

ISSN: 2454-6615

WORLD WIDE JOURNAL OF MULTIDISCIPLINARY RESEARCH AND DEVELOPMENT

VOLUME 11 ISSUE 10

October 2025

Open



WORLD WIDE JOURNAL
OF MULTIDISCIPLINARY RESEARCH
AND DEVELOPMENT

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WWJMRD 2025; 11(10): 1-5
www.wwjmr.com
International Journal
Peer Reviewed Journal
Refereed Journal
Indexed Journal
Impact Factor SJIF 2017:
5.182 2018: 5.51, (ISI) 2020-
2021: 1.361
E-ISSN: 2454-6615

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Comparison of Contrast Sensitivity After the Use of Sodium Hyaluronate Eye Drops in Dry Eye Patients

Anggraeni Adiwardhani, Husnun Amalia, Riani Witjaksana, Noviani Prasetyaningsih, Ariani Ratri Dewi

Abstract

Objective: This study aimed to compare contrast sensitivity status in dry eye patients before and after using sodium hyaluronate eyedrops.

Methods: This study is an experimental study. The subjects of the study were FK employees who were diligent, had corrected visual acuity of at least 6/12, were not using eye drops and were not taking routine medications. The examination carried out was vision with the best corrected visual acuity, contrast sensitivity using Pelli Robson and TF BUT (Tear Film Break Up Time). Data collection was carried out 2 times with a gap of 10 days, patients were asked to use NaHa eye drops 3 times daily. A total of 70 respondents were obtained. The data was analyzed using a 2x2 table (Fisher Test).

Results: The study was attended by 70 respondents, 65,7% were female. Majority of them have dry eye (58,6%) and most contrast sensitivity was normal (91,4%) even before the intervention. Using Fisher test, we compare the relationship between dry eye pre and post intervention, the results found to be no significant difference with $p=0,584$. We also compare the relationship between contrast sensitivity status with dry eye post intervention, the results were also no significant difference with $p=0,656$.

Conclusion: There were 12 dry eye respondents (17.1%) with improved contrast sensitivity after NaHa intervention. However, there was no significant difference in contrast sensitivity results either before or after the intervention

Keywords: Contrast Sensitivity, sodium hyaluronat eyedrops, dry eye.

Introduction

The times are getting more sophisticated, existing technology is making it easier for all lines of life. Individuals are increasingly helped by the technology in electronic devices. This causes an increasing number of individuals to use electronic devices. In addition to the increasing number of users, it turns out that the duration of use by each individual is also getting longer. Electronic devices that are often used include computers, laptops, tablets and mobile phones. Excessive use of these electronic devices can cause complaints in the form of ocular-visual complaints and musculoskeletal complaints.¹ Complaints that often arise include tired eyes, headaches, blurred vision and dry eyes, especially felt by those who spend a long time in front of the Video Display Terminal (VDT) screen such as employees. Ocular complaints arise mainly due to a decrease in the blinking reflex that causes an increase in evaporation in the eyes.^{2,3}

Dry eye is a chronic tear and ocular surface disorder, which is multifactorial and causes discomfort, visual impairment and instability of the tear film (LAM) so that it has the potential to damage the ocular surface. Symptoms that occur include burning, stabbing, dryness, irritation, sandy, blurred vision and obstruction. The prevalence of dry eye varies from 11 – 45% with 33% of adults over the age of 50 suffering from dry eye. The number of women is 2-3 times more compared to men. Symptoms of visual impairment here can be seen from the decrease in the results of the contrast sensitivity examination. LAM instability occurs when one of its 3 components is disturbed, the three components are fat, mucin and aquios.^{4,5,6,7,8}

There is no gold-standard examination for the diagnosis of dry eye. The Tear Film Break Up Time (TFBUT) test is the most commonly used test to check the stability of tears. This examination has a sensitivity of 83% and a specificity of 85%. It is said that the TFBUT examination is a qualitative examination in dry eye cases. In all types of dry eyes, there is instability in LAM and fast tear film break-up time.^{9,10}

Currently, there are many artificial teardrops circulating with various levels of viscosity, including hydroxypropylmethylcellulose (HPMC) cellulose derivatives, anionic cellulose polymer derivatives which are said to have a longer shelf life on the ocular surface than the previous derivate, namely *carboxymethylcellulose* (CMC) and finally the latest compound is *Sodium hyaluronate* (NaHa). This NaHa compound has the ability to hold water and maintain the stability of tears. In addition, NaHa is able to bind to corneal fibronectin so that it increases adhesion and migration of epithelial cells which will accelerate the healing process in the event of corneal erosion, in addition to having more value in the form of the ability to control local inflammation.^{9,11}

Methods

The design of this study is experimental. The location of the research is at the Faculty of Medicine, Trisakti University, Jakarta in February 2024. The population is the education staff of the Faculty of Medicine of Trisakti University. The inclusion criteria consisted of corrected visual acuity of at least 6/12, not in routine drip treatment, and not in routine systemic treatment. The exclusion criteria are the onset of allergic reactions and severe side effects in the use of NaHa eye drops. The data collected were age, gender, TFBUT examination

results both before and after the intervention with NaHa dripping, and the results of contrast sensitivity examination both before and after NaHa dripping. Data collection was carried out 2 times with a span of 10 days. NaHa drops are considered sufficient for 10 days based on In the case of corneal wounds in Saleh TT's research, it was found that the average change in the reduction in corneal wound diameter between groups on days 0-9 was statistically significant. This was not recovered on days 9-14. Therefore, in this study, it is planned to use sodium hyaluronate eye drops in 1 week.¹²

The examination flow starts from administrative data collection and then continues with a visus examination, after being included in the inclusion criteria, then the patient is subjected to a contrast sensitivity examination using the Pelli Robson Chart. The examination was carried out 3 times, namely the right eye, left eye and both eyes. The test result is considered normal. It is a score of 2, if it is less than 2, there is a decrease in contrast sensitivity and if the score is less than 1.5 it indicates a severe decrease in vision.¹³ The last check is the TFBUT check to find out the status of the *dry eye* Respondents. If there is an image of fluorescein break <10 seconds after the respondent opens his eyes, the respondent is declared to have *dry eye*, if it is ≥10 seconds, it is declared normal.^{14,15} Data analysis was performed using SPSS 25.0. Variables were analyzed using the Fisher's exact test (95% confidence level and p-value 5%).

Ethical approval permission to conduct this study was obtained from the Faculty of Medicine, Trisakti University Research Board.

Results

The total respondents in this study were 70 people.

Table 1: Distribution of Respondent Characteristics.

	Variable	N (%)
1	Gender	
	Male	24 (34,3%)
	Female	46 (65,7%)
2	Age	
	≤ 40 years	35 (50%)
	> 40 years	35 (50%)
3	Contrast Sensitivity Before Intervention	
	Less	6 (8,6%)
	Normal	64 (91,4%)
4	Contrast Sensitivity After Intervention	
	Less	5 (7,1%)
	Normal	65 (92,9%)
5	Number of Dry Eyes Before Intervention	
	Dry Eye	61 (87,1%)
	Normal	9 (12,9%)
6	Number of Dry Eyes After Intervention	
	Dry Eye	62 (88,6%)
	Normal	8 (11,4%)

Table 1 shows that the majority of respondents are women (65.7%). The age grouping is divided into early adulthood with a range of 18-40 years and intermediate adulthood with a range of 41-60 years.¹⁶ From the age group, which is divided into 2 groups, namely ≤40 years old and >40 years old, the number of both groups is exactly the same, namely 35 respondents. In this study, out of a total of 70 respondents, there were 61 respondents with *dry eye* status with the number of women with dry eyes as many as 41

people (58.6%).

The results of the contrast sensitivity test before and after the intervention were obtained that only 1 respondent experienced an improvement in the contrast sensitivity status, from 1.95 to 2.10, while the other respondents did not experience any change (whose status was normal remained normal and whose status was less remained less).

Table 2: The Relationship Between Dry Eye Pre and Post Intervention.

Factor	Dry Eye Post Intervensi		
	Dry Eye	Normal	
Dry Eye Pre Intervensi			
Dry Eye	52	8	0,584§
Normal	10	0	

§ : Fisher Test

Dry eye is determined from the results of the TFBUT examination carried out on both eyes, during coding, if one of the eyes has a TFBUT result of <10, the respondent is said to have *dry eye*. This is done for both pre-intervention and post-intervention measurements. The majority of FK

Usakti employees experienced *dry eye* pre and post intervention, as many as 52 respondents (74.3%). The relationship between dry eye pre and post intervention was found to be no significant difference using the Fisher test.

TABLE 3. Relationship between Contrast Sensitivity Status and Dry Eye Post Intervention.

Factor	Dry Eye Post Intervensi		
	Dry Eye	Normal	
Status Kontras Sensitivity			
Repair	12	2	0,656§
Remain	50	6	

§ : Fisher Test

From table 3 above, it was found that the largest number of respondents experienced a state of contrast sensitivity that remained with *dry eye* conditions even after intervention with sodium hyaluronate (NaHa) dripping. The respondents were 50 respondents (71.4%). The relationship between Contrast Sensitivity Status and Dry Eye Post Intervention was found to be meaningless using the fisher test.

Discussion

In the Darsini et al ¹⁷ study on Dry eye due to Sjogren's syndrome, which is an autoimmune disorder, the number of women is higher, because the prevalence of dry eye in autoimmune patients will increase by 8%, of which 78% are women. This was also found in this study where out of a total of 70 respondents there were 61 respondents with *dry eye* status with the number of women with *dry eyes* as many as 41 people (58.6%). Another reason is that the incidence of *dry eye* is more in women because as they age there is a drastic decrease in sex hormones (androgens, estrogen and progesterone), especially before menopause. It is known that sex hormones have an influence on the condition of the ocular surface through their effect on tear secretion, the function of the meibomime gland and the density of conjunctival Goblet cells. Decreased estrogen hormone can result in apoptosis of exocrine secretory cells, while decreased androgen hormone can result in reduced inflammatory protection of the ocular surface and reduced stimulation of aqueous secretion from the lacrimal gland. ¹⁷ In this study, all respondents had at least 6/12 sharp vision, because it was expected to focus on changes in the results of contrast sensitivity. This refers to patients with *dry eye* who can complain of a decrease in vision quality even though their vision is normal, this occurs because a decrease in contrast sensitivity does occur first before the decrease in visual acuity. ⁸

A Tear Film Break Up Time (TFBUT) examination was carried out which is an examination to assess the condition of the tear layer, the examination can be carried out by a semi-invasive method using fluorescein staining or a non-invasive method. This study uses a semi-invasive method. It was mentioned in the research article by Gensheimer et

al. that fluorescein drippings are known to shorten TFBUT so that it can produce less accurate results. ¹⁸

Szczotka et al ¹⁹, found that the results of TFBUT that shortened actually resulted in a sharp improvement in vision. A similar thing happened in this study where there was no improvement in contrast sensitivity in those with *dry eyes*. This can be caused by compensation from the body that causes frequent blinking so that even though TFBUT decreases, it is not accompanied by a sharp decrease in vision ¹⁹

Some of the things that are thought to be the cause of the meaninglessness of NaHa drops in this study include because respondents may not be consistent in using NaHa drops, because it is estimated that although in theory it is said that NaHa drops in the span of 1-2 weeks can improve the corneal epithelialization process but it turns out that it has not been able to improve TFBUT, another possibility that is the cause is an improper coding system, and not taking into account other *dry eye* confounding factors

In the study, Rolando et al ²⁰ stated that the results of contrast sensitivity decreased in respondents with *dry eyes* compared to the control group. In contrast to what was found in the Huang et al ²¹ study, contrast sensitivity decreased significantly only in those who had a history of *dry eye* and suffered from abnormalities in the cornea in the form of keratopathy epithelial punctata. This difference can be caused, among other things, because the contrast sensitivity test is still lacking references and there is no gold standard. However, both studies agreed that there would be an improvement in contrast sensitivity in dry eye sufferers after using artificial teardrops. Improvement in contrast sensitivity can occur because artificial tears can improve optical quality by forming a layer that moisturizes and smoothes the surface of the cornea. This improvement in optical quality will be able to improve contrast sensitivity ⁸

Ridder et al ²⁹, who examined the results of contrast sensitivity tests in *dry eye patients*, concluded the same thing as this study that there was no improvement in contrast sensitivity. Apart from etiologi *dry eye*-n, artificial teardrops are still the first line of therapy for the condition

of the eyes of the g. The International DEWS states that early intervention with artificial teardrops is able to restore the optimal condition of the ocular surface, can help prevent damage and damage caused by the condition of the dry eye.¹⁷

Conclusion

The characteristics of the majority of respondents were women of 46 people (65.7%). Before and after the intervention, the majority of respondents experienced *dry eye* and normal contrast sensitivity.

There was no meaningful association between *dry eye* pre and post-intervention. Respondents with improved contrast sensitivity status who remained *dry eye* after NaHa droplet were 12 respondents (17.1%). However, there was no significant difference in the results of contrast sensitivity both before and after the intervention.

The suggestion for further research to be better is to go down using the OSDI questionnaire, so that even though the drip with NaHa has not shown an improvement in the TFBUT value, if there has been a subjective decrease in complaints, the results will be seen, Daily drug drips should also be monitored more closely than other confounding factors such as environmental factors should also be taken into account such as air humidity levels, daily activities, smoking habits, length of use of gadgets, etc.

Funding

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Conflict of Interest

None declared

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Comparison of Contrast Sensitivity After the Use of Sodium Hyaluronate Eye Drops in Dry Eye Patients

by Anggraeni Adiwardhani FK

Submission date: 11-Jun-2026 09:10AM (UTC+0700)

Submission ID: 2980825967

File name: -sodium-hyaluronate-eye-drops-in-dry-eye-patients_1760530129.pdf (1.03M)

Word count: 3384

Character count: 17470



WJMRD 2025; 11(10): 1-5
www.wjmrj.com
International Journal
Peer Reviewed Journal
Refereed Journal
Indexed Journal
Impact Factor SJIF 2017:
5.182 2018: 5.51, (ISI) 2020-
2021: 1.361
E-ISSN: 2454-6615

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Keywords: Contrast Sensitivity, sodium hyaluronate eyedrops, dry eye.

Introduction

The times are getting more sophisticated, existing technology is making it easier for all lines of life. Individuals are increasingly helped by the technology in electronic devices. This causes an increasing number of individuals to use electronic devices. In addition to the increasing number of users, it turns out that the duration of use by each individual is also getting longer. Electronic devices that are often used include computers, laptops, tablets and mobile phones. Excessive use of these electronic devices can cause complaints in the form of ocular-visual complaints and musculoskeletal complaints. ¹ Complaints that often arise include tired eyes, headaches, blurred vision and dry eyes, especially felt by those who spend a long time in front of the Video Display Terminal (VDT) screen such as employees. Ocular complaints arise mainly due to a decrease in the blinking reflex that causes an increase in evaporation in the eyes. ^{2,3}

Dry eye is a chronic tear and ocular surface disorder, which is multifactorial and causes discomfort, visual impairment and instability of the tear film (LAM) so that it has the potential to damage the ocular surface. Symptoms that occur include burning, stabbing, dryness, irritation, sandy, blurred vision and obstruction. The prevalence of dry eye varies from 11 – 45% with 33% of adults over the age of 50 suffering from dry eye. The number of women is 2-3 times more compared to men. Symptoms of visual impairment here can be seen from the decrease in the results of the contrast sensitivity examination. LAM instability occurs when one of its 3 components is disturbed, the three components are fat, mucin and aqueous. ^{4,5,6,7,8}

There is no gold-standard examination for the diagnosis of dry eye. The Tear Film Break Up Time (TFBUT) test is the most commonly used test to check the stability of tears. This examination has a sensitivity of 83% and a specificity of 85%. It is said that the TFBUT examination is a qualitative examination in dry eye cases. In all types of dry eyes, there is instability in LAM and fast tear film break-up time.^{9,10}

Currently, there are many artificial teardrops circulating with various levels of viscosity, including hydroxypropylmethylcellulose (HPMC) cellulose derivatives, anionic cellulose polymer derivatives which are said to have a longer shelf life on the ocular surface than the previous derivate, namely *carboxymethylcellulose* (CMC) and finally the latest compound is *Sodium hyaluronate* (NaHa). This NaHa compound has the ability to hold water and maintain the stability of tears. In addition, NaHa is able to bind to corneal fibronectin so that it increases adhesion and migration of epithelial cells which will accelerate the healing process in the event of corneal erosion, in addition to having more value in the form of the ability to control local inflammation.^{9,11}

Methods

The design of this study is experimental. The location of the research is at the Faculty of Medicine, Trisakti University, Jakarta in February 2024. The population is the education staff of the Faculty of Medicine of Trisakti University. The inclusion criteria consisted of corrected visual acuity of at least 6/12, not in routine drip treatment, and not in routine systemic treatment. The exclusion criteria are the onset of allergic reactions and severe side effects in the use of NaHa eye drops. The data collected were age, gender, TFBUT examination

results both before and after the intervention with NaHa dripping, and the results of contrast sensitivity examination both before and after NaHa dripping. Data collection was carried out 2 times with a span of 10 days. NaHa drops are considered sufficient for 10 days based on In the case of corneal wounds in Saleh TT's research, it was found that the average change in the reduction in corneal wound diameter between groups on days 0-9 was statistically significant. This was not recovered on days 9-14. Therefore, in this study, it is planned to use sodium hyaluronate eye drops in 1 week.¹²

The examination flow starts from administrative data collection and then continues with a visus examination, after being included in the inclusion criteria, then the patient is subjected to a contrast sensitivity examination using the Pelli Robson Chart. The examination was carried out 3 times, namely the right eye, left eye and both eyes. The test result is considered normal. It is a score of 2, if it is less than 2, there is a decrease in contrast sensitivity and if the score is less than 1.5 it indicates a severe decrease in vision.¹³ The last check is the TFBUT check to find out the status of the dry eye Respondents. If there is an image of fluorescein break <10 seconds after the respondent opens his eyes, the respondent is declared to have dry eye, if it is ≥10 seconds, it is declared normal.^{14,15} Data analysis was performed using SPSS 25.0. Variables were analyzed using the Fisher's exact test (95% confidence level and p-value 5%).

Ethical approval permission to conduct this study was obtained from the Faculty of Medicine, Trisakti University Research Board.

Results

The total respondents in this study were 70 people.

Table 1: Distribution of Respondent Characteristics.

	Variable	N (%)
1	Gender	
	Male	24 (34,3%)
	Female	46 (65,7%)
2	Age	
	< 40 years	35 (50%)
	> 40 years	35 (50%)
3	Contrast Sensitivity Before Intervention	
	Less	6 (8,6%)
	Normal	64 (91,4%)
4	Contrast Sensitivity After Intervention	
	Less	5 (7,1%)
	Normal	65 (92,9%)
5	Number of Dry Eyes Before Intervention	
	Dry Eye	61 (87,1%)
	Normal	9 (12,9%)
6	Number of Dry Eyes After Intervention	
	Dry Eye	62 (88,6%)
	Normal	8 (11,4%)

Table 1 shows that the majority of respondents are women (65.7%). The age grouping is divided into early adulthood with a range of 18-40 years and intermediate adulthood with a range of 41-60 years.¹⁶ From the age group, which is divided into 2 groups, namely <40 years old and >40 years old, the number of both groups is exactly the same, namely 35 respondents. In this study, out of a total of 70 respondents, there were 61 respondents with dry eye status with the number of women with dry eyes as many as 41

people (58.6%). The results of the contrast sensitivity test before and after the intervention were obtained that only 1 respondent experienced an improvement in the contrast sensitivity status, from 1.95 to 2.10, while the other respondents did not experience any change (whose status was normal remained normal and whose status was less remained less).

Table 2: The Relationship Between Dry Eye Pre and Post Intervention.

Factor	Dry Eye Post Intervensi		
	Dry Eye	Normal	
Dry Eye Pre Intervensi			
Dry Eye	52	8	0,584§
Normal	10	0	

§ : Fisher Test

Dry eye is determined from the results of the TFBUT examination carried out on both eyes, during coding, if one of the eyes has a TFBUT result of <10, the respondent is said to have *dry eye*. This is done for both pre-intervention and post-intervention measurements. The majority of FK

Usakti employees experienced *dry eye* pre and post intervention, as many as 52 respondents (74.3%). The relationship between *dry eye* pre and post intervention was found to be no significant difference using the Fisher test.

TABLE 3. Relationship between Contrast Sensitivity Status and Dry Eye Post Intervention.

Factor	Dry Eye Post Intervensi		
	Dry Eye	Normal	
Status Kontras Sensitivity			
Repair	12	2	0,656§
Remain	50	6	

§ : Fisher Test

From table 3 above, it was found that the largest number of respondents experienced a state of contrast sensitivity that remained with *dry eye* conditions even after intervention with sodium hyaluronate (NaHa) dripping. The respondents were 50 respondents (71.4%). The relationship between Contrast Sensitivity Status and Dry Eye Post Intervention was found to be meaningless using the fisher test.

Discussion

In the Darsini et al¹⁷ study on Dry eye due to Sjogren's syndrome, which is an autoimmune disorder, the number of women is higher, because the prevalence of dry eye in autoimmune patients will increase by 8%, of which 78% are women. This was also found in this study where out of a total of 70 respondents there were 61 respondents with *dry eye* status with the number of women with *dry eyes* as many as 41 people (58.6%). Another reason is that the incidence of *dry eye* is more in women because as they age there is a drastic decrease in sex hormones (androgens, estrogen and progesterone), especially before menopause. It is known that sex hormones have an influence on the condition of the ocular surface through their effect on tear secretion, the function of the meibomime gland and the density of conjunctival Goblet cells. Decreased estrogen hormone can result in apoptosis of exocrine secretory cells, while decreased androgen hormone can result in reduced inflammatory protection of the ocular surface and reduced stimulation of aqueous secretion from the lacrimal gland.¹⁷ In this study, all respondents had at least 6/12 sharp vision, because it was expected to focus on changes in the results of contrast sensitivity. This refers to patients with *dry eye* who can complain of a decrease in vision quality even though their vision is normal, this occurs because a decrease in contrast sensitivity does occur first before the decrease in visual acuity.⁸

A Tear Film Break Up Time (TFBUT) examination was carried out which is an examination to assess the condition of the tear layer, the examination can be carried out by a semi-invasive method using fluorescein staining or a non-invasive method. This study uses a semi-invasive method. It was mentioned in the research article by Gensheimer et

al. that fluorescein drippings are known to shorten TFBUT so that it can produce less accurate results.¹⁸

Szczotka et al¹⁹, found that the results of TFBUT that shortened actually resulted in a sharp improvement in vision. A similar thing happened in this study where there was no improvement in contrast sensitivity in those with *dry eyes*. This can be caused by compensation from the body that causes frequent blinking so that even though TFBUT decreases, it is not accompanied by a sharp decrease in vision.¹⁹ Some of the things that are thought to be the cause of the meaninglessness of NaHa drops in this study include because respondents may not be consistent in using NaHa drops, because it is estimated that although in theory it is said that NaHa drops in the span of 1-2 weeks can improve the corneal epithelialization process but it turns out that it has not been able to improve TFBUT, another possibility that is the cause is an improper coding system, and not taking into account other *dry eye* confounding factors

In the study, Rolando et al²⁰ stated that the results of contrast sensitivity decreased in respondents with *dry eyes* compared to the control group. In contrast to what was found in the Huang et al²¹ study, contrast sensitivity decreased significantly only in those who had a history of *dry eye* and suffered from abnormalities in the cornea in the form of keratopathy epithelial punctata. This difference can be caused, among other things, because the contrast sensitivity test is still lacking references and there is no gold standard. However, both studies agreed that there would be an improvement in contrast sensitivity in *dry eye* sufferers after using artificial teardrops. Improvement in contrast sensitivity can occur because artificial tears can improve optical quality by forming a layer that moisturizes and smoothes the surface of the cornea. This improvement in optical quality will be able to improve contrast sensitivity.⁸

Ridder et al²⁹, who examined the results of contrast sensitivity tests in *dry eye patients*, concluded the same thing as this study that there was no improvement in contrast sensitivity. Apart from etiologi *dry eye*-n, artificial teardrops are still the first line of therapy for the condition

of the eyes of the g. The International DEWS states that early intervention with artificial teardrops is able to restore the optimal condition of the ocular surface, can help prevent damage and damage caused by the condition of the dry eye.¹⁷

Conclusion

The characteristics of the majority of respondents were women of 46 people (65.7%). Before and after the intervention, the majority of respondents experienced *dry eye* and normal contrast sensitivity.

There was no meaningful association between *dry eye* pre and post-intervention. Respondents with improved contrast sensitivity status who remained *dry eye* after 7aHa droplet were 12 respondents (17.1%). However, there was no significant difference in the results of contrast sensitivity both before and after the intervention.

The suggestion for further research to be better is to go down using the OSDI questionnaire, so that even though the drip with NaHa has not shown an improvement in the TFBut value, if there has been a subjective decrease in complaints, the results will be seen. Daily drug drips should also be monitored more closely then other confounding factors such as environmental factors should also be taken into account such as air humidity levels, daily activities, smoking habits, length of use of gadgets, etc.

5 Finding

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Conflict of Interest

None declared

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