

Dry-Eyes Oral Therapy Beyond Fish Oils

(COPE 27217-OP)

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Problems with Current DES Therapies

1. Tear-replacement drops build dependency.
2. Lubricant drops are useful, but do nothing to reverse the cause of Dry-Eyes Syndrome (DES).
3. Plugs do not reverse the underlying problem.
4. Oral Omega 3 (mostly as fish oils) & Omega 6 oils (fatty acids) can ameliorate underlying issues, but often fall short.
5. The cornea requires nutrients from tears.

Nutritional Epidemiology to the Rescue!

1. All the vitamins are required for healthy survival.
2. Many vitamins are clearly necessary for a normal tear film.
3. Essential minerals are like vitamins in that they are essential for health. More than a few are essential for the tear film.
4. Essential fatty acids (Omega 3 & Omega 6) are essential for the tear film, but do not solve the DES when other important nutrients are deficient.

Some Oral Risk Factors that Compromise the Tear Film

1. Lane & Hart (IOVS 1986); Hart, Lane, Josephson et al (*Ophthalmol* 1987) documented oral interactions producing lipid deposits on soft contact lenses:
2. Excessive (XS) meds with anticholinergics, sympathomimetics, diuretics that do not spare potassium (K), some anti-depressants [--incl in '87: Aldomet, Desyrel, Lasix, Librax, Minipress, Tavist, Tolinase, Ventolin, & also diabetics on hypoglycemics] – all also result in low tear K.
3. XS Protein intake (> 167% RDA), Odds Ratio (OR) =24, $p=0.0056$, after excluding those on meds or alcohol > 10 g/day, is typically found in persons with lipid deposits on CLs.

More Oral Risk Factors (--Lane & Hart)

1. Low Tear Potassium (K), especially assoc with lipid deposits on hydrogel CLs if include those on specific meds, $OR=7.65, p=0.008$.
2. XS cholesterol intake > 680 mg/day is assoc with lipid deposits on soft CLs.
3. XS alcohol > 9 g/day results in episodes of triglycerides in the tear film.

Diet & Tear-Film Breakup Time (TBUT) – Lane & Hart

1. Depressed TBUT < 10 secs likely if ratio of (sucrose intake) / (food-folic-acid intake) is > 6 tsp sucrose / 100 mcg folate intake, $OR=40$, $p=0.0126$. (Folate is vitamin B9.)
2. Depressed TBUT likely < 10 secs if food potassium intake < 2500 mg/day, $OR = 15$, $p=0.0357$.

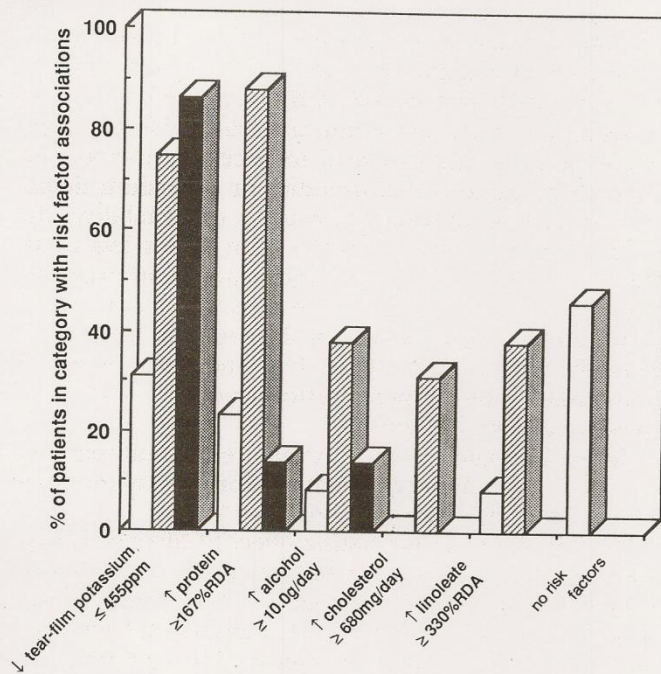


Fig 3. White bar (□) represents the 13 controls (nondepositors). The mean number of risk factors per control is 0.8. Bar with diagonal lines (▨) represents the 16 lipid depositors not taking medication. The mean number of risk factors per these depositing patients is 2.7. Black bar (■) represents the 7 lipid depositors taking medication. The mean number of risk factors per medication-taking patients is 1.1 (excluding medication as a risk factor).

FAST & MODERATE LIPID DEPOSITORS

S#	Drugs	k	chol	lin	alc	pro
1		•	•	•	•	•
2		•	•	•		•
3		•	•	•		•
4		•		•	•	•
5			•	•		•
6		•			•	•
7		•		•		•
8		•			•	•
9		•			•	•
10		•	•			•
11		•				•
12		•				•
13						•
14					•	
15		•				•
16	•	•				•
17	•			•		•
18	•	•				
19	•	•				
20	•					
21	★	•				
22	★	•				
23		•				

NON-DEPOSITOR CONTROLS

S#	Drugs	k	chol	lin	alc	pro	none
N1		•		•		•	
N2						•	
N3						•	
N4					•		

NLD1	★						
N5		•					
N6							0
N7							0
N8							0
N9							0
N10							0
NLD2							0
NLD3							0

Notes on previous Hart & Lane figures

- “Fig 3” White bar is for Non-Depositors
- Diagonal-lined bar is for lipid depositors not on meds, but with compromised tear film.
- Black bar is for lipid depositors taking meds.
- “Fig 4” columns are Subject #; Use of Meds; tear-K < 455ppm; Cholesterol intake >680mg / day; Linoleate intake > 330% RDA; Alcohol intake > 10 g/day; Protein intake > 167% RDA. **Note: All depositors have diet risk factors.**

More on “Figure 4” Scatterplot

- Fig 4 shows how one, two, three, four, five or six oral intake factors singly or in combinations can destabilize the tear film.
- The majority of non-depositor controls were subject to zero risk factors. Only one non-depositor contact lens wearer had more than one risk factor involvement.

Even More on “Figure 4”

- The most prevalent lipid-depositing factor in those not on meds was too much protein.
- The lipid depositors on meds typically became depositors associated with lowered potassium in tears and not with xs protein.
- The broken horizontal line separates those with dietary risk factors above the line from no associated diet errors below the line.

Minerals Needed from the Tears

1. Calcium, Magnesium, Potassium, & Sodium are necessary & sufficient minerals from tears for the cornea. (Graeme Wilson, Dec '83)
2. Lane ('84) reported deficient potassium in **hair** of patients with contact lens deposit/coating syndromes. (Avg 8.9 +/- 9.7 ppm for cases, 65.3 +/- 43.0, controls).
3. Potassium & zinc in diet may be necessary for tears. (Barbara Caffery, *Optom & Vis Sci*, 1991)
4. Refresh, Systane, Theratears contain Ca, Mg, K, Na as “inactive” ingredients.

Which vitamins are essential for eyes?

- *All* the vitamins are equally essential!
- 4 vitamins seem more important, because they are the ones we are not getting adequately.
- The **four** most deficient are the ones most easily damaged by even typical gentle steaming and most-usual packaging for shelf-life. They are:
 - Vitamin B6 (Pyridoxine)
 - Vitamin B9 (Folic acid)
 - Vitamin B12 (Cobalamin)
 - Vitamin C (Ascorbic acid)

The lachrymal system needs these vitamins! (Lane, A healthy diet: The proven enhancement for dry eye treatment. *Managing Dry Eye – Premier Issue*, Dec 15, 2009, publ by *Optom Management*, online.)

About Vit B₆ and the Tear Film

1. Ned Paige, OD (Toronto): B6 supplementation appeared to turn around DES in first study. Less clear in 2nd study. (*Optom Monthly*, 1978)
2. B6 is especially important for *remodeling*.
3. B6 potentiates transaminase enzymes in brush border of small intestines to enable conversion of amino acids in diet to amino acids required to make special proteins.

More about Vitamin B₆

1. B6 is critical for remodeling specialized tissues throughout body. An example is Bruch's membrane (Lane, ARVO July 2006; Christen, Glynn, Chew et al, Feb 23, 2009, Arch Internal Med). Functional blood test for B6: Erythrocyte Glutamic Oxaloacetic Transaminase (EGOT).
2. B6 is most effective for potentiating transamination either when presented together with digested protein (3 mg works) or if intake >50mg as much as 12 hours earlier.
3. B6 is the most heat/cooking-vulnerable vitamin.

About Folic Acid (Vit B₉) & the Tear Film

1. Folic acid is the 2nd most heat-vulnerable vitamin.
2. New cells require DNA. DNA synthesis requires B9.
3. Mucous membranes & epithelial lining of tear glands and ducts have a high turnover & a high demand for B9 for replacement, repair, remodeling.
4. B9 supplementation helps turn around Sjogren's Syndrome. (Functional test for B9: 24-hr Formimino-Glutamic Acid in Urine [FIGLU]).
5. Advise daily intake of fresh, ripe fruits and raw salads without traditional dressings rich in Omega 6.

How best to use Omega 3 & 6 for DES

1. Has the DES patient been taking fish-oil supplements or Omega-3 ($\omega 3$) or Omega-6 ($\omega 6$) or Flaxseed Oil or Evening Primrose or Borage Oil or using olive oil and other dressings frequently and in significant quantities and over what time period?
2. Ideally order, from fasting specimen, “Plasma Phospholipid Essential Fatty Acid Profile (including Trans FAs)” (as from Vitamin Diagnostics Lab, S Amboy, NJ or from your local lab as “Lipids, Total, Serum & Phospholipids, Serum” (CPT 84311 x 2)).
3. **Calculate concentration ratio of (Arachidonic Acid)/EPA.**

Arachidonic Acid vs EPA

1. Arachidonic Acid (AA) / Eicosapentaenoic Acid (EPA)
= ratio of concentrations of (20:4 ω 6) / (20:5 ω 3).
2. Normal range is 7.17 through 25.6 for adults.
3. Low ratio suggests likelihood of increased risk for bleeding.
4. High ratio suggests likelihood of increased risk for thrombosis.
5. As always, balance is the key to an ideal level of EPA and Docosahexaenoic Fatty Acid (DHA) and AA.

When is Protein Too Much?

1. >167% of RDA for daily Protein for months becomes excessive, especially if protein is mostly denatured—cooked more than “rare” (140 deg F).
2. XS prolonged intake of protein supplements that do not contain B6 or are not augmented with B6 can be dangerous for eye health.
3. XS protein was the major risk factor for disadvantaged tear film in the Lane-Hart study.

Is Inflammation Healthy or Unhealthy?

1. Normal inflammation is an important aid in the repair of tissues and systems. It provides the scaffolding & fluid to assist in repair.
2. Healing takes longer when inflammation is thwarted.
3. Almost all non-toxic, non-doctored fish, colorful veggies, and ripe fruits are relatively anti-inflammatory and also directly help support the repair process by providing essential nutrients.
4. Experience and professional judgment are required in making an ideal decision as to the nature of intervention.

Adding Nutrients to Treat DES.

1. If K intake $< 4,000\text{mg}$, encourage to add fresh fruit daily: bananas, oranges, cantaloupe, tomatoes.
2. If B9 $< 500\text{mcg}$ daily, add raw fresh fruits & veggies, espec green leafy like kale & spinach, also Brussels sprouts, red cabbage, asparagus, string beans, broccoli, chick peas soaked 24 hrs in refrigerator, yams, avocado, cantaloupe, oranges.
3. Avoid added sugar. It depletes potassium. Sucrose intake > 11 tsps increases risk for CL intolerance/dry eyes.
4. If daily Vit C < 400 mg, need more fresh raw fruits & veggies.

B₆ and Tear film & Diuresis Considerations

1. If food B₆ < 4mg daily, switch to high-protein foods only if they may be safely eaten raw or rare-cooked (uncooked rolled oats, soft or medium cooked eggs, 24-hr soaked lentils, or a rare-baked fillet of wild-caught Sockeye salmon) or supplement with “anti-stress” B-complex + C.
2. Lasix & many other diuretic meds deplete K & with aspirin contribute to DES & CL intolerance. Recommendation: Conservative B₆ and C may or may not help enough with diuresis while ameliorating DES. Need to monitor & adjust.

DES & Arthritis

1. Good nutrition & life style statistically reduce the risk for acquiring arthritis.
2. Low B₆ is assoc w elev of inflammation marker C-reactive protein. (Friso et al, 2001)
3. Rheumatoid arthritis patients are deficient in B₆, zinc, copper, and magnesium. (Kremer et ano, 1996)
4. Ss with primary Sjogren's Syndrome are deficient in B₆. (Tovar et al, 2002)
5. Patients w rheumatoid arthritis may have higher B₆ needs. (Chiang et al, 2005)
6. Years of B₆ deficiency affect slow remodeling of tissues & correction can result in slow recovery. (Lane, 1999)

Complementary DES Therapy

1. Most effective: Fresh, ripe raw fruits & at least 50% of veggies as raw salads—at least improves effectiveness of oral supplements.
2. Supplements of B₆, B₉, and C and life-style changes in protein intake and food selection are helping to turn around DES and to make attempts at $\omega 3$ & $\omega 6$ therapy more successful.

More on the web: [www. NutriOptom.com](http://www.NutriOptom.com)

References

- References are in handout and available as an MS Word document attachment.