Life is a breeze....... except when you're dry as a bone

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Testing oral pH

Taste and see.....why not?

Complicated, real life situations

Spotlight on Sjogren’s syndrome - primary

• dry mouth   • 2012 – nearly 6 years
• dry eyes    • 2016 – down to 3
• antibodies   • 2017 – target 2.5
• 4 million Americans

Saliva and tears

• inflamed lacrimal glands
• body destroys glands
• lack of flow
• poor quality

Demographics

• 90% female
• age 40 approx - menopause
  • 10% male – 10%
  • under and undiagnosed
    • children – not common
    • enlarged parotid gland

Ocular symptoms

• abraded cornea
• infections
• discomfort
• blurry vision
• stuck eye lids

Impact

• quality of life
• financial
• emotional
• 5+ heath care providers
Improving the patient’s outcome

Best external evidence

Individual clinical expertise

Patient values & expectations

EBM

Complex patients - complex solutions

Who has the highest risk?

Complicated, real life situations

- 70 year old female
- severe polypharmacy-induced xerostomia
- high caries risk
- every 3 months - something new
- extremely sensitive tissues
- has had severe mucositis to everything I have recommended for use in her custom fl trays

Challenges

- life style
- self care
- dry mouth
- compliance

Complicated, real life situations

Who has the highest risk?

Multiple terms - quality of life

- dry mouth / syndrome
- hypo-salivation
- xerostomia

Hyposalivation

- clinical diagnosis
- decreased salivary flow
- insufficient in saliva

Dry mouth

Prevalence and clinical presentation


Xerostomia

- Subjective term
- Perceived lack of moisture
- Changes in composition

Prevalence

- 30% population
- More women
- 10% early 30s
- Over age 50

Insufficient flow

- Subtle changes
- 50% decrease - noticeable
- pH decreases
- Increased demineralization

Visual observations

- Red, glossy, parched
- Pebbled tongue
- Cracking in commisures
- Chapped lips
- Thick, foamy, ropy saliva

Clinical complaints

- Sore mucosa
- Burning sensation
- Stickiness
- Halitosis
- Metallic taste

Additional complaints

- Difficulty talking
- Problems chewing
- Taste alterations
- Difficulty swallowing
- Dry/sore throat
- Dental hypersensitivity

Feel dry when eating?

- Sip liquids to swallow dry food?
- Amount of saliva seem reduced?

Night time

- Wake up dry
- Dry during the daytime

Tongue burn?

- Problems tasting?
- Sensitive to acidic, salty or spicy foods?
Dry eyes

- recurring decay problems
- chew gum/candy for relief

**Saliva functions and benefits**

- Digestion
  - chewing
  - bolus
  - swallowing
  - enzymes
  - taste

- Protection
  - dilution
  - lubrication
  - cleansing
  - increase pH

- Protection
  - buffering-neutralizes
  - remineralization
  - anti-microbial
  - healing

**Additional functions**

- speech
- nutrition
- social interaction

**The kiss**

- longest - 58 hours, 35 minutes and 58 sec
- lowers cortisol levels
- heart beats faster
- more oxygen reaches your brain

**Saliva - The magic fluid**


Salivary Glands

Sources
- 90% - whole saliva
  - parotid - 30%
  - sub-mandibular - 60%
  - sub-lingual - 5%
- 10% - minor glands - 5%
- found throughout the mouth

Healthy saliva - composition
- also contains
  - proteins
  - enzymes
  - mucins
  - buffering compounds

99% water

Secretions serous and mucous
- parotid - serous and enzymes
- submandibular - 90% serous, 10% mucous
- sublingual and minor - 80% daily mucous

Salivary protein functions
- antibacterial
- antifungal
- antiviral
- buffering
- tasting
- tissue coating
- wound healing
- remineralization
- digestion
- lubrication

Mucins - wetness and comfort proteins with carbohydrate chains
- lubricates
- controls viscosity / elasticity
- affects stickiness
- saliva contact with oral cavity

Salivary protein functions
Proline-rich proteins and arginine
- PRPs - 70% of all salivary proteins
- formation / function acquired pellicle
- arginine - ammonia production
- buffering compounds

Proline-rich proteins and arginine

Types of flow
- spontaneous
  - minor salivary glands - mucins
  - stimulated
  - parotid - serous
  - unstimulated (resting)
  - sublingual and minor - serous and mucous

Healthy - daily flow rate
- 0.5 to 1.5 liters
- resting - 0.25 to 0.4 /min
- stimulated - 1 - 3 ml / min
- establish a baseline!

Flow rate - visual inspection
- retract lower lip
- dry with gauze
- 1 min - drops on mucosa
- sufficient flow - pooling in floor of mouth

Secrets of Saliva

Salivary protein functions

Healthy saliva - composition

Secretions serous and mucous

Proline-rich proteins and arginine

Types of flow

Healthy - daily flow rate

Flow rate - visual inspection
Testing flow rate / per min
- chew wax - 5 min
- spit in cup
  - normal - 1 to 3 ml
  - low - 0.7 to 1 ml
  - very low - < 0.7 ml

Stimulated saliva
- 80 - 90% daily salivary production
  - anticipatory tongue/lip movements
  - chewing
  - taste
  - smell


Stimulated saliva
- quality improves - proteins
- increased bicarbonate
- neutralizes acids
- bicarbonate reserves are limited
- proteins - secondary path - neutralization

Saliva - Fast facts.......
- peak flow - late afternoon
- during sleep - near zero flow
- acid substances - salivary flow rates
- parotid gland - 50% of stimulated saliva

Salivary pH - impact on tooth structure
- critical pH – is a dynamic number
- dependent - salivary calcium and phosphorus
- average resting salivary pH 6.4 – 7.

Critical pH
- dependent - salivary calcium and phosphorus
- average resting salivary pH 6.4 – 7.

Healthy salivary pH
- resting - pH 6.8 - 7.2
- favors homeostasis
- supports remineralization
- suppresses pathogens

Quality of life
- resting - pH 6.8 - 7.2
- favors homeostasis
- supports remineralization
- suppresses pathogens

When do teeth melt???
- root structure - pH 6.7
- enamel - between pH 5 and 5.5
- fluorapatite - pH 4.5


When do teeth melt???
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Stookey GK. The effect of saliva on dental caries. JADA 2008 May; 139;11S-17S.

**Tasting**

**Neuroscience made understandable**  
Alexander van Aken  
Brighton and Sussex Medical School  
2014 © 2019

**Tongue papillae**

- 1 - 200 tastebuds per papillae  
- taste pores house taste cells  
- 50-150 taste receptor cells per taste bud  


**Taste buds**

- sensitive to - sweet, bitter, salt, or sour  
- taste buds - taste pores  
- chemicals in solution - stimulate receptor cells  


**Tasting food**

- saliva initiates taste  
- poor taste - anorexia  
- adequate nutrition  
- supports muscle mass  
- immune system

http://www.webmd.com/oral-health/tc/taste-changes-topic-overview

**Taste disturbances**

- ageusia - complete lack of taste  
- hypogeusia - decrease taste sensitivity  
- dysgeusia - metallic/foul/rancid/salty  
- phantoguesia - phantom taste  
- cacogeusia - revolting taste

http://www.webmd.com/oral-health/tc/taste-changes-topic-overview

**Compromises**

- food sticks to teeth  
- raw food - hard to chew  
- increase sticky, processed foods


Lussi A, Schlueter N, Rakhmatullina E, Ganss C. Dental erosion--an overview with emphasis on chemical and histopathological aspects. Caries Res. 2011;45.

**Liquid intake challenges**

- sip on sweet drinks  
- require no chewing / preparation  
- high carb nutritional supplements


**What Does Water do for You?**

- Needed by the brain to manufacture hormones and neurotransmitters  
- keeps mucosal membranes moist  
- allows body’s cells to grow, reproduce and survive  
- flushes body waste, mainly in urine  
- lubricates joints  
- Water is the major component of most body parts  
- helps deliver oxygen all over the body

Compromises

‣ high fluid intake
‣ often sweet
‣ dilutes existing saliva
‣ frequent bathroom breaks
‣ disturbed sleep

Aging

Medical conditions

‣ Sjögren syndrome - primary
‣ Hashimoto’s disease - thyroid
‣ rheumatoid arthritis
‣ secondary SS - other autoimmune disorders

Medical conditions

‣ diabetes
‣ endocrine disorders
‣ Parkinson’s disease
‣ pregnancy - nursing
‣ chronic fatigue syndrome

Medical conditions - complication

‣ intestinal failure
‣ COPD
‣ anxiety
‣ depression
‣ cancer therapy
‣ liver transplant

Pathology and sequela

‣ salivary gland disfunction
‣ removal salivary glands
‣ end of life / terminal illness
‣ menopause

Medical and environmental conditions

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Medical and environmental conditions
Treatments

‣ hemodialysis
‣ radiation treatment
‣ hormone imbalance

Medications - OTC and Rx

‣ HBP
‣ anxiety
‣ nausea
‣ pain
‣ depression
‣ appetite control
‣ seasonal allergies

Conditions - lead to dehydration

‣ fever
‣ vomiting
‣ blood loss
‣ excessive sweating
‣ diarrhea

Respiratory

‣ seasonal allergies
‣ facial anatomy
‣ dust / wind
‣ nasal congestion
‣ coughing
‣ sleep apnea
‣ mouth breathing
‣ asthma

Oral appliances

‣ dentures / partial dentures
‣ bite guards
‣ orthodontic aligners
‣ sports mouth guards
‣ whitening trays

Lifestyle

‣ stress
‣ anxiety/fear
‣ recreational drugs
‣ C-Pap machine
‣ prolonged speaking / singing
‣ smoking / vaping
‣ alcohol
‣ heavy exercise
Climate
- air conditioning
- central heat
- desert climates
- cold temperatures
- airplanes / hotel rooms

Smoking prevalence by state

Smoking statistics - USA
- 17.8% (42.1 million) Americans
- 20.5% of men
- 15.3% of women

Lifestyle - sodium intake
- Too much salt!
- 94% from food!
- high sodium intake
- processed foods

Gateway - the rest of the body
- oral disease is complex
- changing hormone levels
- medications causing dry mouth
- genetics
- immune system
- lifestyle / environmental factors
- natural aging process

Who has the highest risk?

Understand sodium intake levels

Smoking prevalence by state

Smoking statistics - USA

Lifestyle - sodium intake

Gateway - the rest of the body

Who has the highest risk?
Bioceramics masterpieces

Biofilm attachment

Caries — infection that involves microbes

How does erosion happen?

Erosion — a multifactorial condition

Erosion

Erosion vs. caries

Acid erosion

Erosion — surface softening

- progressive loss of hard tissue
- chemical loss - not bacterial
- most important factor - hypersensitivity
- erosive lesions — generally sensitivity

Erosion vs. caries

- surface-softening lesion
- non-bacterial - extrinsic and intrinsic acids
- complicated by attrition and abrasion
- remineralization difficult
- prevalence - increases with age

Acid erosion

- citric acid pH 2.3
- 6 X 5 min/day
- 10 days
- stored in salt solution
**Erosion – complicating medical conditions**

- GERD – gastric esophageal reflux
  - 7% adults – daily episodes
  - 36% monthly
  - Children also experience GERD

- Anorexia
  - 47% – binge/purge subcategory
  - Refuse to maintain normal weight

- Bulimia
  - Typically normal weight
  - Self-induced vomiting after eating

**Erosion from GERD**

- Loss of occlusal anatomy
- Rising amalgams

**Eating disorders – behaviors and findings**

- Vomiting – palatal surfaces – maxillary teeth
- Eroded surfaces – smooth/glossy
- Erosion – 2+ years of self-induced vomiting
- Active lesions – smooth/unstained
- Inactive lesions – stain over time

**Eating disorders – common behaviors and findings**

- Erosion – 2+ years – self-induced vomiting
- Excessive – acidic beverages and fresh fruits
- Antidepressants – cause dry mouth
- Binge/purge – high carbohydrate intake
- Anorexia – often poor oral hygiene

**Erosion – factors**

- Regurgitation
- Reflux
- Bulimia
- Chemotherapy
- Pregnancy
- Alcoholism
- Peptic ulcers
- Gastritis
- Drug side effects

**Extrinsic factors**

- Diet
  - Drinks, fruits, candies, pickled foods
- Environmental
  - Occupational (acid vapors from industrial electrolytic processes / wine tasting)
  - Recreational (swimming pools)

**Sensitivity and fungal infections**

- Common
- Transient pain
- Short, sharp sensations
- Exogenous stimuli

**Dentinal hypersensitivity**

- Common
- Transient pain
- Short, sharp sensations
- Exogenous stimuli

**Stimulus**

- Thermal stimulus (cold) 75%
- Tactile stimulus 25%
- Osmotic stimulus (sweet) 16%
- Air blast ?%
Dentinal hypersensitivity

Two conditions are necessary

- Exposed dentin via loss of enamel or periodontal tissues
- Open dentin tubules - patent to the pulp – loss of smear layer


Hidden hypersensitivity

Rule out other conditions

- Occlusal trauma
- Cracked tooth syndrome
- Caries – new and recurrent
- Pulpal pathology
- Gingival sensitivity
- Layered sensitivities


Redheads

- High anxiety
- Fear of pain
- Avoid dental care
- More sensitive to cold
- Subcutaneous lidocaine significantly less effective


Candidiasis

- Tongue
- Commissures
- Buccal mucosa
- Palate


Structural differences between sensitive and non-sensitive dentin*

<table>
<thead>
<tr>
<th></th>
<th>Non-sensitive</th>
<th>Sensitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of open tubules</td>
<td>x</td>
<td>8 x</td>
</tr>
<tr>
<td>Diameter of tubules</td>
<td>0.43</td>
<td>0.83</td>
</tr>
<tr>
<td>Fluid Flow (Poiseuille’s law)</td>
<td>y</td>
<td>16 y</td>
</tr>
</tbody>
</table>


Solutions

Get the facts
- Coaching not scolding
- Develop positive energy
- Create a legitimate spin


Conversation starters!

Get the facts
- Coaching not scolding
- Develop positive energy
- Create a legitimate spin


Conversation starters!

Health benefits
- Save money, time, comfort
- Offer alternatives

Solutions

- stimulate saliva
- raise pH
- balance components
- limit fermentable CHO intake

Improving saliva and neutralizing acids

- non-fermentable sweeteners
- metabolic inhibitors - fluoride
- anti-adhesion - xylitol
- arginine products

The magic of xylitol

- interferes with Strep Mutans metabolism
- disrupts biofilm integrity
- promotes neutral pH
- stimulates salivary flow

Using xylitol

- one of first three ingredients
- gum/candy - four times a day for 3-5 minutes
- 4 - 10 grams per day
- toothpaste, wipes, pacifier, mouth rinse, spray, gel
- excessive use – laxative effect

Washington state xylitol innovations!

- slow release
- adhesive back
- stick and stay
- US birch xylitol
- 18 flavors
- one tin = 1 week

New! Hydris Dry Mouth System

- Rinse
- soothing locks in moisture
- low impact flavor

Tooth paste
- plant-based ingredients
- coconut oil sodium fluoride
- no alcohol


Marginal

Lozenges
- RiteAid lozenges - 5.2
- CVS lozenges - 5.28
- TheraBreath - 5.82
- Act lozenges - 5.72

Rinses or Sprays
- Biotene PBF Oral Moisturizing - 5.39
- MedAc@ve SnF2 Rinse Complete - 5.4
- MedAc@ve spray - 5.92

Unsafe

Lozenges
- MedActive - 2.43 to 2.73
- DenTek - 2.9
- Luden’s Pectin - 2.93
- Cotton Mouth - 3.1
- Thayer’s Sugar-Free - 3.17
- OraMoist Patch - 3.54
- Hylamint - 4.84
- Hager Pharma - 4.44

Saliva support

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Saliva support
- super saturated calcium phosphate
- dissolve in water
- electrolyte concentration = saliva
- Rx product

More solutions

humidifier
artificial saliva
salivary stimulants
- frozen gauze - best
- ice chips
- water spray
- moisturizer
- lip / mouth

What is arginine?

- natural amino acid
- naturally found in saliva
- bipolar molecule - + and - charged groups
- net positive charge

Arginine - mode of action

Urea - few bacteria
- saliva & crevicular fluid
- broken down by urea
- byproduct-ammonia

Arginine - many bacteria
- low in saliva/abundant in peptides
- ADS - 3 enzyme system
- byproduct - ammonia
- action produces ATP

Arginine - mode of action

- exogenous source of arginine - toothpaste
- enhances alkaline pH in saliva and plaque
- 4 weeks - arginine toothpaste
- alkali production higher - plaque samples caries active (CA) subjects
- CA subjects - shift in bacterial composition - healthier

Arginine bicarbonate calcium carbonate tooth paste - lower DMFS

- 6,000 children - low to moderate risk - 6-12 years old
- double blind, randomized - 3 groups - 2 year study
- 1,450 ppm F paste
- 1,450 F + 1.5% arginine/calcium carbonate or dicalcium phosphate
- 16.5% lower DMFS - arginine/calcium/fluoride groups than FL paste alone

References:
1. Panagakis F, Schiff T, Guignon A. Den@n hypersensi@vity: Effec@ve treatment with an in-office desensi@zing paste containing 8% arginine and calcium carbonate. Amer J Dent. 2009. 22:March.
3. Huang X, Schulte RM, Burne RA, Nascimento MM. Characteriza@on of the arginoly@c microflora provides insights into pH homeostasis in human oral biofilms. Caries Res. 2015;49(2):165-76.
Emerging research – Arginine calcium carbonate

- inhibits bacterial adhesion - tooth surfaces
- reduces biofilm thickness
- reduces EPS matrix density
- arginine + fluoride - suppresses S. mutans and P. gingivalis
- suppresses C. albicans growth
- facilitates microbial resistance - acidic environment

Arginine bicarbonate calcium carbonate – keeping saliva neutral

Stony Brook University School of Dental Medicine - Spring 2014

Arginine-based products

Discontinued!

Remineralization strategies

Tubule occlusion

Stannous fluoride = toothpaste, gel, rinse
High fluoride = varnish, gels
Precipitating salts = calcium phosphate, arginine bicarbonate
Restorative materials = adhesives, silicates, resins, hydroxyapatite
Laser = soft laser

ACP – Amorphous calcium phosphate
- releases calcium and phosphorus
- highly soluble compound - prolonged substantivity?
- building block of apatite

CPP-ACP compounds
- contains casein phosphopeptide (Recaldent)
- adheres to soft tissue, plaque, teeth
- calcium and phosphate – released during acid challenge
- contraindicated with milk allergy

Tricalcium phosphate action

- moisture breaks down barrier
- fluoride, calcium, phosphate - readily available
- creates fluorapatite

Fluoride platforms

Professional

- 5,000 PPM fluoride
- uses TCP chemistry
- Rx

Home

- 0.21% sodium fluoride
- uses TCP chemistry
- not an Rx
- Amazon / Dental supply companies

Patient-centered choices
**Varnish recommendations**

- **Application**
  - 2+ times a year
  - caries prevention
  - high risk populations

- **Benefits**
  - less time
  - less patient discomfort
  - patient acceptance
  - preschool / adolescents / geriatrics

**Patient-centered choices**

- 24 hour uptake time
- application - moist or in plaque
- horizontal swipe
- surface migration
- dry teeth / mix product
- paint all susceptible surfaces
- no wait time - eating/drinking

**Stannous Fluoride Zinc Phosphate**

- anti-cavity, anti-gingivitis and anti-sensitivity
- bioavailable stannous and fluoride
- protective mineral shield

**Silver diamine fluoride 38%**

- natural antibacterial
- hypersensitivity relief
- carious dentin lesion turns black
- no anesthesia

- arrests caries
- less than $1 / 1-2 teeth
- 8ml bottle
- anyone who can apply fluoride

**Theobromine**

- theobromine - found in cacao (chocolate) plus minerals
- growth of larger hydroxyapatite crystals (4X larger)
- occlusion - 7 days
- FDA GRAS (generally regarded as safe) status
- does not contain fluoride

**Increase in surface micro hardness - 7 days**

**Setting the stage for healthy biofilm - getting rid of pathogens**
Supportive strategies - Slowing down erosion

- Use a straw
- Drink quickly
- Beverages during meals
- Add ice
- Avoid snacks/drinks
- Brush before morning juices, etc.
- Rinse with water - reduces titratable acidity, not pH
- Soft bristle brushes / low abrasion paste

Summary - factors that affect erosion

✓ Chemical - Fl level, pH, titratable acidity, calcium & phosphorus
✓ Biological - saliva composition, flow, buffering capacity,
  pellicle formation and tooth composition
✓ Behavioral - drinking habits, frequency, duration, timing of exposure

What is the take home message?

- Dietary intake / patterns
- Saliva composition / bacterial risk
- Intervention and remineralization
- Every patient is unique

What do we owe our patients?

- Current, in-depth health hx
- Assess total needs
- Tell the truth
- Provide all options

- Current scientific information
- Patients must make the final choice