A Nutritional Approach to Treating Dry Eyes

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What is Dry Eye Syndrome

Dry Eye Syndrome (DES) is a disorder of the tear film due to either diminished tear production or excessive tear evaporation.

What is Dry Eye Syndrome

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.

DEWS (2007)

What is Dry Eye Syndrome

DRY EYE DISEASE

Dry Eye Population

- Estimated between 12-49 million in U.S.
- About 20-40% of adult population
- Increasing every year
- 75% of Americans over 65 years old have DES.
Number of Americans Age 65+

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Dry Eye Population
- 48% of adults experience one or more dry eye symptoms regularly.
- 52% of women experience one or more dry eye symptoms regularly.
- A majority of adults who use OTC drops to manage dry eye relief.
- 69% of US adults who experience dry eye have not visited an eyecare professional.
- Of the 31% who have visited an eyecare professional, 19% needed more than one visit and 22% found no relief.

Why is Dry Eye Important for Optometric Practices?
- Frequent complaint
- Contact lens success
- Computer use
- LASIK complication
- Improve practice reputation and revenue

Dry Eye Disease Process Current Theory

The Healthy Tear Film A Delicate Balance
- Lipid, aqueous and mucin components
  - Outer lipid layer prevents evaporation
    - Secreted by meibomian glands
  - Aqueous component – a complex mixture of proteins, mucins, electrolytes
    - Secreted by main & accessory lacrimal glands
  - Mucins provide viscosity and stability during the blink cycle
    - Mucin gel decreases in density toward tear film surface

Altered Tear Composition in Dry Eye
- Alterations in mucins, proteins, lipids
  - Decreased soluble mucin concentration
  - Decreased antibacterial proteins
  - Balance between immunosuppressive cytokines and their antagonists disrupted
  - Protease activity increased
- Increased osmolality
  - From 296 (normal) to 335 mEq/L (Spillers et al., 1994)
Causes of Dry Eyes

- Environment
- Age/Gender
- LASIK
- Lid Abnormality
- Computer Vision Syndrome
- Systemic Medications
- Chronic Diseases
- Contact Lens

Environment

Air conditioning/Heating
Smoke
Airplanes
Geography
Computer-based offices

Age/Gender

Hormones
- Androgen receptors are in the lacrimal glands.
- Decrease levels in menopausal women & elderly.

Oil content
- At 65 years old we have 60% less oil in our bodies than we did at 18 years old.

LASIK

Neural feedback loop - Sever LPC nerves that innervate cornea.
Thin lipid layer - Poorer quality lipid layer may predispose to dry eyes

Lid Abnormality

Lid deformities- Entropian, Exotropian, etc.
Cosmetics- Can plug up meibomian gland ducts.

"Meibo-Makeup"

Computer Vision Syndrome is “the complex of eye and vision problems related to near work which are experienced during or related to computer use”

-American Optometric Association
CVS-related Dry Eye Problems

When gazing at eye height, rather than at normal reading angle, computer users blink less and their tears evaporate faster.

Tsubota and Nakamore, 1993

Causes of Dry Eyes

Systemic Medications
- Anti-histamines: for allergies and stomach disorders
- Psychotropic drugs: Prozac, Valium, Lithium, etc.
- Hormones: Birth control pills, HRT
- Scopolomine: motion sickness
- Diuretics: hypertension
- Beta-blockers: Glaucoma, Cardiac disease

Chronic Diseases
- Sjögren Syndrome: 5% of population
- Lupus
- Rheumatoid Arthritis
- Grave’s Disease
- Sarcoid Disease
- 5th Nerve Disease: reduced sensitivity

Contact Lenses
- Makes existing condition worse
- Soft vs. RGP
- Fitting concerns
- Material effects: dry eye or dry lens?
- Is Silicone Hydrogel the savior?

Tests for Dry Eyes
- Tear Breakup Time (TBUT): tear film integrity
- Zone Quick (Thread): tear volume
- Blink Rate: evaporation rate
- Tear Osmolarity: “salt concentration”
- Shirmer’s Test: tear volume
- Rose Bengal: debranched conjunctival cells
- Lissamine Green: debranched goblet cells
- Micro-assay: lactoferrin levels
- Lid Wiper Epitheliopathy: symptom differential

Multiple tests needed to diagnose dry eyes

TearLab

Tests Tear Osmolarity
Normal range: 308-315
Traditional Treatments for Dry Eyes

- Artificial Tears
- Punctal Plugs
- Lipid Layer Enhancement
- Tear Quality Enhancement
- Epithelial Surface Treatment

-76% of patients rated their conditions as the same or worse compared with the previous year despite treatment. (Kavanaugh, 2000)

Treatments for Dry Eyes New Developments

- Anti-evaporatives
- Secretagogues
- Mucomimetics
- Anti-inflammatory
- Polymers
- Autologous Serum
- Homeopathics
- Oral Supplements

Anti-Inflammatory

- Block the inflammatory pathway in the immune system
- Steroids (Alrex, Lotemax, Velox) - cytokine inhibitors
- Cyclosporine A - Restasis (Allergan) - immunosuppressant
- Essential Fatty Acids (EFA) - natural source

Natural Anti-Inflammatories

- Quercetin - bioflavonoids
- Ginger - gingerols (anti-inflammatory)
- White Willow Bark - extracted as salicin
- Curcumin - Tumeric

Orals

- Essential Fatty Acids
  - Hydro-Eye
  - Hydrate Essential
  - TheraTears Nutrition
  - BioTears
  - Dry Eye Formula
  - EyePromise EZ Tears
Pilot, Prospective, Randomized, Double-masked, Placebo-controlled Clinical Trial of an Omega-3 Supplement for Dry Eye

Patients with dry eye received a daily dose of fish oil, containing 450 mg of EPA, 300 mg of DHA and 1000 mg of flaxseed oil for 90 days. Dietary supplementation with omega-3 fatty acids in dry eye showed no significant effect in melibube lipid composition or aqueous tear evaporation rate. On the other hand, the average tear production and tear volume was increased in the omega-3 group as indicated by both Schirmer testing and fluorophotometry.

Węgier-Mecik J.C., et al., Cornea, ePub 28 Oct 2010

Defining Fatty Acids
- α-linolenic acid (ALA, C18:3; n-3)
- Linoleic Acid (LA, C18:2; n-6)
- Arachidonic acid (ARA, C20:4; n-6)
- Eicosapentaenoic acid (EPA, C20:5; n-3)
- Docosahexaenoic acid (DHA, C22:6; n-3)

Randomized Clinical Trials on Treatment of Dry Eyes with Omega-3


2. Kangari H, Eftekhari MB, Sardari S, Hashemi H, Salamzadeh J, Ghassemi-Broumand M, Khabazkhoob M. Oral consumption of omega-3 fatty acids (180 mg EPA and 120 mg DHA twice daily for 30 days) is associated with a decrease in the rate of tear evaporation, an improvement in dry eye symptoms, and an increase in tear secretion.


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Short-term Consumption of Oral Omega-3 and Dry Eye Syndrome
- Sixty-four patients with dry eye symptoms between the ages of 45 and 90 years
- The treatment group received 2 capsules of omega-3 (each containing 180 mg EPA and 120 mg DHA) daily for 30 days, and the placebo group received 2 medium-chain triglyceride oil capsules daily for 1 month. The outcomes were measured 1 month after the intervention.
- Oral consumption of omega-3 fatty acids (180 mg EPA and 120 mg DHA) is associated with a decrease in the rate of tear evaporation, an improvement in dry eye symptoms, and an increase in tear secretion.

Metabolic Pathways of Omega-3 and Omega-6 Fatty Acids
Prostaglandins

**PGE1**
- Reduces inflammation and inhibits blood clotting.
- Capable of reducing pain, swelling and redness associated with inflammation, particularly in mucosal tissues, which includes the eyes.
- Can only be produced by Omega-6 fatty acids.

Prostaglandins

**PGE2**
- Are opposite of PGE1s but can only be produced by Omega-6 fatty acids.
- Are pro-inflammatory mediators that constrict blood vessels, increase body temperature, and encourage blood clotting.
- These events are lifesaving when the body suffers a wound or injury, for without PGE2s, a person could bleed to death.
- However, in excess this type of prostaglandin is harmful because it sets up a chronic inflammatory condition in the body.

Prostaglandins

**PGE3**
- Are available from Omega-3 fatty acids.
- The Omega-3 fatty acid, EPA, also plays an important anti-inflammatory role.
- It appropriately blocks the release of Omega-6 arachidonic acid.
- Without sufficient Omega-3s in the diet, chronic inflammation becomes one of the problems now linked to many degenerative diseases of the eye.

Possible Effects of Omega EFA on Dry Eyes

- Provide overall anti-inflammatory effect
- Increase fluidity of meibomian gland secretions
- Alter polar characteristics of lipid layer and decrease evaporative loss
- Optimize function of goblet cells
- Improve epithelial cells microvilli expression and adhesion

Is dry eye an indicator of systemic essential fatty acid deficiency or imbalance?
Anti-inflammatory Diet

- Breakfast could be oatmeal served with fresh berries and walnuts, with a cup of almond milk. Any whole grain cereal without sugar.
- Snack on whole fruits, nuts, seeds, and fresh vegetables throughout the day instead of cookies and candy.
- Eat more fish and less corn-fed red meat.
- Stay away from deep fried foods and bake or stir fry your meals instead.
- Choose green, orange, and yellow vegetables for your side dishes.
- Drink plenty of water, fresh 100 percent juice and vegetable juices, herbal teas and green tea.

The Bottom Line

Do not confuse all the processed food items that contain hydrogenated trans-fats with Omega 6 essential fatty acid intake. All fatty acids are destroyed by the hydrogenated process.

The series one anti-inflammatory prostaglandins (PGE1s) from natural Omega 6s are more specific to mucosal tissues (eyes) than the series three prostaglandins (PGE3s) from Omega 3s.

Sources of EFAs

<table>
<thead>
<tr>
<th>Oil</th>
<th>Omega-3</th>
<th>Omega-6</th>
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<tr>
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<tr>
<td>Black Currant Seed Oil</td>
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Omega-3 vs. Omega-6

“Omega-6 administration increases the PGE1 levels in tears of patients with Sjögren’s Syndrome and improves ocular surface signs and symptoms of ocular discomfort.”

Systemic Omega-6 EFA Treatment and PGE1 Tear Content in Sjögren’s Syndrome Patients

Aragon, P., Bucolo, C., et al
IOVS 2005; 46:4474-4479

Omega-3 vs. Omega-6

“This study provides evidence for a beneficial effect of particular orally administered omega-6 fatty acids in alleviating dry eye symptoms and improving overall lens comfort in patients suffering from contact lens associated dry eye.”

Oral omega-3 essential fatty acid treatment in contact lens associated dry eye
Flax Seed Oil
- Does contain a large amount of Omega-3 EFA
- Highly unstable, must be refrigerated
- Contains none of the nutrient co-factors necessary to ensure conversion to PGE1 anti-inflammatory
- Does not enhance production of lactoferrin
- Excess now linked to cortical opacities and prostate cancer.
- May cause intestinal blockage, thyroid problems and reduce platelet aggregation.
- Poor conversion to longer chain fatty acids

Dry Eye Headlines
“Flaxseed oil may be an effective anti-inflammatory nutritional therapy alternative to long-term antibiotics”
Ken Nicola, Co-author
Dec 2007 Ophthalmology
“Flaxseed oil was not used as the primary treatment. It was used only as a maintenance treatment after lid margin disease was controlled”
“Primary treatment consisted of modified lid hygiene, topical antibiotics and steroids. Systemic oral antibiotics also were administered”
CONCLUSION: “Flaxseed oil ... is a promising new addition in the management of blepharitis”

What’s HOT in science-supported nutritional medicine? You guessed it!

Fish Oil & Coagulation Status
- CASE REPORT
  Omega-3 fatty acids may lower thromboxane A(2) supplies within the platelet as well as decrease factor VII levels. This case report illustrates that fish oil can provide additive anticoagulant effects when given with Warfarin
- STUDY
  Effects of Marine Fish Oils on the Anticoagulation Status of Patients Receiving Chronic Warfarin Therapy. “Fish oil supplementation in doses of 3-6 grams per day does not seem to create a statistically significant effect on the anticoagulation status of patients receiving chronic Warfarin therapy”

“Vitaholics”
- Ginkgo biloba
- Omega-3
- Fish Oil
- Bilberry
- Flaxseed oil
- Vitamin E
- Resveratrol

Vitamin A
- Vital for the health of epithelial cells of the cornea and conjunctiva, as well as the function of the immune system.
- It is also necessary for goblet cell and lacrimal gland production of the large variety of mucins now associated with the base layer of the tear film.

Blood Thinners
Vitamin B6

- One of the nutrient co-factors required to push the metabolic pathway conversion of GLA to DGLA.
- Required for the neuronal blink response.

Vitamin C

- Absorbyl palmitate (fat-soluble) modulates PGE1 synthesis due to the extended half-life of the fat-soluble vitamin C over ascorbic acid.
- This vitamin C combination also enhances the production of IgE concentrates in tears, the first line of basophil and mast cell defense against invading pathogens and allergens that frequently cause dry eye symptoms.

Post-surgical Vitamin C Levels

Ascorbic acid levels in human tears after photorefractive keratectomy, transepithelial photorefractive keratectomy, and laser in situ keratomileusis

CONCLUSION: After PRK, transepithelial PRK, and LASIK, the ascorbic acid levels of the tear fluid decreased significantly. Because ascorbic acid is the major scavenger of superoxide radicals in tears, topical ascorbic acid therapy may help eliminate the harmful effect of free radicals from excimer laser surgery.


Vitamin D

- It should be included in all nutraceutical formulations that include Vitamin A due to an increased risk of fractures in older patients taking large amounts of supplemental Vitamin A.

Vitamin E

- Vitamin E should be included in all fatty acid-based nutraceutical formulations to help prevent or slow lipid oxidation.
- This particularly includes any formulation that includes flax seed oil or any type of fish oil.

Lactoferrin

- The replication and biofilm formation of fungi, bacteria and viruses in mucosal tissues are iron-dependent. Growth of these pathogens becomes almost impossible if adequate amounts of iron-binding proteins, particularly lactoferrin, are concentrated in these fluids.
- Adequate levels of tear lactoferrin, naturally produced by the lacrimal gland and neutrophils, are particularly important for the eye surgery or contact lens patient with an increased risk of infection.
**Additional Tear Support**

- **Minerals**
  - Zinc and Magnesium: important in immune functions

- **Mucin Enhancers**
  - Aloe Vera Oil
  - Hyaluronic Acid

**Nutritional Support**

Nutritional supplements can play an important role in the management of inflammation associated with dry eye by enhancing the body’s natural defense system, and the protection provided by nutritional therapy may be better than after-the-fact treatment by pharmaceuticals.

**Summary**

- Multi-pronged approach recommended
- Minimize adverse environmental conditions, anticholinergic medications, visual strain
- Nonpreserved artificial tears
- Use topical corticosteroids only for short periods because of side effects
- Topical cyclosporine: for severe cases
- Treatment should not cause disruption in patient’s lifestyle
- Many patients prefer the “natural” approach

**“Just take some Fish Oil!”**

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**ONS**

OCULAR NUTRITION SOCIETY

Focused on Nutrition Education

www.ocularnutritionsociety.org
A Nutritional Approach to Treating Dry Eyes

Thank you

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