with grade 3 dry eye, 2 patients were in 31-40 years  
 146 age group, 2 in 41-50 and 1 patient was in 51-60 years age group.(Table2)  
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148 **Table 3: Gender distribution of patients studied according to grade of dry eye**

Gender	Grade of dry eye			Total
	Grade 1	Grade 2	Grade 3	
Female	32(64%)	20(44.44%)	2(40%)	50(50%)
Male	18(36%)	25(55.56%)	3(60%)	50(50%)
Total	50(100%)	45(100%)	5(100%)	100(100%)

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151 P=0.114, Not Significant but positive association, Fisher Exact test

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153 In total number of 50 patients with grade 1 dry eye 32 patients (64%) were female and  
 154 18(36%) were male. In total number of 45 patients with grade 2 dry eye 20 patients (44.44%)  
 155 were female and 25 patients (55.56%) were male and in total number of 5 patients with  
 156 grade 3 dry eye 2 patients were female and 3 were male.(table3)  
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**Table 4: Gender distribution of patients studied according to study groups**

Gender/Study groups	CMC	CMC+Omega3 Fatty Acids	CMC+Vitamin A & C	Total	P-Value
Male	14 (41%)	19 (59%)	13 (38%)	46 (46%)	0.178
Female	20 (59%)	13 (41%)	21 (62%)	54 (54%)	
Total	34	32	34	100	

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161 According to study groups among total number of 34 patients in 1st study group, 14(41%)  
 162 were male and 20(59%) were female. Among total number of 32 patients in 2nd study group,  
 163 19(59%) were male and 13(41%) were female and among total number of 34 patients in 3rd  
 164 study group, 13(38%) were male and 21(62%) were female.(Table 4)

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**Table 5: TBUT according to time of presentation in study groups**

TBUT (Sec)	1st visit	1st follow up	2nd follow up	% Change	P-Value
<b>CMC group</b>					
≥10	7(20.6%)	25(73.5%)	30(93.8%)	73.2%	**P<0.001
5-9	27(79.4%)	9(26.5%)	2(6.2%)	-73.2%	
<5	0(0%)	0(0%)	0(0%)	0.0%	
<b>CMC + Omega 3 Fatty acids group</b>					
≥10	2(6.3%)	20(62.5%)	30(100%)	93.7%	**P < 0.001
5-9	25(78.1%)	12(37.5%)	0(0%)	-78.1%	
<5	5(15.6%)	0(0%)	0(0%)	-15.6%	
<b>CMC +Vitamin A&amp;C group</b>					
≥10	0(0%)	14(41.2%)	23(71.9%)	71.9%	**P< 0.001
5-9	28(82.4%)	18(52.9%)	9(28.1%)	-54.3%	
<5	6(17.6%)	2(5.9%)	0(0%)	-17.6%	

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171 In 1<sup>st</sup> study group 79.4% of patients had TBUT of 5-9 sec in 1<sup>st</sup> visit that in 2<sup>nd</sup> follow up  
 172 93.8% of patients had TBUT of ≥10. . (P value<0.001)  
 173 In 2<sup>nd</sup> study group 78.1% of patients had TBUT of 5-9 sec and 15.6%, TBUT of <5 sec in 1<sup>st</sup>  
 174 visit that in 2<sup>nd</sup> follow up 100% of patients had TBUT of ≥10. (P value<0.001)  
 175 In 3<sup>rd</sup> study group 82.4% of patients had TBUT of 5-9 sec and 17.6% had TBUT of <5 sec  
 176 that in 2<sup>nd</sup> follow up 71.9% of patients had TBUT of ≥10 sec. (P value<0.001). (Table 5)

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**Table 6: TBUT mean values according to study groups/time of presentation**

TBUT Mean±SD P values	CMC group	CMC+Omega3 Fatty Acids group	CMC+Vitamin A & C group
1st visit Mean ± SD	8.03 ± 1.14	6 ± 1.81	5.97 ± 1.59
1st follow up Mean ± SD	9.88 ± 1.30	9.25 ± 1.48	8.12 ± 2.39
2nd follow up Mean ± SD	10.52 ± 0.63	10.84 ± 0.72	10.39 ± 1.45

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Comparison of mean values of TBUT in study groups in 2<sup>nd</sup> follow up showed significant improvement in 2<sup>nd</sup> study group and 3<sup>rd</sup> study group as compared to 1<sup>st</sup> study group .(Table 6)

**Table 7: Schirmer's 1 test according to time of presentation in study groups**

Schirmer's 1 (mm)	1st visit	1st follow up	2nd follow up	% Change	P-Value
<b>CMC group</b>					
≥15	2(5.9%)	18(52.9%)	28(87.5%)	81.6%	**P<0.001
9-14	32(94.1%)	14(41.2%)	4(12.5%)	-81.6%	
4-8	0(0%)	2(5.9%)	0(0%)	0.0%	
<4	0(0%)	0(0%)	0(0%)	0.0%	
<b>CMC + Omega3 Fatty Acids group</b>					
≥15	0(0%)	15(46.9%)	26(86.7%)	86.7%	**P<0.001
9-14	10(31.3%)	14(43.8%)	4(13.3%)	-18.0%	
4-8	21(65.6%)	3(9.4%)	0(0%)	-65.6%	
<4	1(3.1%)	0(0%)	0(0%)	-3.1%	

CMC + Vitamin A & C group				
≥15	0(0%)	13(38.2%)	24(75%)	75.0%
9-14	7(20.6%)	17(50%)	8(25%)	4.4%
4-8	27(79.4%)	4(11.8%)	0(0%)	-79.4% **P<0.001
<4	0(0%)	0(0%)	0(0%)	0.0%

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189 In 2<sup>nd</sup> study group on CMC and Omega 3 fatty acids 65.6% of patients had schirmer's 1 of 4-  
190 8mm and 31.1%, schirmer's 1 of 9-14mm in 1<sup>st</sup> visit that in 2<sup>nd</sup> follow up 86.7% of patients  
191 had schirmer's of ≥15. (P value<0.001)

192 In 3<sup>rd</sup> study group on CMC and Vitamin A & C 79.4% of patients had schirmer's 1 of 4-8mm  
193 and 20.6% had schirmer;s 1 of 9-14 that in 2<sup>nd</sup> follow up 75% of patients had schirmer's 1 of  
194 ≥15. (P value<0.001).(Table7)

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**Table8: Shirmer's 1 mean values in study groups/time of presentation**

Schirmer's 1 Mean/SD P values	CMC group	CMC+Omega3fatty acids group	CMC+Vitamin A&C group
1st visit Mean ± SD	11.82 ± 1.34	8.09 ± 3.14	8.38 ± 2.57
1st follow up Mean ± SD	14.47 ± 1.88	12.75 ± 2.71	11.82 ± 3.44
2nd follow up Mean ± SD	15.32 ± 0.54	15.38 ± 1.21	14.97 ± 1.68

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198 Comparison of mean values of schirmer's 1 test in study groups in 2<sup>nd</sup> follow up showed  
199 significant improvement in 2<sup>nd</sup> study group and 3<sup>rd</sup> study group as compared to 1<sup>st</sup> study  
200 group .(Table 8)

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**Table 9: Schirmer's 2 test according to time of presentation in study groups**

Schirmer's 2	1st visit	1st follow up	2nd follow up	% Change	P-Value
CMC group					



≥15	0(0%)	2(5.9%)	10(31.3%)	31.3%	
9-14	11(32.4%)	22(64.7%)	22(68.8%)	36.4%	
4-8	23(67.6%)	10(29.4%)	0(0%)	-67.6%	**P<0.001
<4	0(0%)	0(0%)	0(0%)	0.0%	
CMC + Omega 3 fatty Acids group					
≥15	0(0%)	0(0%)	12(40%)	40.0%	
9-14	8(25%)	18(56.3%)	18(60%)	35.0%	**P<0.001
4-8	18(56.3%)	10(31.3%)	0(0%)	-56.3%	
<4	6(18.8%)	4(12.5%)	0(0%)	-18.8%	
CMC + Vitamin A & C group					
≥15	0(0%)	2(5.9%)	10(31.3%)	31.3%	
9-14	10(29.4%)	18(52.9%)	18(56.3%)	26.9%	
4-8	15(44.1%)	10(29.4%)	4(12.5%)	-31.6%	**P<0.001
<4	9(26.5%)	4(11.8%)	0(0%)	-26.5%	

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205 In 1<sup>st</sup> study group 67.6% of patients had schirmer's 2 test of 4-8 mm in 1<sup>st</sup> visit that in 2<sup>nd</sup>  
 206 follow up 68.8% of patients had schirmer's 2 test 9-14mm and 31.3% ≥15mm. (P  
 207 value<0.001)

208 In 2<sup>nd</sup> study group 56.6% of patients had schirmer's 2 of 4-8mm and 18.8%, schirmer's 2 of  
 209 <4mm in 1<sup>st</sup> visit that in 2<sup>nd</sup> follow up 60% of patients had schirmer's of 9-14mm and  
 210 40%≥15mm. (P value<0.001)

211 In 3<sup>rd</sup> study group 44.4% of patients had schirmer's 2 of 4-8mm and 26.5% had schirmer;s 2  
 212 of <4mm that in 2<sup>nd</sup> follow up 56.6% of patients had schirmer's 2 of 9-14mm and  
 213 31.3%≥15mm. (P value<0.001).(Table 9)

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215 **Table 10: Schirmer's 2 test mean values in study groups/time of presentation**

Schirmer's 2 Mean/SD P values	CMC group	CMC+Omega3 Acids group	Fatty CMC+Vitamin A & C group
1st visit Mean ± SD	9.29 ± 1.24	5.97 ± 3.03	5.88 ± 2.52
1st follow up Mean ± SD	11.74 ± 1.81	9.13 ± 2.49	8.91 ± 3.05
2nd follow up Mean ± SD	13.16 ± 0.64	12.88 ± 1.96	12.12 ± 1.86

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217 Comparison of mean values of schirmer's 2 test in study groups in 2<sup>nd</sup> follow up showed  
218 significant improvement in 2<sup>nd</sup> study group and 3<sup>rd</sup> study group as compared to 1<sup>st</sup> study  
219 group .(Table 10)  
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**Table 11: Rose Bengal Test according to time of presentation in study groups**

Rose Bengal	1st visit	1st follow up	2nd follow up	% Change	P-Value
<b>CMC group</b>					
0	12(35.3%)	22(64.7%)	31(96.9%)	61.6%	P< 0.001
1-3	22(64.7%)	12(35.3%)	1(3.1%)	-61.6%	
4-6	0(0%)	0(0%)	0(0%)	0.0%	
7-9	0(0%)	0(0%)	0(0%)	0.0%	
<b>CMC+ Omega 3 Fatty Acids group</b>					
0	0(0%)	16(50%)	26(86.7%)	86.7%	P< 0.001
1-3	12(37.5%)	11(34.4%)	4(13.3%)	-24.2%	
4-6	15(46.9%)	5(15.6%)	0(0%)	-46.9%	
7-9	5(15.6%)	0(0%)	0(0%)	-15.6%	
<b>CMC + Vitamin A &amp; C group</b>					

0	0(0%)	17(50%)	22(68.8%)	68.8%	
1-3	10(29.4%)	9(26.5%)	10(31.3%)	1.9%	
4-6	18(52.9%)	8(23.5%)	0(0%)	-52.9%	P < 0.001
7-9	6(17.6%)	0(0%)	0(0%)	-17.6%	

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In 1<sup>st</sup> study group 64.7% of patients had rose bengal score of 1-3 in 1<sup>st</sup> visit that in 2<sup>nd</sup> follow up 96.9 % of patients had rose bengal score of 0 (Negetive staining). (P value<0.001)

In 2<sup>nd</sup> study group 46.6% of patients had rose bengal score of 4-6 and 15.6%, rose bengal score of 7-9 in 1<sup>st</sup> visit that in 2<sup>nd</sup> follow up 86.7% of patients had rose bengal score of 0(Negetive staining). (P value<0.001)

In 3<sup>rd</sup> study group 52.9% of patients had rose bengal score of 4-6 and 17.6% had rose bengal score of 7-9 that in 2<sup>nd</sup> follow up 68.8% of patients had rose bengal score of 0 (Negetive staining) and 31.3%,1-3. (P value<0.001).(Table 11)

**Table12: Rose bengal test mean values in study groups/ time of presentation**

Study groups	CMC group	CMC+Omega3 fatty Acids group	CMC+ Vitamin A & C group
Mean ±SD 1st visit	1.74 ± 1.48 (3)	4.69 ± 1.87 (5.5)	5.29 ± 1.29 (6)
Mean ±SD 1st follow up	0.47 ± 1.05 (0)	2.09 ± 2.11 (3)	2.91 ± 2.14 (3)
Mean ±SD 2nd follow up	0 (0)	0.72 ± 1.28 (0)	0.74 ± 1.29 (0)

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Comparison of mean values of rose bengal score in study groups in 2<sup>nd</sup> follow up showed significant improvement in 2<sup>nd</sup> study group and 3<sup>rd</sup> study group as compared to 1<sup>st</sup> study group .(Table 12)

**Table13: OSDI score according to time of presentation in study groups**

OSDI Score	1st visit	1st follow up	2nd follow up	% Change	P-Value
CMC group					
0-12	0(0%)	16(47.1%)	28(87.5%)	87.5%	

Study groups	CMC group	CMC+Omega3 Acids group	Fatty	CMC+Vitamin A & C group	
13-22	20(58.8%)	18(52.9%)	4(12.5%)	-46.3%	**P<0.001
23-32	14(41.2%)	0(0%)	0(0%)	-41.2%	
33-100	0(0%)	0(0%)	0(0%)	0.0%	
CMC + Omega 2 Fatty acids group					
0-12	0(0%)	9(28.1%)	23(76.7%)	76.7%	**P<0.001
13-22	10(31.3%)	17(53.1%)	7(23.3%)	-8.0%	
23-32	21(65.6%)	6(18.8%)	0(0%)	-65.6%	
33-100	1(3.1%)	0(0%)	0(0%)	-3.1%	
CMC + Vitamin A & C group					
0-12	0(0%)	8(23.5%)	20(62.5%)	62.5%	**P<0.001
13-22	12(35.3%)	18(52.9%)	10(31.3%)	-4.0%	
23-32	20(58.8%)	6(17.6%)	2(6.3%)	-52.5%	
33-100	2(5.9%)	0(0%)	0(0%)	-5.9%	

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241 In 1<sup>st</sup> study group 58.8% of patients had OSDI score of 13-22 and 41.2%,23-32 in 1<sup>st</sup> visit  
 242 that in 2<sup>nd</sup> follow up 87.5% of patients had OSDI score of 0-12 .(P value<0.001)

243 In 2<sup>nd</sup> study group 65.6% of patients had OSDI score of 23-32 and 31.3%, OSDI score of  
 244 13-22 in 1<sup>st</sup> visit that in 2<sup>nd</sup> follow up 76.7% of patients had OSDI score of 0-12. (P  
 245 value<0.001)

246 In 3<sup>rd</sup> study group 58.8% of patients had OSDI score of 23-32 and 35.3% had OSDI score of  
 247 13-22 that in 2<sup>nd</sup> follow up 62.5% of patients had OSDI score of 0-12 and 31.3%, 13-22. (P  
 248 value<0.001) (Table13)

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250 **Table 14: OSDI mean values in study groups /time of presentation**

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Mean $\pm$ SD 1st visit	20.65 $\pm$ 4.55	25.22 $\pm$ 4.51	26.14 $\pm$ 4.26
Mean $\pm$ SD 1st follow up	12.55 $\pm$ 4.30	17.13 $\pm$ 5.00	19.52 $\pm$ 4.75
Mean $\pm$ SD 2nd follow up	10.33 $\pm$ 0.82	12.96 $\pm$ 2.59	14.71 $\pm$ 2.38

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**Table 15: Grade of dry eye in study groups according to time of presentation**

Comparison of mean values of OSDI score in study groups in 2<sup>nd</sup> follow up showed significant improvement in 2<sup>nd</sup> study group and 3<sup>rd</sup> study group as compared to 1<sup>st</sup> study group .(Table 14)

Study groups/Grade of dry eye	CMC group	CMC+Omega3 Fatty Acids group	CMC+Vitamin A & C group	Total	P-Value
1st visit					
1	34 (100%)	10 (31%)	6 (18%)	50 (50%)	
2	0	18 (56%)	27 (79%)	45 (45%)	**P<0.001
3	0	4 (13%)	1 (3%)	5 (5%)	
1st follow up					
0	20 (59%)	8 (25%)	6 (18%)	34 (36%)	
1	14 (41%)	21 (66%)	19 (56%)	52 (55%)	
2	0	3 (9%)	8 (23%)	11 (12%)	*P=0.001
3	0	0	1 (3%)	1 (1%)	
2nd follow up					
0	30 (93.75%)	27 (89.01%)	27 (84.4%)	84 (89.36%)	
1	2(6.25%)	3 (10.99%)	5 (15.6%)	10 (10.63%)	*P=0.004

259 In 1<sup>st</sup> study group or our control group all patients had grade 1 dry eye. According to AAO  
260 treatment guidelines all patients with grade 2 or more need to receive supportive treatment  
261 in addition to artificial tears and hence are not included in this group.<sup>106</sup> Hence, in 2<sup>nd</sup> follow  
262 up 93.75%(30) of patients had no dry eye.  
263 In 2<sup>nd</sup> study group 53% of patients had grade 2 dry eye and 4 patients had grade 3 dry eye  
264 that in 2<sup>nd</sup> follow up 89.01% of patients had no dry eye.  
265 In 3<sup>rd</sup> study group 79% of patients had grade 2 dry eye and 1 patient had grade 3 that in 2<sup>nd</sup>  
266 follow up 84.4% of patients had no dry eye.  
267 This showed in 2<sup>nd</sup> and 3<sup>rd</sup> study groups though there were more patients with higher grade  
268 of dry eye the improvement in 2<sup>nd</sup> follow up was more significant as compared to our control  
269 group.(P=0.004)(Table 15)  
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#### 272 4. DISCUSSION

273  
274 Dry eye disease is highly variable ocular surface disorder. The unpredictability of this  
275 disorder lies in its pathogenesis, as the clinical manifestations can be dramatically modified  
276 by external stimuli. Few studies have highlighted the efficacy of vitamin A and vitamin C in  
277 treatment of dry eye and comparison of their efficacy with omega 3 fatty acids.  
278 Miljanovic B, et al. showed women with a higher intake of omega3 fatty acids tended to have  
279 a lower risk of dry eye syndrome than did women with a lower intake [5].  
280 Creuzot C, et al. in a double-masked study of 71 patients with mild to moderate dry eye  
281 syndrome demonstrated a significant improvement in the Schirmer test, tear break-up time  
282 test, and fluorescein and lissamine green staining with the oral administration of  
283 polyunsaturated fatty acids [16].  
284 Macsai MS, also showed omega-3 dietary supplementation in blepharitis and meibomian  
285 gland dysfunction patients improved TBUT and schirmer score values significantly as  
286 compared to placebo [17].  
287 Drouault-Holowacz S, et al. showed that after 12 weeks of supplementation with anti-oxidant  
288 combination, tear film break up time(TBUT) scores (27.3%±8.4% with anti-oxidant  
289 combination versus 3.61%±4.3% with the placebo, p=0.017) and the Schirmer scores  
290 (26.9%±14.2% with anti-oxidant combination versus -4.7%±3.4% with the placebo,  
291 p=0.037) were significantly improved [18].  
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#### 294 5. CONCLUSION

295  
296 Dry eye syndrome is a disorder of the tear film, leading to excess dryness of the cornea and  
297 conjunctiva that leads to ocular discomfort, blurred vision, and damage to the ocular surface.  
298 It is diagnosed by obtaining a thorough history, including a review of symptoms, medications,  
299 social history, and a comprehensive eye examination with diagnostic testing. There are  
300 several treatment options that range from artificial tears to autologous blood serum drops.  
301 The best treatment option for each patient must be individualized for the type of dry eye  
302 state. The appropriate treatment of this highly prevalent condition may require modifying or  
303 adding additional treatments based on how they respond, but it ultimately can improve their  
304 quality of life and prevent ocular damage. In this study we compared efficacy of omega 3  
305 fatty acids with Vitamin A & C in treatment of dry eye. This improvement was more significant  
306 in 2<sup>nd</sup> study group as compared to 3<sup>rd</sup> group. These results are in agreement with those of  
307 previous studies which highlighted the efficacy of Omega3 fatty acids in the improvement of  
308 dry eye.

309 The strength of our study was the evaluation and follow up of dry eye patients by employing  
310 different dry eye diagnostic tests. The weakness of this study was less number of patients  
311 for study as most of them were not available for follow up.

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