

# lessons learned from things done well and things done poorly in dry eye

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# disclosures

- |   |   |   |
|---|---|---|
| last 12 months  | last 12 months  | last 12 months  |
| allergan/abbvie<br>bausch health<br>novartis<br>sun pharma<br>kala pharma<br>tarsus pharma<br>hovione scientia<br>silk-tech | sydnexis<br>topcon<br>eyenovia bio<br>laboratoires Thea<br>aurinia pharma<br>eyevance pharma<br>surface pharma<br>nevakar, inc.<br>visus therapeutics | aperta biosciences<br>astareal, inc.<br>azura ophthalmics<br>aldeyra therapeutics<br>allysta<br>vyluma<br>nicox<br>ocuphire |

## Lessons Learned

Algorithms

Artificial tears

Tear break up patterns

Tear Film Oriented Therapy

## Dry eye/MGD algorithms

**ASRS PREOPERATIVE OSD ALGORITHM**

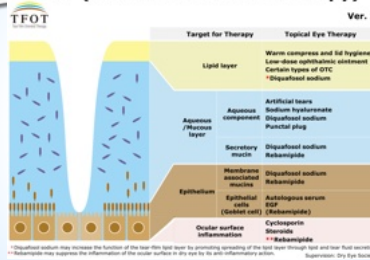
**Diagnosing the severity of dry eye: a color and practical algorithm** (Ophthalmol. 2014 Sep;26(9):1548-75)

**A Practical Approach to Severity Classification and Treatment of Dry Eye Disease: A Proposal from the Mexican Dry Eye Disease Expert Panel** (Can Ophthalmol. 2022 Apr;26:1931-1956)

**The Ocular Surface, 2017** (JAMA 2017;317(2):276-283, Craig JP, Nichols KK, Akpek EK, et al. TFOS DEWS II Definition and Classification Report)

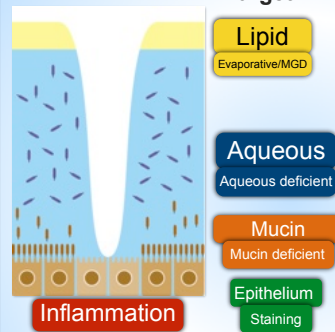
## Tear Film Oriented Therapy (TFOT)

### TFOT (Tear Film Oriented Therapy) Ver. 1



Yokoi N, Georgiev GA. Tear Film-Oriented Diagnosis and Tear Film-Oriented Therapy for Dry Eye Based on Tear Film Dynamics. Invest Ophthalmol Vis Sci. 2018 Nov 1;59(14):DES13-DES22. doi: 10.1167/iov.17-23700. PMID: 30481801.

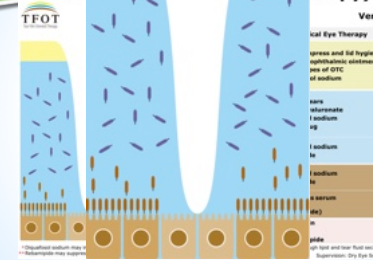
### Target Topical therapy



Yokoi N, Georgiev GA. Tear Film-Oriented Diagnosis and Tear Film-Oriented Therapy for Dry Eye Based on Tear Film Dynamics. Invest Ophthalmol Vis Sci. 2018 Nov 1;59(14):DES13-DES22. doi: 10.1167/iov.17-23700. PMID: 30481801.

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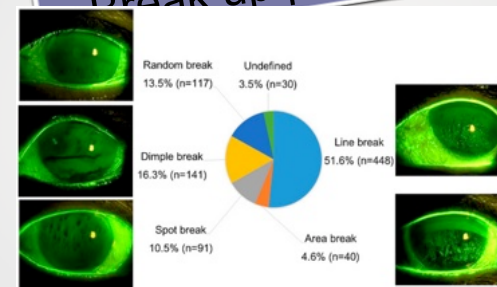
## Tear break-up time

## Break up pattern

“TBUT less than 10 s...an abnormal tear film...5 s to 10 s considered marginal...less than 5 s indicative of dry eye”  
 “The cutoff value for short TBUT is 5 seconds.”

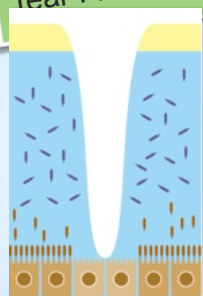
Vidas Pauk S, Petriček I, Jukić T, Popović-Suić S, Tomić M, Kalauz M, Jandroković S, Masnec S. NONINVASIVE TEAR FILM BREAK-UP TIME ASSESSMENT USING HANDHELD LIPID LAYER EXAMINATION INSTRUMENT. *Acta Clin Croat.* 2019 Mar;58(1):63-71. doi: 10.20471/acc.2019.58.01.09. PMID: 31363327; PMCID: PMC6629192.  
 Tsubota K. Short Tear Film Breakup Time-Type Dry Eye. *Invest Ophthalmol Vis Sci.* 2018 Nov 1;59(14):DES6-DES70. doi: 10.1167/iov.17-23746. PMID: 30481808.

## Break up pattern



Shigeyasu C, Yamada M, Yokoi N, Kawashima M, Suwaki K, Uchino M, Hiratsuka Y, Tsubota K, On Behalf Of The Deca-J Study Group. Characteristics and Utility of Fluorescein Breakup Patterns among Dry Eyes in Clinic-Based Settings. *Diagnostics (Basel).* 2020 Sep 17;10(9):711. doi: 10.3390/diagnostics10090711. PMID: 32957707; PMCID: PMC7555739.

## Tear Film Oriented Therapy (TFOT)



Break up pattern	Dry eye subtype
Line break	Aqueous deficient (ADDE)
Spot break	Mucin deficient
Dimple break	Mucin deficient
Random break	Evaporative (EDE) (MGD)

Yokoi N, Georgiev GA. Tear Film-Oriented Diagnosis and Tear Film-Oriented Therapy for Dry Eye Based on Tear Film Dynamics. *Invest Ophthalmol Vis Sci.* 2018 Nov 1;59(14):DES13-DES22. doi: 10.1167/iov.17-23700. PMID: 30481801.

## Aqueous

## Aqueous deficient

Schirmer test

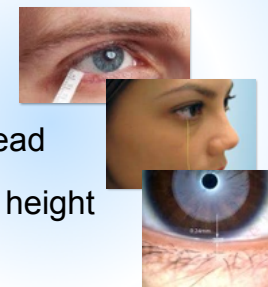
≤5mm 5min

Phenol red thread

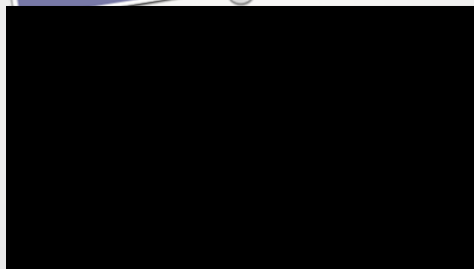
≤10mm 15s

Tear meniscus height

≤0.1mm



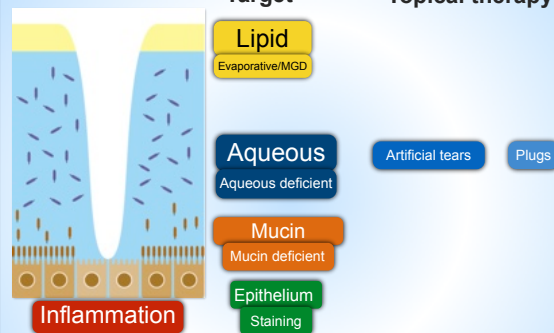
## BUP: Lines



Shigeyasu C, Yamada M, Yokoi N, Kawashima M, Suwaki K, Uchino M, Hiratsuka Y, Tsubota K, On Behalf Of The Deca-J Study Group. Characteristics and Utility of Fluorescein Breakup Patterns among Dry Eyes in Clinic-Based Settings. *Diagnostics (Basel).* 2020 Sep 17;10(9):711. doi: 10.3390/diagnostics10090711. PMID: 32957707; PMCID: PMC7555739.

## Target

## Topical therapy

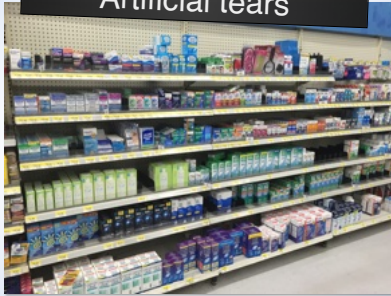


Yokoi N, Georgiev GA. Tear Film-Oriented Diagnosis and Tear Film-Oriented Therapy for Dry Eye Based on Tear Film Dynamics. *Invest Ophthalmol Vis Sci.* 2018 Nov 1;59(14):DES13-DES22. doi: 10.1167/iov.17-23700. PMID: 30481801.

## Artificial tears

Virtually every DED treatment regimen includes artificial tears

## Artificial tears



## Artificial tears

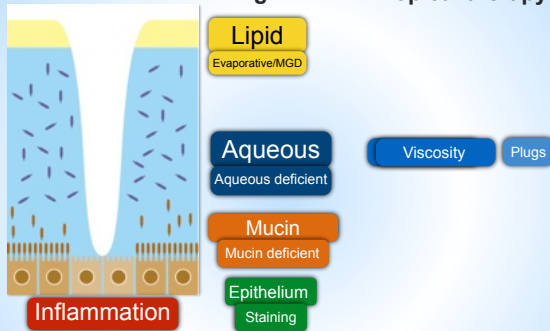
All the same?

“Given the large number of artificial tear formulations...it is difficult to propose that one OTC artificial tear formulation is superior to another for the treatment of dry eye syndrome”

Pucker AD, Ng SM, Nichols JJ. Over the counter (OTC) artificial tear drops for dry eye syndrome. Cochrane Database Syst Rev. 2016;2:CD009729

Product	Mechanism of Action	Ingredient	Category
Systane Ultra/Classic	pH activated	HP Guar	Viscosity
Refresh	muco-adhesive	cmc	Viscosity
Refresh PM/Systane Nighttime/ Soothe Lubricant Nighttime	ointment	mineral oil/white petrolatum	Viscosity
Optive	compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
Soothe XP	oily tears	mineral oil	Emulsion
Systane Balance	oily tears	mineral oil	Emulsion/Viscosity
Systane Complete	oily tears/nanomicellar	HP Guar	Emulsion/Viscosity
Refresh Digital	oily tears	castor oil	Emulsion
	compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
Refresh Optive Mega-3	oily tears/nanomicellar	trehalose castor oil L-carnitine/erythritol/cmc	Cytoprotective Emulsion Osmo-protectants/Viscosity
		trehalose	Cytoprotective
		sodium hyaluronate (HA)	HA
I/Via	high shear thinning	sodium hyaluronate (HA)	Osmo-protectants
blink tears	high shear thinning	sodium hyaluronate (HA)	HA
Refresh Relieva	high shear thinning compatible solutes	sodium hyaluronate (HA) L-carnitine/erythritol/cmc	HA Osmo-protectants/Viscosity
Biotrue Hydration Boost	high shear thinning	sodium hyaluronate (HA)	HA
Oasis	high shear thinning	sodium hyaluronate (HA)	HA
Systane Hydration	high shear thinning	sodium hyaluronate (HA) HP Guar	HA/Viscosity
blink Triple Care	high shear thinning compatible solutes	sodium hyaluronate (HA) castor oil	Emulsion HA
		trehalose	Cytoprotective
Refresh Relieva PF Xtra	high shear thinning compatible solutes	sodium hyaluronate (HA) L-carnitine/erythritol/cmc	HA Osmo-protectants/Viscosity

Target Topical therapy



Yokoi N, Georgiev GA. Tear Film-Oriented Diagnosis and Tear Film-Oriented Therapy for Dry Eye Based on Tear Film Dynamics. Invest Ophthalmol Vis Sci. 2018 Nov 1;59(14):DES13-DES22. doi: 10.1167/iov.17-23700. PMID: 30481801.

## Viscosity cmc



<https://www.youtube.com/watch?v=c3Dfka-Ywg>

Product	Mechanism of Action	Ingredient	Category
Systane Ultra/Classic	pH activated	HP Guar	Viscosity
Refresh	muco-adhesive	cmc	Viscosity
Refresh PM/Systane Nighttime/ Soothe Lubricant Nighttime	ointment	mineral oil/white petrolatum	Viscosity
Optive	compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
Soothe XP	oily tears	mineral oil	Emulsion
Systane Balance	oily tears	mineral oil	Emulsion/Viscosity
Systane Complete	oily tears/nanomicellar	HP Guar	Emulsion/Viscosity
Refresh Digital	oily tears	castor oil	Emulsion
	compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
Refresh Optive Mega-3	oily tears/nanomicellar	trehalose castor oil L-carnitine/erythritol/cmc	Cytoprotective Emulsion Osmo-protectants/Viscosity
		trehalose	Cytoprotective
		sodium hyaluronate (HA)	HA
I/Via	high shear thinning	sodium hyaluronate (HA)	Osmo-protectants
blink tears	high shear thinning	sodium hyaluronate (HA)	HA
Refresh Relieva	high shear thinning compatible solutes	sodium hyaluronate (HA) L-carnitine/erythritol/cmc	HA Osmo-protectants/Viscosity
Biotrue Hydration Boost	high shear thinning	sodium hyaluronate (HA)	HA
Oasis	high shear thinning	sodium hyaluronate (HA)	HA
Systane Hydration	high shear thinning	sodium hyaluronate (HA) HP Guar	HA/Viscosity
blink Triple Care	high shear thinning compatible solutes	sodium hyaluronate (HA) castor oil	Emulsion HA
		trehalose	Cytoprotective
Refresh Relieva PF Xtra	high shear thinning compatible solutes	sodium hyaluronate (HA) L-carnitine/erythritol/cmc	HA Osmo-protectants/Viscosity

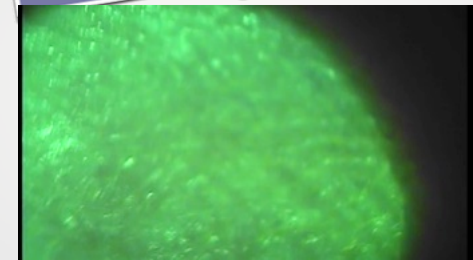
## Mucin

## Break up pattern

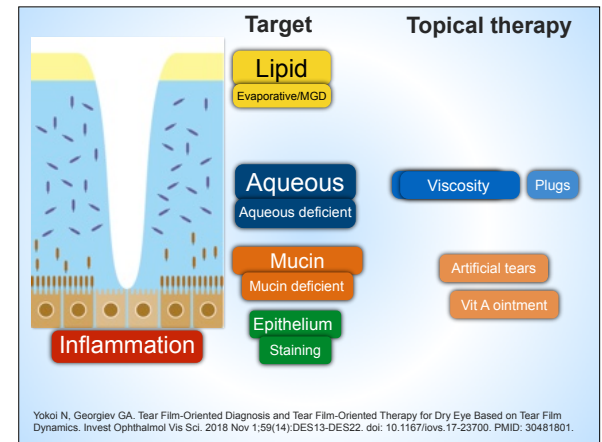
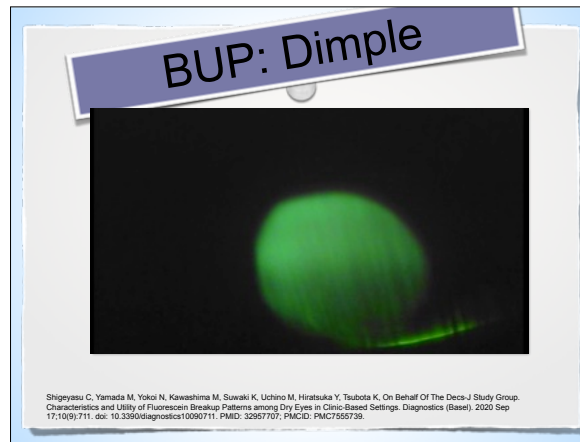
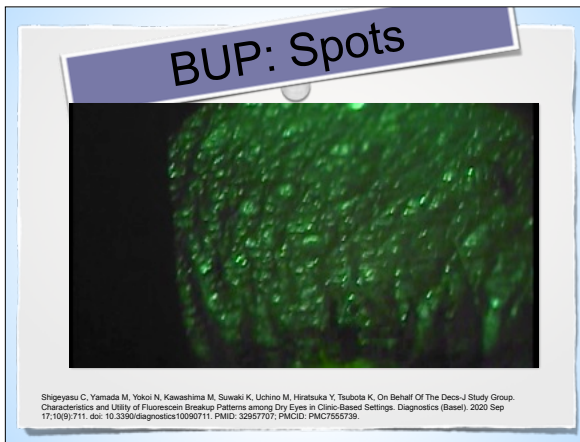
“Den et al. and Uchino et al. reported the association of mucin components with TBUT...suggesting the involvement of mucin as a major player in short TBUT”

Tsubota K. Short Tear Film Breakup Time-Type Dry Eye. Invest Ophthalmol Vis Sci. 2018 Nov 1;59(14):DES64-DES70. doi: 10.1167/iov.17-23746. PMID: 30481808..

## BUP: Spots



Shigeyasu C, Yamada M, Yokoi N, Kawashima M, Sasaki K, Uchino M, Hiratsuka Y, Tsubota K. On Behalf Of The Decs-J Study Group. Characteristics and Utility of Fluorescein Breakup Patterns among Dry Eyes in Clinic-Based Settings. Diagnostics (Basel). 2022 Sep 17;10(9):1711. doi: 10.3390/diagnostics10090711. PMID: 32957707; PMCID: PMC7556739.



**Vitamin A**

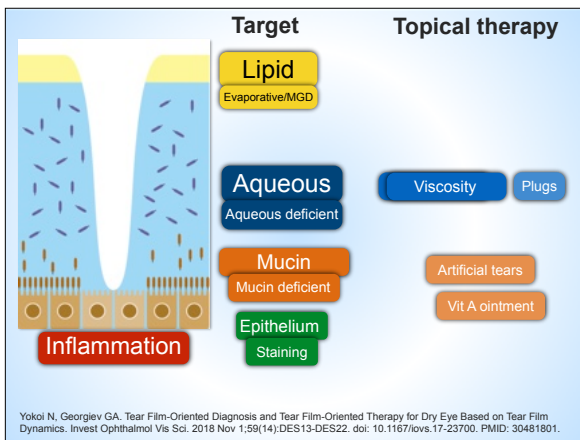
"vitamin A...led to a significant improvement in [OSDI] score and prevented the gradual decline in tear break-up time"

Cui X, Xiang J, Zhu W, Wei A, Le Q, Xu J, Zhou X. Vitamin A Palmitate and Carborer Gel Protects the Conjunctiva of Patients With Long-term Prostaglandin Analogs Application. *J Glaucoma*. 2016 Jun;25(6):487-92. doi: 10.1097/IJG.0000000000000316. PMID: 26317483.

**Vitamin A**

"Vitamin A palmitate significantly increased the Goblet Cell density after treatment"

Cui X, Xiang J, Zhu W, Wei A, Le Q, Xu J, Zhou X. Vitamin A Palmitate and Carborer Gel Protects the Conjunctiva of Patients With Long-term Prostaglandin Analogs Application. *J Glaucoma*. 2016 Jun;25(6):487-92. doi: 10.1097/IJG.0000000000000316. PMID: 26317483.



Product	Mechanism of Action	Ingredient	Category
Systane Ultra/Classic	pH activated	HP Guar	Viscosity
Refresh	muco-adhesive	cmc	Viscosity
Refresh PM/Systane Nighttime/Soothe Lubricant Nighttime	ointment	mineral oil/white petrolatum	Viscosity
Optive	compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
Soothe XP	oily tears	mineral oil	Emulsion
Systane Balance	oily tears	mineral oil	Emulsion/Viscosity
Systane Complete	oily tears/nanomicellar	HP Guar	Emulsion
Refresh Digital	compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
Refresh Optive Mega-3	oily tears/nanomicellar	trehalose castor oil L-carnitine/erythritol/cmc	Cytoprotective Emulsion Osmo-protectants/Viscosity
iVizia	high shear thinning	sodium hyaluronate (HA)	HA Osmo-protectants
blink tears	high shear thinning	sodium hyaluronate (HA)	HA
Refresh Relieva	high shear thinning compatible solutes	sodium hyaluronate (HA) L-carnitine/erythritol/cmc	HA Osmo-protectants/Viscosity
Biotrue Hydration Boost	high shear thinning	sodium hyaluronate (HA)	HA
Oasis	high shear thinning	sodium hyaluronate (HA)	HA
Systane Hydration	high shear thinning	sodium hyaluronate (HA) HP Guar	HA/Viscosity
blink Triple Care	high shear thinning compatible solutes	sodium hyaluronate (HA) castor oil trehalose	Emulsion HA Cytoprotective
Refresh Relieva PF Xtra	high shear thinning compatible solutes	sodium hyaluronate (HA) L-carnitine/erythritol/cmc	HA Osmo-protectants/Viscosity

**Carboxymethylcellulose cmc**

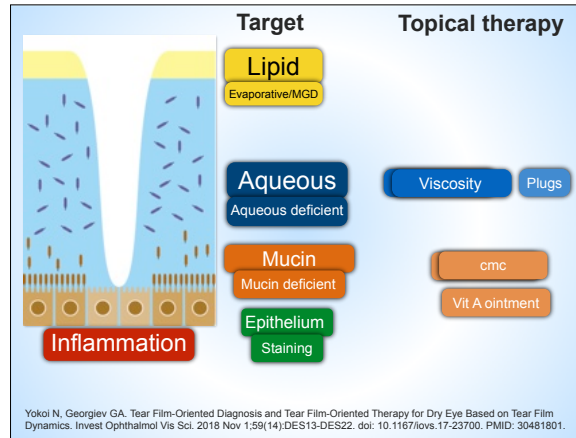
"CMC, well-known for its mucoadhesive...properties, binds to corneal epithelial cells and remains bound for at least several hours"

Garrett Q, Simmons PA, Xu S, Vehige J, Zhao Z, Ehrmann K, Willcox M. Carboxymethylcellulose binds to human corneal epithelial cells and is a modulator of corneal epithelial wound healing. *Invest Ophthalmol Vis Sci*. 2007 Apr;48(4):1559-67. doi: 10.1167/iov.06-0848. PMID: 17389485.

# Carboxymethylcellulose cmc

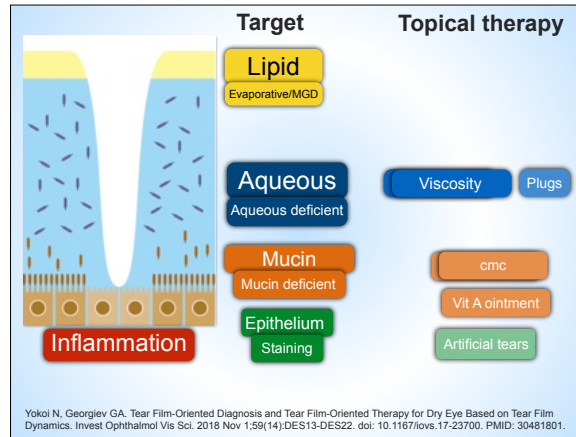
"a formulation containing mucoadhesive CMC prolongs the adherence of the matrix to the mucosa"

Cook SL, Woods S, Methven L, Parker JK, Khutoryanskiy VV. Mucoadhesive polysaccharides modulate sodium retention, release and taste perception. Food Chem. 2018 Feb 1;240:482-489. doi: 10.1016/j.foodchem.2017.07.134. Epub 2017 Jul 26. PMID: 28946301; PMCID: PMC5625848.



Product	Mechanism of Action	Ingredient	Category
Systane Ultra/Classic	pH activated	HP Guar	Viscosity
Refresh	muco-adhesive	cmc	Viscosity
Refresh PM/Systane Nighttime/ Soothe Lubricant Nighttime	ointment	mineral oil/white petrolatum	Viscosity
Optive	compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
Soothe XP	oily tears	mineral oil	Emulsion
Systane Balance	oily tears	mineral oil	Emulsion/Viscosity
Systane Complete	oily tears/nanomocellular	HP Guar	Emulsion
Refresh Digital	oily tears	castor oil	Emulsion
Refresh Optive Mega-3	oily tears/nanomocellular	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
		trehalose	Cytoprotective Emulsion
		castor oil	Osmo-protectants/Viscosity
		L-carnitine/erythritol/cmc	Cytoprotective HA
Ivzia	high shear thinning	sodium hyaluronate (HA)	Osmo-protectants
blink tears	high shear thinning	sodium hyaluronate (HA)	HA
Refresh Relieva	high shear thinning compatible solutes	sodium hyaluronate (HA) L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
Biotrue Hydration Boost	high shear thinning	sodium hyaluronate (HA)	HA
Oasis	high shear thinning	sodium hyaluronate (HA)	HA
Systane Hydration	high shear thinning	sodium hyaluronate (HA) HP Guar	HA/Viscosity
blink Triple Care	high shear thinning compatible solutes	sodium hyaluronate (HA) castor oil	Emulsion
Refresh Relieva PF Xtra	high shear thinning compatible solutes	trehalose sodium hyaluronate (HA) L-carnitine/erythritol/cmc	HA Cytoprotective Osmo-protectants/Viscosity

Epithelium



## Neurotrophic keratitis



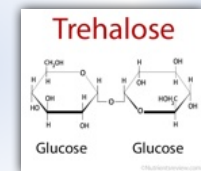
Product	Mechanism of Action	Ingredient	Category
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Systane Balance	oily tears	mineral oil	Emulsion/Viscosity
Systane Complete	oily tears/nanomocellular	HP Guar	Emulsion
Refresh Digital	oily tears	castor oil	Emulsion
Refresh Optive Mega-3	oily tears/nanomocellular	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
		trehalose	Cytoprotective Emulsion
		castor oil	Osmo-protectants/Viscosity
		L-carnitine/erythritol/cmc	Cytoprotective HA
Ivzia	high shear thinning	sodium hyaluronate (HA)	Osmo-protectants
blink tears	high shear thinning	sodium hyaluronate (HA)	HA
Refresh Relieva	high shear thinning compatible solutes	sodium hyaluronate (HA) L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
Biotrue Hydration Boost	high shear thinning	sodium hyaluronate (HA)	HA
Oasis	high shear thinning	sodium hyaluronate (HA)	HA
Systane Hydration	high shear thinning	sodium hyaluronate (HA) HP Guar	HA/Viscosity
blink Triple Care	high shear thinning compatible solutes	sodium hyaluronate (HA) castor oil	Emulsion
Refresh Relieva PF Xtra	high shear thinning compatible solutes	trehalose sodium hyaluronate (HA) L-carnitine/erythritol/cmc	HA Cytoprotective Osmo-protectants/Viscosity

Trehalose

950

## Trehalose

Sugar  
Stress  
protectant



## Artificial tears

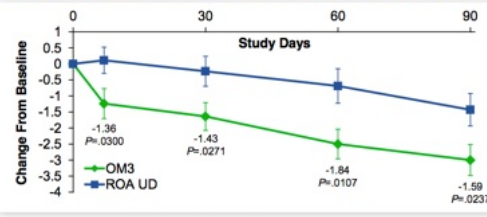
“Trehalose, a natural disaccharide, was also found to protect corneal epithelial cell[s]”

“trehalose plays an important cytoprotective role for corneal and conjunctival epithelial cells in order to prevent their apoptosis, one of the underlying etiological roles of DED”

Labetoulle M, Benitez-Del-Castillo JM, Barabino S, Herrero Vanrell R, Daull P, Garrigue JS, Rolando M. Artificial Tears: Biological Role of Their Ingredients in the Management of Dry Eye Disease. *Int J Mol Sci.* 2022 Feb 23;23(5):2434. doi: 10.3390/ijms23052434. PMID: 35269576; PMCID: PMC8910031.

## Mega-3

Figure 3. Combined Corneal and Conjunctival Staining



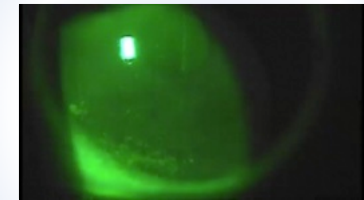
Hom MM, Berdy GJ, Downie LE, El-Harazi S, Verachtert A, Liu H, Carlise-Wilcox C, Simmons PA, Vehige JG. Clinical evaluation of a novel lipid-containing lubricant eye drop with omega-3 oil and trehalose. *Invest Ophthalmol Vis Sci* 2017;58(8):ARVO E-Abstract.2671 - A0261

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Refresh	muco-adhesive	cmc	Viscosity
Refresh PM/Systane Nighttime/ Soothe Lubricant Nighttime	ointment	mineral oil/white petrolatum	Viscosity
Optive	compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
Soothe XP	oily tears	mineral oil	Emulsion
Systane Balance	oily tears	mineral oil	Emulsion/Viscosity
Systane Complete	oily tears/nanomicellar	HP Guar	Emulsion/Viscosity
Refresh Digital	oily tears compatible solutes	castor oil L-carnitine/erythritol/cmc	Emulsion Osmo-protectants/Viscosity
Refresh Optive Mega-3	oily tears/nanomicellar	trehalose castor oil L-carnitine/erythritol/cmc	Cytoprotective Emulsion Osmo-protectants/Viscosity
IViZia	high shear thinning	trehalose sodium hyaluronate (HA)	Cytoprotective HA Osmo-protectants
blink tears	high shear thinning	sodium hyaluronate (HA)	HA
Refresh Relieva	high shear thinning compatible solutes	sodium hyaluronate (HA) L-carnitine/erythritol/cmc	HA Osmo-protectants/Viscosity
Biotue Hydration Boost	high shear thinning	sodium hyaluronate (HA)	HA
Oasis	high shear thinning	sodium hyaluronate (HA)	HA
Systane Hydration	high shear thinning	sodium hyaluronate (HA) HP Guar	HA/Viscosity
blink Triple Care	high shear thinning compatible solutes	sodium hyaluronate (HA) castor oil	Emulsion HA
Refresh Relieva PF Xtra	high shear thinning compatible solutes	trehalose sodium hyaluronate (HA) L-carnitine/erythritol/cmc	Cytoprotective HA Osmo-protectants/Viscosity

Case: Poor blinker

## The poor blinker

34 year old female wanting  
SCL  
No symptoms of dryness



## The poor blinker

6 months later....

## The poor blinker



## The poor blinker



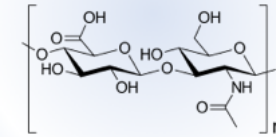
# Diagnosis

Microbial keratitis  
related to poor blinking  
Dryness related staining

# Treatment

Antibiotics  
3G 4G FQs  
Steroid  
Doxycycline  
Artificial tear?

## Hyaluronate acid (HA)

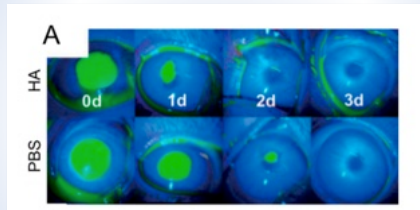


## Artificial tears

"HA, especially high molecular weight HA (HMW-HA)...accelerate wound healing of the epithelium after corneal debridement abrasion and alkali burn injuries"

Labetoulle M, Benitez-Del-Castillo JM, Barabino S, Herrero Vanrell R, Dauli P, Garrigue JS, Rolando M. Artificial Tears: Biological Role of Their Ingredients in the Management of Dry Eye Disease. *Int J Mol Sci.* 2022 Feb 23;23(5):2434. doi: 10.3390/ijms23052434. PMID: 35269576; PMCID: PMC8910031.

## Artificial tears

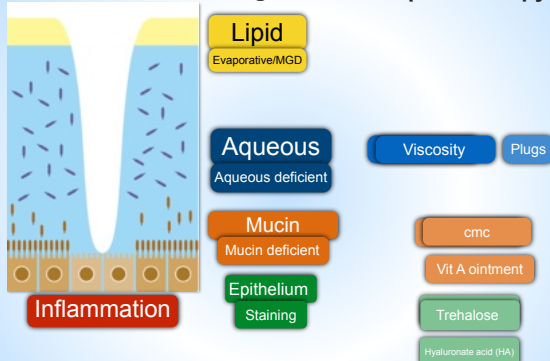


Labetoulle M, Benitez-Del-Castillo JM, Barabino S, Herrero Vanrell R, Dauli P, Garrigue JS, Rolando M. Artificial Tears: Biological Role of Their Ingredients in the Management of Dry Eye Disease. *Int J Mol Sci.* 2022 Feb 23;23(5):2434. doi: 10.3390/ijms23052434. PMID: 35269576; PMCID: PMC8910031.

Product	Mechanism of Action	Ingredient	Category
Systane Ultra/Classic	pH activated	HP Guar	Viscosity
Refresh	muco-adhesive	cmc	Viscosity
Refresh PM/Systane Nighttime/Soothe Lubricant Nighttime	ointment	mineral oil/white petrolatum	Viscosity
Optive	compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
Soothe XP	oily tears	mineral oil	Emulsion
Systane Balance	oily tears	mineral oil	Emulsion/Viscosity
Systane Complete	oily tears/nanocellular	HP Guar	Emulsion
Refresh Digital	oily tears	castor oil	Emulsion
Refresh Optive Mega-3	compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
	oily tears/nanocellular	trehalose	Cytoprotective
		castor oil	Emulsion
		L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
<b>Iviza</b>	high shear thinning	trehalose	Cytoprotective
		sodium hyaluronate (HA)	HA
<b>blink tears</b>	high shear thinning	sodium hyaluronate (HA)	Osmo-protectants
		sodium hyaluronate (HA)	HA
<b>Refresh Relieva</b>	high shear thinning compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
<b>Biotue Hydration Boost</b>	high shear thinning	sodium hyaluronate (HA)	HA
<b>Oasis</b>	high shear thinning	sodium hyaluronate (HA)	HA
<b>Systane Hydration</b>	high shear thinning	sodium hyaluronate (HA)	HA/Viscosity
		HP Guar	Emulsion
<b>blink Triple Care</b>	high shear thinning compatible solutes	sodium hyaluronate (HA)	HA
		castor oil	Emulsion
		trehalose	Cytoprotective
<b>Refresh Relieva PF Xtra</b>	high shear thinning compatible solutes	sodium hyaluronate (HA)	HA
		L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity

### Target

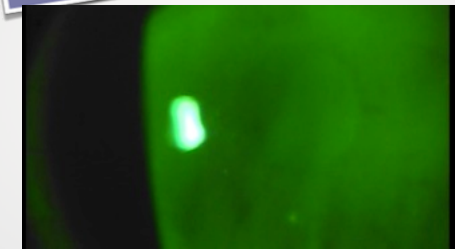
### Topical therapy



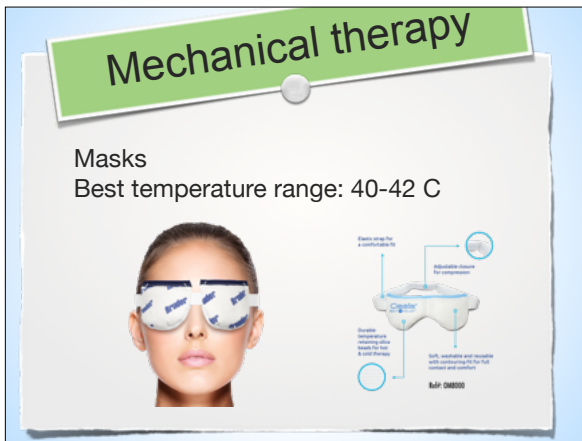
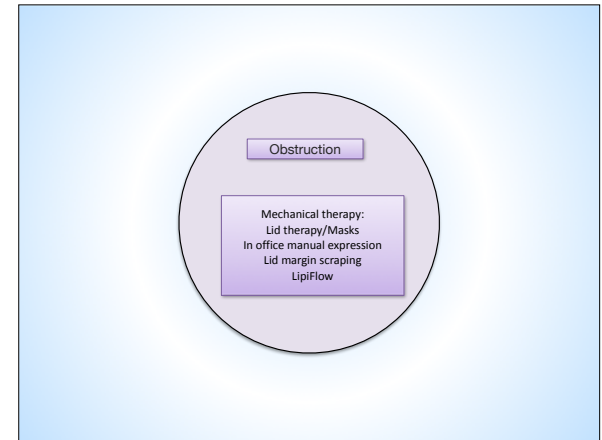
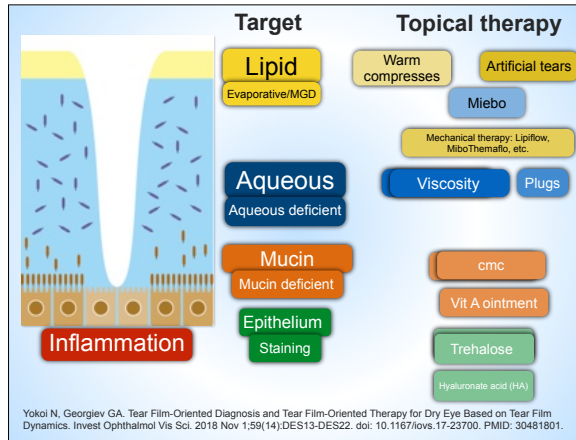
Yokoi N, Georgiev GA. Tear Film-Oriented Diagnosis and Tear Film-Oriented Therapy for Dry Eye Based on Tear Film Dynamics. *Invest Ophthalmol Vis Sci.* 2018 Nov 15;59(14):DES13-DES22. doi: 10.1167/iov.17-23700. PMID: 30481801.

## Lipid

## BUP: Random



Shigeyasu C, Yamada M, Yokoi N, Kawashima M, Sasaki K, Uchino M, Hiratsuka Y, Tsubota K, On Behalf Of The Decs-J Study Group. Characteristics and Utility of Fluorescein Breakup Patterns among Dry Eyes in Clinic-Based Settings. *Diagnostics (Basel).* 2022 Sep 17;10(9):1711. doi: 10.3390/diagnostics10090711. PMID: 32957707; PMCID: PMC7555739.



**Case: Diabetes**

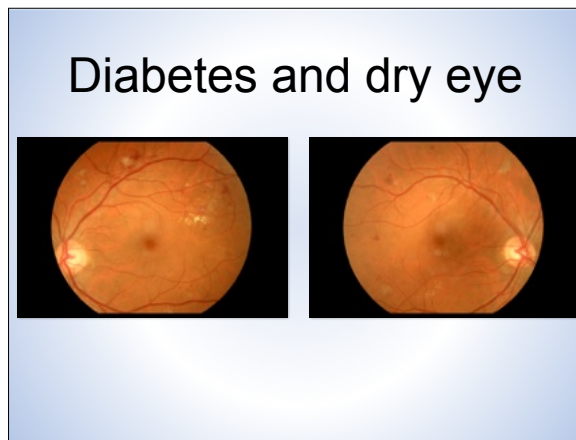
**Diabetes and dry eye**

52 year old female  
Dry eye symptoms: OSDI 25.0 moderate

**Diabetes and dry eye**

HA1c: 11.0%  
6.5% + diabetic

June 2009 American Diabetes Association,  
European Association for Study of Diabetes,  
International Diabetes Federation.



**Diabetes and MGD**

"long-term diabetes could induce...keratinization...inflammation...in the MG, which were consistent with characteristics of MGD"

Guo Y, Zhang H, Zhao Z, Luo X, Zhang M, Bu J, Liang M, Wu H, Yu J, He H, Zong R, Chen Y, Liu Z, Li W. Hyperglycemia Induces Meibomian Gland Dysfunction. *Invest Ophthalmol Vis Sci*. 2022 Jan 3;63(1):30. doi: 10.1167/iov.63.1.30. PMID: 35072689; PMCID: PMC8802017.



# Treatment?

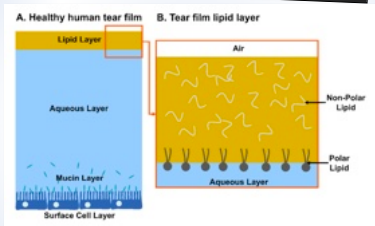
# Emulsions

# Tears

MGD  
Stage 1-1st line treatment:  
emulsion tears

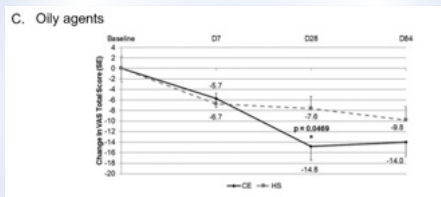
Barr JT, Hamrah P, Hom MM. et al. Today's methods for managing dry eye. Review of Optometry. 2015

# Artificial tears



Labetoulle M, Benitez-Del-Castillo JM, Barabino S, Herrero Vanrell R, Dauli P, Garrigue JS, Rolando M. Artificial Tears: Biological Role of Their Ingredients in the Management of Dry Eye Disease. Int J Mol Sci. 2022 Feb 23;23(5):2434. doi: 10.3390/ijms23052434. PMID: 35269576; PMCID: PMC8910031.

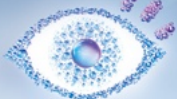
# Artificial tears



Labetoulle M, Benitez-Del-Castillo JM, Barabino S, Herrero Vanrell R, Dauli P, Garrigue JS, Rolando M. Artificial Tears: Biological Role of Their Ingredients in the Management of Dry Eye Disease. Int J Mol Sci. 2022 Feb 23;23(5):2434. doi: 10.3390/ijms23052434. PMID: 35269576; PMCID: PMC8910031.

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Refresh PM/Systane Nighttime/Soothe Lubricant Nighttime	ointment	mineral oil/white petrolatum	Viscosity
Optive	compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
Soothe XP	oily tears	mineral oil	Emulsion
Systane Balance	oily tears	mineral oil	Emulsion/Viscosity
Systane Complete	oily tears/nanomicellar	HP Guar	Emulsion
Refresh Digital	oily tears	castor oil	Emulsion
Refresh Optive Mega-3	oily tears/nanomicellar	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
		trehalose	Cytoprotective
		castor oil	Emulsion
		L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
I/Visa	high shear thinning	sodium hyaluronate (HA)	Cytoprotective
blink tears	high shear thinning	sodium hyaluronate (HA)	Osmo-protectants
Refresh Relieva	high shear thinning compatible solutes	sodium hyaluronate (HA)	HA
		L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
Biotree Hydration Boost	high shear thinning	sodium hyaluronate (HA)	HA
Oasis	high shear thinning	sodium hyaluronate (HA)	HA
Systane Hydration	high shear thinning	sodium hyaluronate (HA)	HA
		HP Guar	HA/Viscosity
blink Triple Care	high shear thinning compatible solutes	sodium hyaluronate (HA)	Emulsion
		castor oil	HA
		trehalose	Cytoprotective
Refresh Relieva PF Xtra	high shear thinning compatible solutes	sodium hyaluronate (HA)	HA
		L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity

Miebo  
(perfluorhexylolactone  
ophthalmic solution)



100%  
of patients had  
clinical signs of MGD<sup>1,2</sup>

Robust, reproducible  
efficacy and tolerability  
results across  
2 pivotal studies<sup>1</sup>

### Study design<sup>1,2</sup>

<sup>1</sup> Two 57-day, multicenter, double-masked, saline-controlled studies (SOE and M2JAVE) were conducted in adults ≥18 years old with a self-reported history of OED in both eyes.  
<sup>2</sup> Primary endpoints were change from baseline in ICF3 and change from baseline in eye dryness score (Visual Analog Scale) at Day 57.  
<sup>3</sup> Day 57 was the earliest time point at which signs and symptoms were evaluated in the trials. Day 57 was the last.

**HIGHLIGHTS OF PRESCRIBING INFORMATION**  
These highlights do not include all the information needed to use MIEBO safely and effectively. See full prescribing information for MIEBO.

**MIEBO**™ (perfluorhexylolactone ophthalmic solution), for topical ophthalmic use  
Initial U.S. Approval: 2023

**INDICATIONS AND USAGE**  
MIEBO (perfluorhexylolactone ophthalmic solution) is a semfluorinated alkane indicated for treatment of the signs and symptoms of dry eye disease. (1)

**-DOSAGE AND ADMINISTRATION-**  
Instill one drop of MIEBO four times daily into each eye. (2, 1)

**-DOSAGE FORMS AND STRENGTHS-**  
Ophthalmic solution, 100% perfluorhexylolactone. (3)

**CONTRAINDICATIONS**  
None. (4)

**ADVERSE REACTIONS**  
In clinical studies, the most common adverse reaction was blurred vision. Blurred vision occurred in 2% of individuals. (5, 1)

**USE REACTIONS**, contact Bausch & Lomb or FDA at 1-800-FDA-1088

**DRUG INFORMATION**  
Revised: 5/2023

**Where's your data?!**

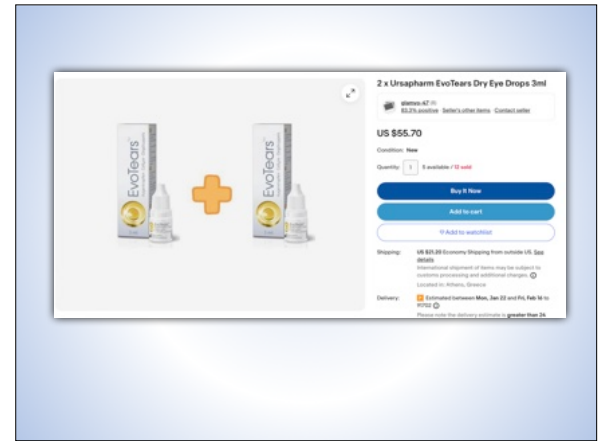
**Associated with Study**

**Study**

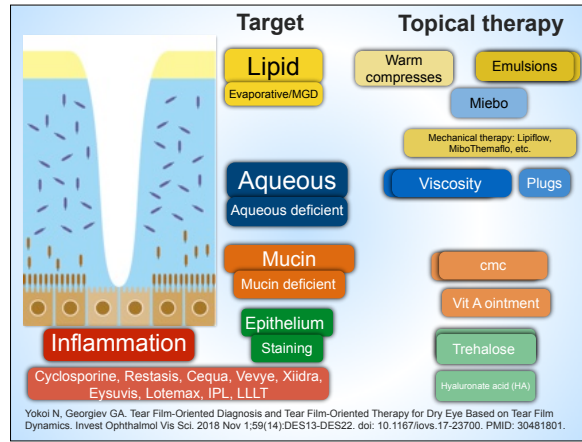
**Study**



CVS Pharmacy	88% deal Save 2%	\$798.30	Get free savings
Walmart	85% deal Save 2%	\$775.93	Get free savings
Walgreens	88% deal Save 2%	\$803.42	Get free savings
Yours Pharmacy	88% deal Save 2%	\$771.80	Get free savings
Costco*	88% deal Save 2%	\$859.53	Get free savings



Inflammation



Does IPL increase meibum secretion?

**You**  
does IPL increase meibum?

**ChatGPT**  
There isn't direct research specifically linking the Indian Premier League (IPL) cricket tournament to an increase in meibum secretion. Meibum is the oily substance produced by the meibomian glands in the eyelids, and its production can be influenced by various factors such as hormonal changes, environmental conditions, and ocular health.

However, it's possible that activities associated with watching or participating in IPL matches could indirectly affect meibum production. For example, spending long hours watching screens, particularly in environments with air conditioning or dry air, can contribute to dry eye symptoms, which are related to meibomian gland dysfunction (MGD).

Friction related disease

Friction related disease

Superior limbic keratoconjunctivitis (SLK)  
Conjunctivochalasis  
Lid wiper epitheliopathy (LWE)

Ahn H, Ji YW, Jun I, Kim TI, Lee HK, Seo KY. Effects of meibomian gland dysfunction and aqueous deficiency on friction-related disease. *Ocul Surf.* 2022 Oct;26:295-299. doi: 10.1016/j.jtos.2022.02.002. Epub 2022 Feb 24. PMID: 35219899.

Friction related disease

"The reviewed literature demonstrated that...[HP-guar] showed...a low coefficient of friction in an in-vitro model!"

Springs CL. Novel hydroxypropyl-guar gellable lubricant eye drops for treatment of dry eye. *Adv Ther.* 2010 Oct;27(10):681-90. doi: 10.1007/s12325-010-0052-3. Epub 2010 Aug 26. PMID: 20803266.

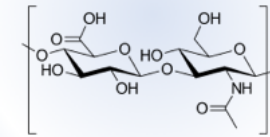
# Aqueous deficient

“HA/HPG...reduced surface friction to a greater extent than HA ( $P \leq 0.02$ ) and maintained lubricity after the formulations were rinsed away.”

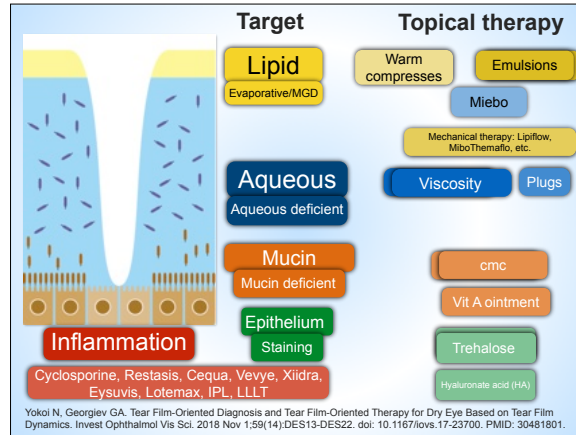
Rangarajan R, Kraybill B, Ogundele A, Ketelson HA. Effects of a Hyaluronic Acid/ Hydroxypropyl Guar Artificial Tear Solution on Protection, Recovery, and Lubricity in Models of Corneal Epithelium. *J Ocul Pharmacol Ther.* 2015 Oct;31(8):491-7. doi: 10.1089/jop.2014.0164. Epub 2015 Jun 11. PMID: 26067908; PMCID: PMC4599388.

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Soothe XP	oily tears	mineral oil	Emulsion
Systane Balance	oily tears	mineral oil	Emulsion/Viscosity
Systane Complete	oily tears/nanomicellular	HP Guar	Emulsion/Viscosity
Refresh Digital	oily tears	castor oil	Emulsion
Refresh Digital	compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
Refresh Optive Mega-3	oily tears/nanomicellular	trehalose castor oil	Cytoprotective Emulsion
Refresh Optive Mega-3	compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
Refresh Optive Mega-3	compatible solutes	trehalose	Cytoprotective
Refresh Optive Mega-3	compatible solutes	sodium hyaluronate (HA)	Osmo-protectants
Refresh Optive Mega-3	compatible solutes	sodium hyaluronate (HA)	HA
Refresh Relieva	high shear thinning	sodium hyaluronate (HA)	HA
Refresh Relieva	compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
Biotrue Hydration Boost	high shear thinning	sodium hyaluronate (HA)	HA
Oasis	high shear thinning	sodium hyaluronate (HA)	HA
Systane Hydration	high shear thinning	sodium hyaluronate (HA) HP Guar	HA/Viscosity
blink Triple Care	high shear thinning	sodium hyaluronate (HA)	Emulsion
blink Triple Care	compatible solutes	HA	HA
blink Triple Care	compatible solutes	trehalose	Cytoprotective
Refresh Relieva PF Xtra	high shear thinning	sodium hyaluronate (HA)	HA
Refresh Relieva PF Xtra	compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity

## Hyaluronate acid (HA)



Product	Mechanism of Action	Ingredient	Category
Systane Ultra/Classic	pH activated	HP Guar	Viscosity
Refresh	mucco-adhesive	cmc	Viscosity
Refresh PM/Systane Nighttime/ Soothe Lubricant Nighttime	ointment	mineral oil/white petrolatum	Viscosity
Optive	compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
Soothe XP	oily tears	mineral oil	Emulsion
Systane Balance	oily tears	mineral oil	Emulsion/Viscosity
Systane Complete	oily tears/nanomicellular	HP Guar	Emulsion/Viscosity
Refresh Digital	oily tears	castor oil	Emulsion
Refresh Digital	compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
Refresh Optive Mega-3	oily tears/nanomicellular	trehalose castor oil	Cytoprotective Emulsion
Refresh Optive Mega-3	compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity
Refresh Optive Mega-3	compatible solutes	trehalose	Cytoprotective
Refresh Optive Mega-3	compatible solutes	sodium hyaluronate (HA)	Osmo-protectants
Refresh Optive Mega-3	compatible solutes	sodium hyaluronate (HA)	HA
Refresh Relieva	high shear thinning	sodium hyaluronate (HA)	HA
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Biotrue Hydration Boost	high shear thinning	sodium hyaluronate (HA)	HA
Oasis	high shear thinning	sodium hyaluronate (HA)	HA
Systane Hydration	high shear thinning	sodium hyaluronate (HA) HP Guar	HA/Viscosity
blink Triple Care	high shear thinning	sodium hyaluronate (HA)	Emulsion
blink Triple Care	compatible solutes	HA	HA
blink Triple Care	compatible solutes	trehalose	Cytoprotective
Refresh Relieva PF Xtra	high shear thinning	sodium hyaluronate (HA)	HA
Refresh Relieva PF Xtra	compatible solutes	L-carnitine/erythritol/cmc	Osmo-protectants/Viscosity



thank you!

milton m. hom  
eyemage@mminternet.com

Yokoi N, Georgiev GA. Tear Film-Oriented Diagnosis and Tear Film-Oriented Therapy for Dry Eye Based on Tear Film Dynamics. *Invest Ophthalmol Vis Sci.* 2016 Nov 1;59(14):DES13-DES22. doi: 10.1167/iovs.17-23700. PMID: 30481801.