Vital Considerations in Oral Hygiene: Bridging the Dental-Medical Divide

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Navy Cmdr. Karima Ayesh, D.M.D. graduated from Florida International University in 2001, earning a Bachelor of Science Degree in Biology with a minor in Chemistry. She later attended Nova Southeastern University in 2006, earning a Doctor of Dental Medicine Degree from the College of Dental Medicine. She is a Board-Certified General Dentist.

Cmdr. Ayesh practiced for eight years throughout the states of Florida and Illinois. Inspired by her Navy colleague at Great Lakes and hearing about her deployments to Afghanistan, she decided to pursue a career in the Navy as a Dentist. She received her commission through the Direct Accession Program in April of 2014. CDR Ayesh has served as the Tri-Service Dental Point of Contact for the Active-Duty Dental Program at Defense Health Agency since May of 2021.

Her awards include the Navy Commendation Medal (two) and various other unit commendations and service medals.

Disclosures

- Navy Cmdr. Ayesh has no relevant financial or non-financial relationships to disclose relating to the content of this activity.
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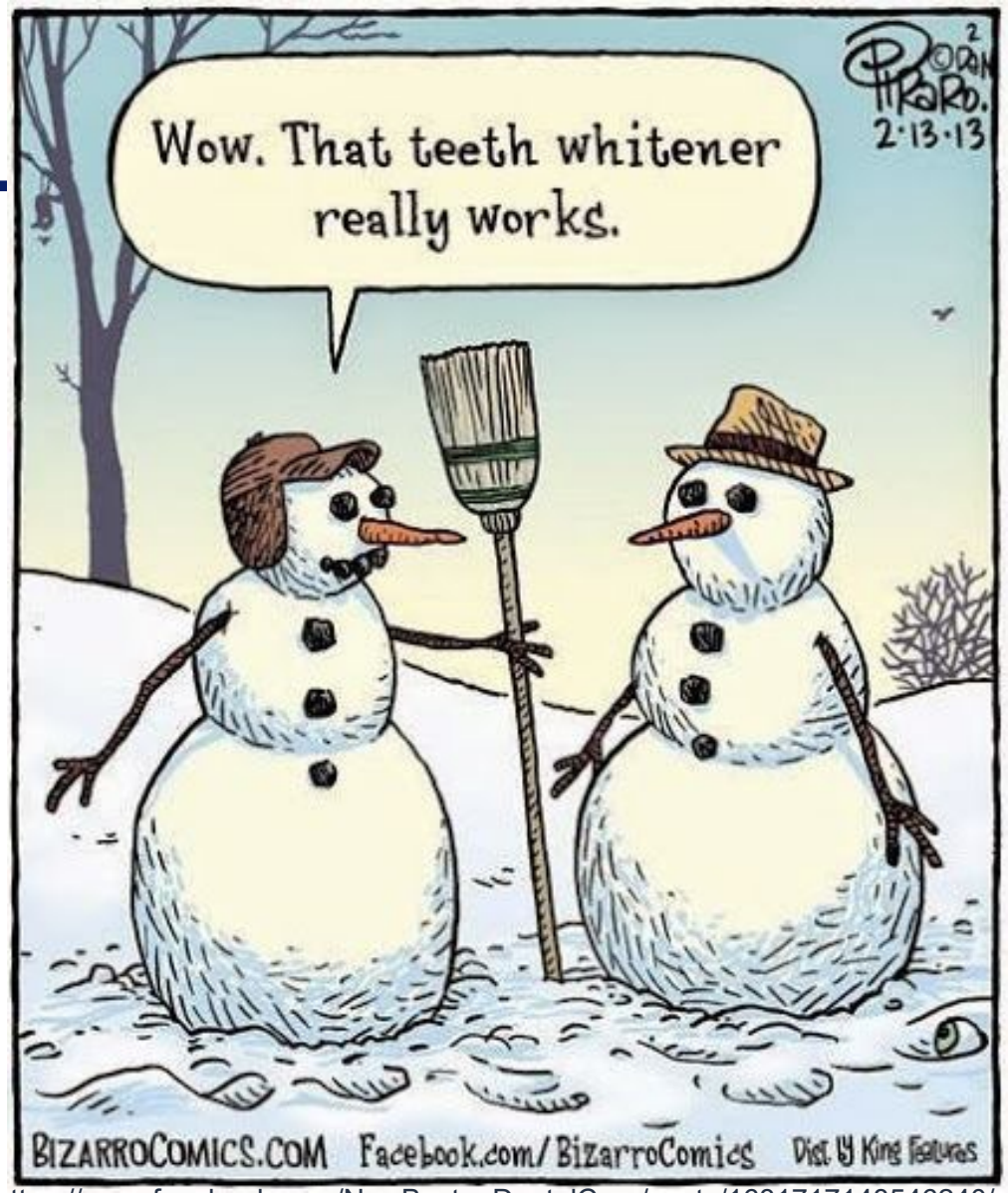
LEARNING OBJECTIVES

At the conclusion of this activity, participants will be able to:

1) Analyze systemic correlations between oral and overall health
2) Deconstruct the etiology of caries and periodontitis
3) Explain how to take care of the pediatric and adult dentition
4) Identify when dental clearance is indicated

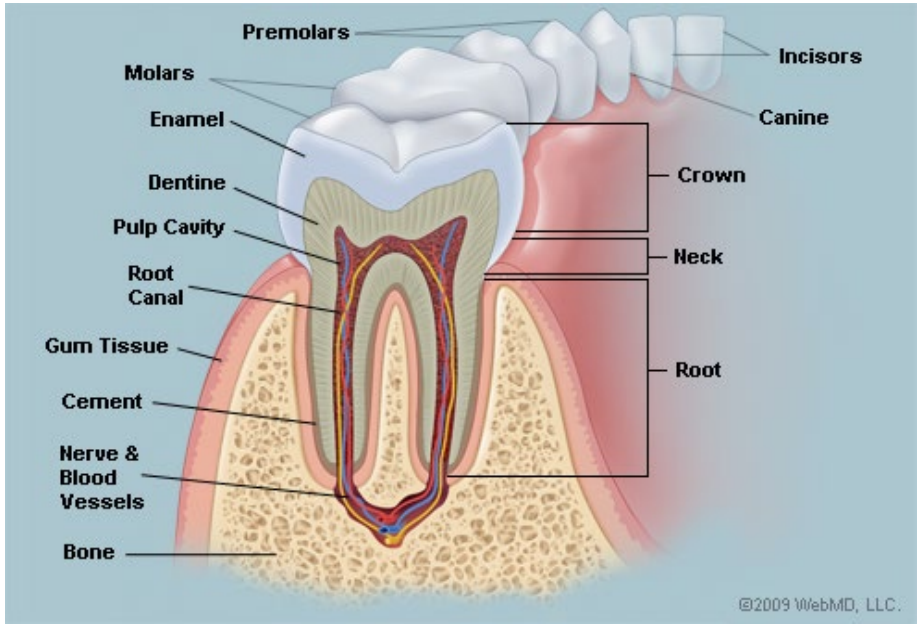
Dental Humor

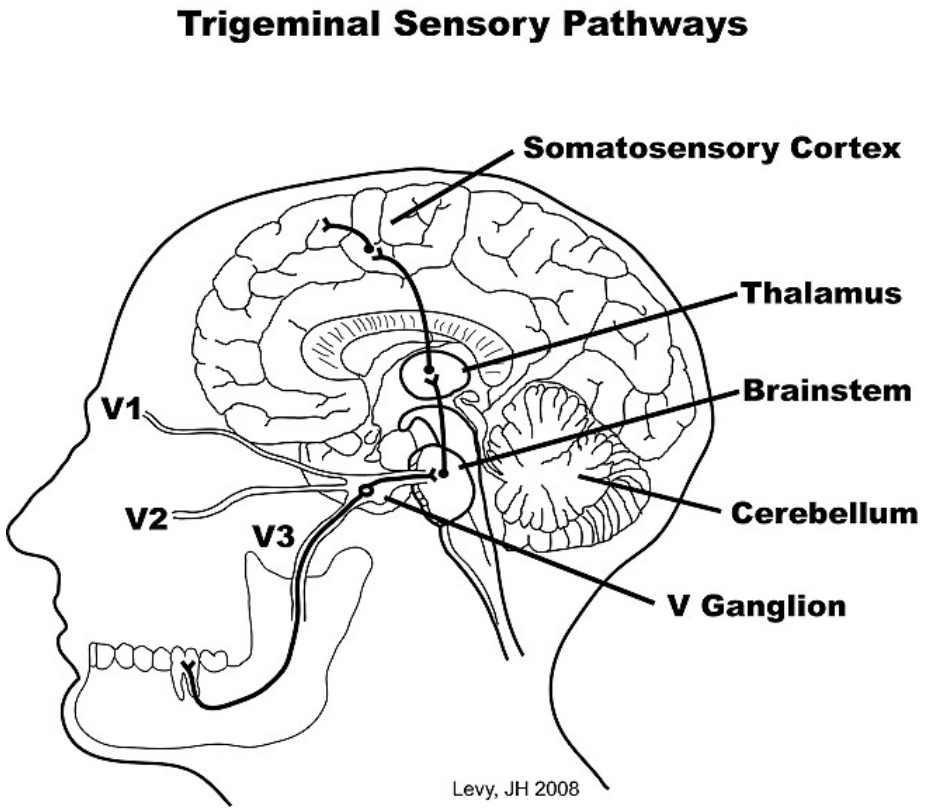


https://www.facebook.com/NewBostonDentalCare/posts/1681717148546240/

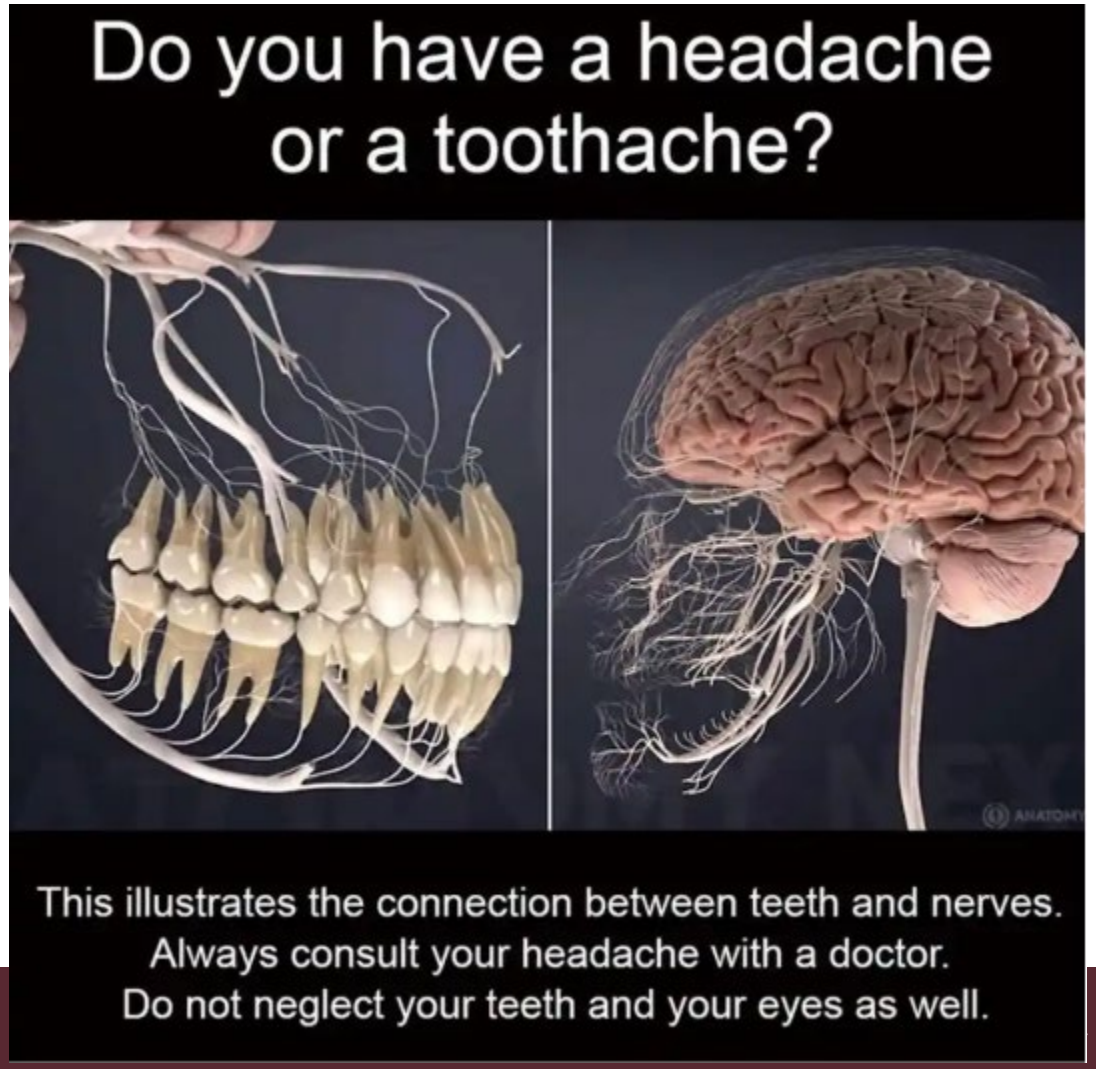
Dental Anatomy

- Each tooth is a specialized organ





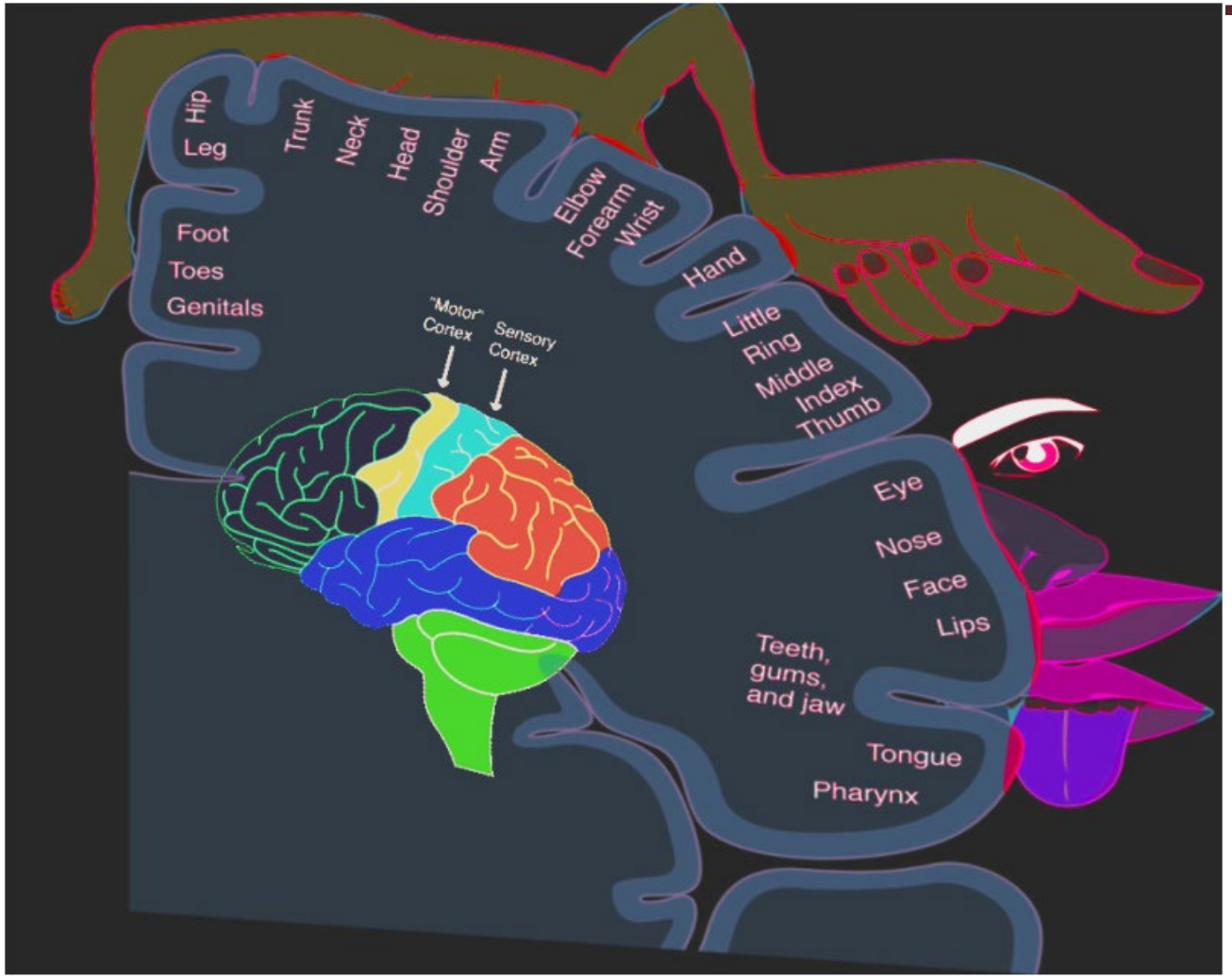
“Your brain is wired to monitor your teeth. We have drastically underestimated the importance of our teeth.”



(Hovington, 2023)

Images courtesy of Tomas Eichler, PhD student in Neurogenetics at Research Institute of Molecular Pathology (IMP).

Homunculus



- The tongue represents roughly 45% of the cortical space that your brain uses to monitor muscle
- The face is the structure that takes up the most area of the sensory homunculus

(Hovington, 2023; Nguyen & Duong, 2022)

https://www.ncbi.nlm.nih.gov/books/NBK551718/figure/article-18527.image.f5/

Poll Instructions

Join by Web

1. Go to **PollEv.com**
2. Enter **CEPO**
3. Respond to activity

Join by Text

1. Text **CEPO** to **22333**
2. Text in your message

Polling Question #1

In your experience, what percentage of patients enjoy eating healthy and exercising?

Polling Question #2

In your experience, what percentage of patients enjoy undergoing gastric bypass and/or cardiac bypass surgery?

Dental Diseases

- There are several diseases of the head and neck. The two most commonly found in the oral cavity are:
  1. Caries – "**Although largely preventable, dental caries and periodontal disease are the two biggest threats to oral health and are among the most common chronic diseases in the United States.** Dental caries is the most common chronic disease in children; it is about five times as common as asthma and seven times as common as hay fever. The most common cause of tooth loss among adults is untreated periodontal disease."
  2. Periodontal disease – affects 90% of the population. Two forms, gingivitis and periodontitis.
- Dental diseases are mostly "silent" until the latter stages. Therefore, patients can be falsely led to believe that they are healthy because nothing hurts.

(Gasner & Schure, 2022; Benjamin, 2010)

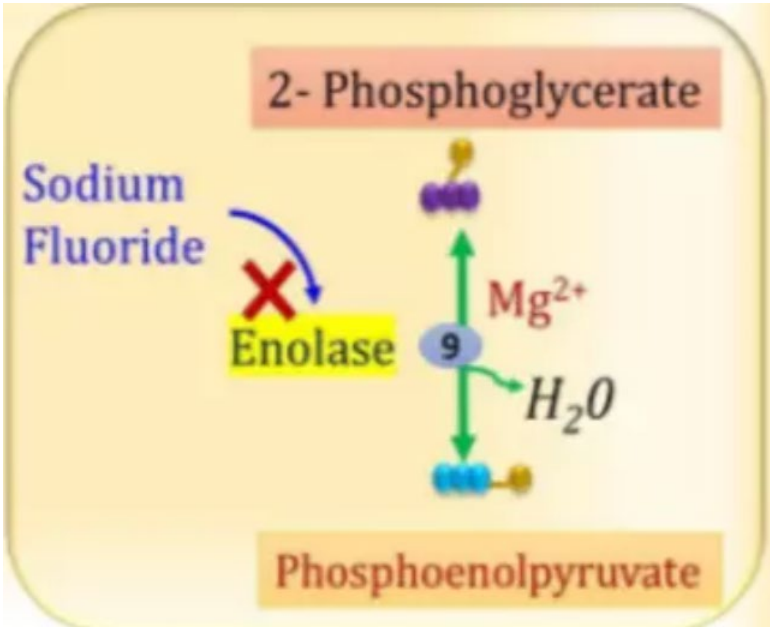
Caries

- Dental caries is an infectious, transmissible disease
- Bacteria ferment the carbohydrates you leave behind in your mouth. Their byproduct is acid which is what causes dental caries
- Repeated exposure to acids, exogenous or endogenous: Gastroesophageal reflux disease (GERD), acidic foods/beverages.

(Images courtesy of CDR Ayesh)

Caries Metabolism and Fluoride

- Carbohydrates used in bacterial glycolysis
- Fluoride inhibits glycolysis
- Helps remineralize enamel
- Increases resistance to acid
- Teeth can resist a lower pH
- Increased hardness
- Hydroxyapatite becomes Fluorapatite; Fl^- replaces OH^-



(Han, Fardini, Chen, Iacampo, Peraino, Shamonki & Redline, 2010)

Gingivitis

- Inflammation of the gingiva surrounding the teeth, with no radiographic evidence of bone loss
- Caused by bacteria that form dental plaque and calculus, which irritate the gingiva and cause an immune response = chronic or acute infection
- REVERSIBLE damage

(Images courtesy of CDR Ayesh)

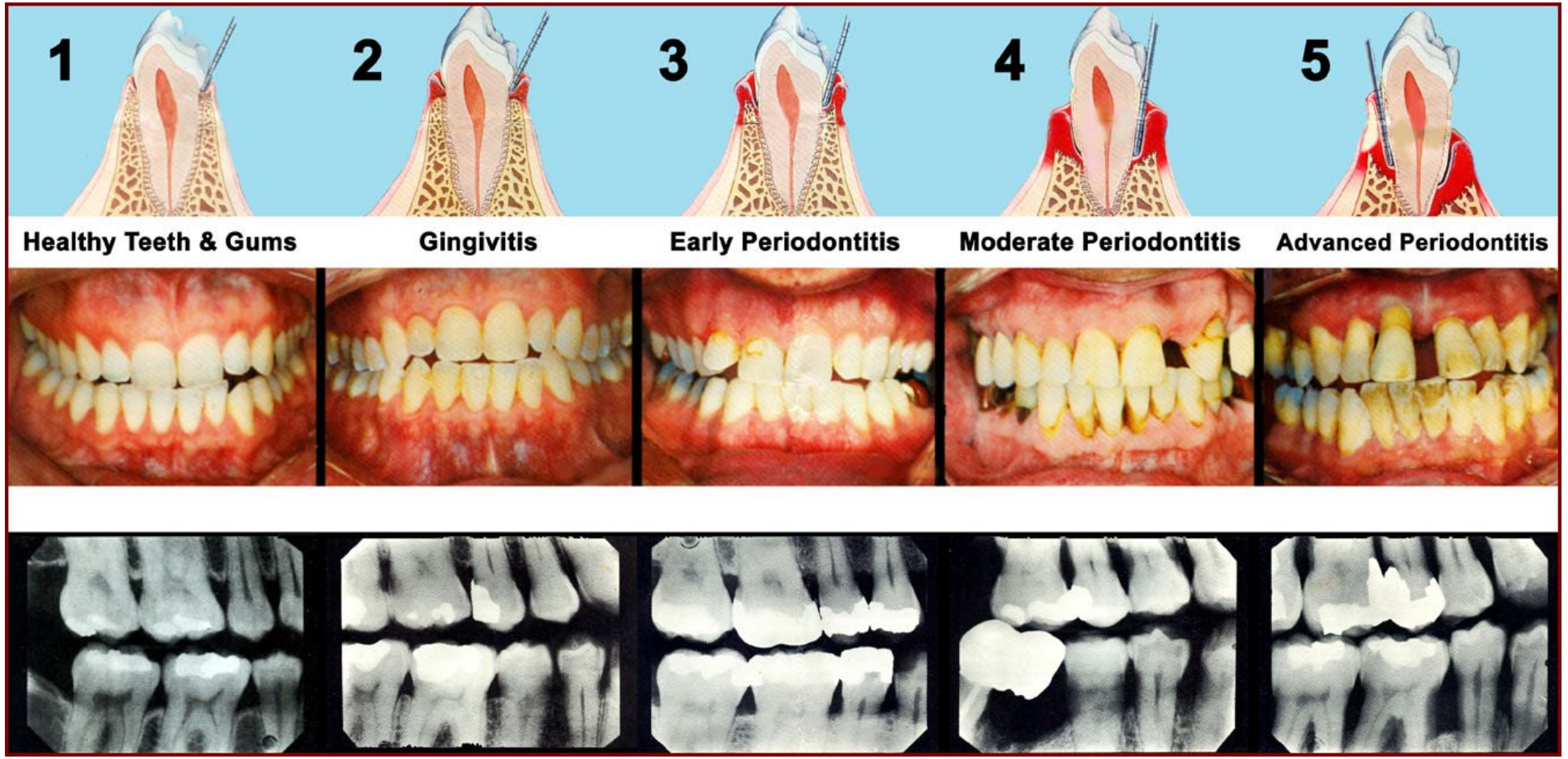
Periodontitis

- Loss of supporting bone around the tooth
- IRREVERSIBLE damage – bone does not grow back; bone is what holds your teeth in your mouth. No bone = no teeth = dentures
- Chronic or acute infection
- Sixth most common disease worldwide

(Images courtesy of CDR Ayesh)

(Sanz et al., 2020)

Stages of Periodontal Disease



(Images courtesy of Dr. Daniel Pestana)

Oral Microbiology

- The oral cavity has extremely diverse and populous micro flora; approximately 700 species.
- Specific oral bacterial species have been implicated in several systemic diseases, such as bacterial endocarditis, aspiration pneumonia, osteomyelitis in children, preterm low birth weight and cardiovascular disease.
- “Periodontal disease is an independent risk factor for head and neck cancer. Periodontally compromised individuals with co-existing lifestyle risk factors should be encouraged to monitor and maintain periodontal health to minimize cancer risk.”

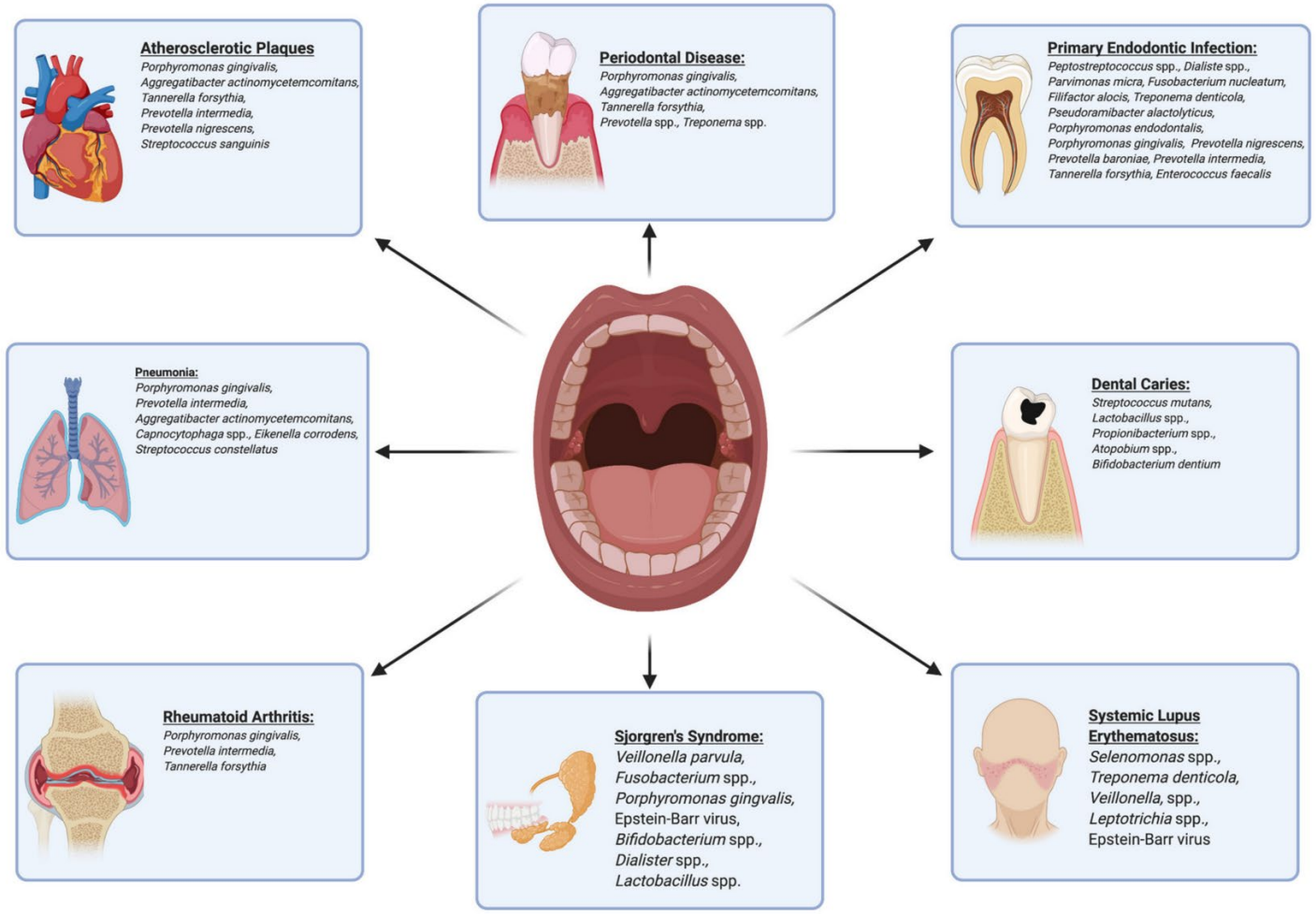
(Deo & Deshmukh, 2019; Berbari, Cockerill, & Steckelberg, 1997; Beck, Garcia, Heiss, Vokonas, & Offenbacher, 1996; Buduneli, Baylas, et al 2005; Dodman, Robson, & Pincus, 2000; Offenbacher et al, 1998; Scannapieco, 1999; Wu et al. 2000; Gopinath et al. 2020)

Systemic Implications

- Cardiovascular disease (CVD)
  - Significantly higher levels of C-reactive protein (CRP) in periodontal patients vs healthy, and in CVD and periodontal patients vs either condition alone
  - Oral bacteria found in arterial plaque
  - 91% of patients with CVD demonstrated moderate to severe periodontitis
  - Bi-directional
- Type II diabetes mellitus (DM)
  - Decreased immune response and advanced glycation end products (AGEs)
  - Bi-directional
- Pregnancy complications
  - Bacteria/inflammatory markers cross the placenta, causing fetal toxicity resulting in preterm delivery, low-birth-weight babies, even stillbirth
- Osteoporosis
  - Osteoporosis and fractures are associated with periodontitis
  - Cytokines -> inflammation->inhibition of osteoblasts; aging = oxidative stress and cellular senescence drive progression of osteoporosis and aggravate periodontal disease

(Sanz et al., 2020; Păunică et al., 2023; Wu et al., 2020; Hong et al., 2021; Bustamante et al., 2023)

Oral flora and systemic implications



(Khor, Snow, Herrman, Ray, Mansukhani, Patel, Said-Al-Naief, Maier, & Machida, 2021)

Oral flora and systemic implications

Table 3. Link between and significance of oral and GI microorganisms and specific systemic diseases.

Disease	Link to Oral/GI Microbiota	Significance	Ref.
Atherosclerotic Plaques	*Porphyromonas gingivalis, Aggregatibacter actinomycetemcomitans, Tannerella forsythia, Prevotella intermedia, Prevotella nigrescens, Streptococcus sanguinis*	These bacteria have been found in atherosclerotic plaque samples. *Porphyromonas gingivalis* and *Aggregatibacter actinomycetemcomitans* have shown high levels of inflammatory immune response and presence of these bacteria may lead to a significantly increased risk for developing coronary artery disease.	[14]
Pneumonia	*Porphyromonas gingivalis, Prevotella intermedia, Aggregatibacter actinomycetemcomitans, Capnocytophaga* spp., *Eikenella corrodens, Streptococcus constellatus*	These bacteria are thought to play direct roles in the pathogenesis of pneumonia.	[15]
Systemic Lupus Erythematosus (SLE)	*Selenomonas* spp., *Treponema denticola, Veillonella* spp., *Leptotrichia* spp.	Salivary levels of the following microorganisms have been shown to increase in patients with SLE and correlate directly with increased levels of inflammatory cytokines.	[49]
Systemic Lupus Erythematosus (SLE)/ Sjogren's Syndrome (SS)	Lower Firmicutes to Bacteroidetes ratio	A lower Firmicutes to Bacteroidetes ratio has been shown in patients with SLE/SS and potentially increases inflammation.	[53]
	Epstein–Barr virus (EBV)	EBV lytic phase antigens may be responsible for activation of SLE/SS immune responses creating auto-reactive antibodies.	[48]
Sjogren's Syndrome (SS)	*Bifidobacterium* spp., *Dialister* spp., *Lactobacillus* spp., *Leptotrichia* spp.	The first three bacteria are increased in salivary concentration for cases of primary SS. *Leptotrichia* spp. abundance was reduced in primary SS.	[55]
	Veillonella parvula, Fusobacterium spp.	These bacteria have also shown elevated concentrations in patients with SS, with *Veillonella parvula* showing promise as a biomarker in the early detection of SS.	[56]
Rheumatoid Arthritis (RA)	*Porphyromonas gingivalis*	Antibodies against human citrullinated alpha-enolase show cross reactivity with *Porphyromonas gingivalis* enolase and could be a potential source for autoimmunity directed against anticitrullinated protein antibodies (ACPAs).	[50]
	Porphyromonas gingivalis, Prevotella intermedia, Tannerella forsythia	Patients with RA have elevated antibody levels against periodontal pathogens which correspond to increased serum levels of ACPAs and C-reactive protein.	[59]

(Khor, Snow, Herrman, Ray, Mansukhani, Patel, Said-Al-Naief, Maier, & Machida, 2021)

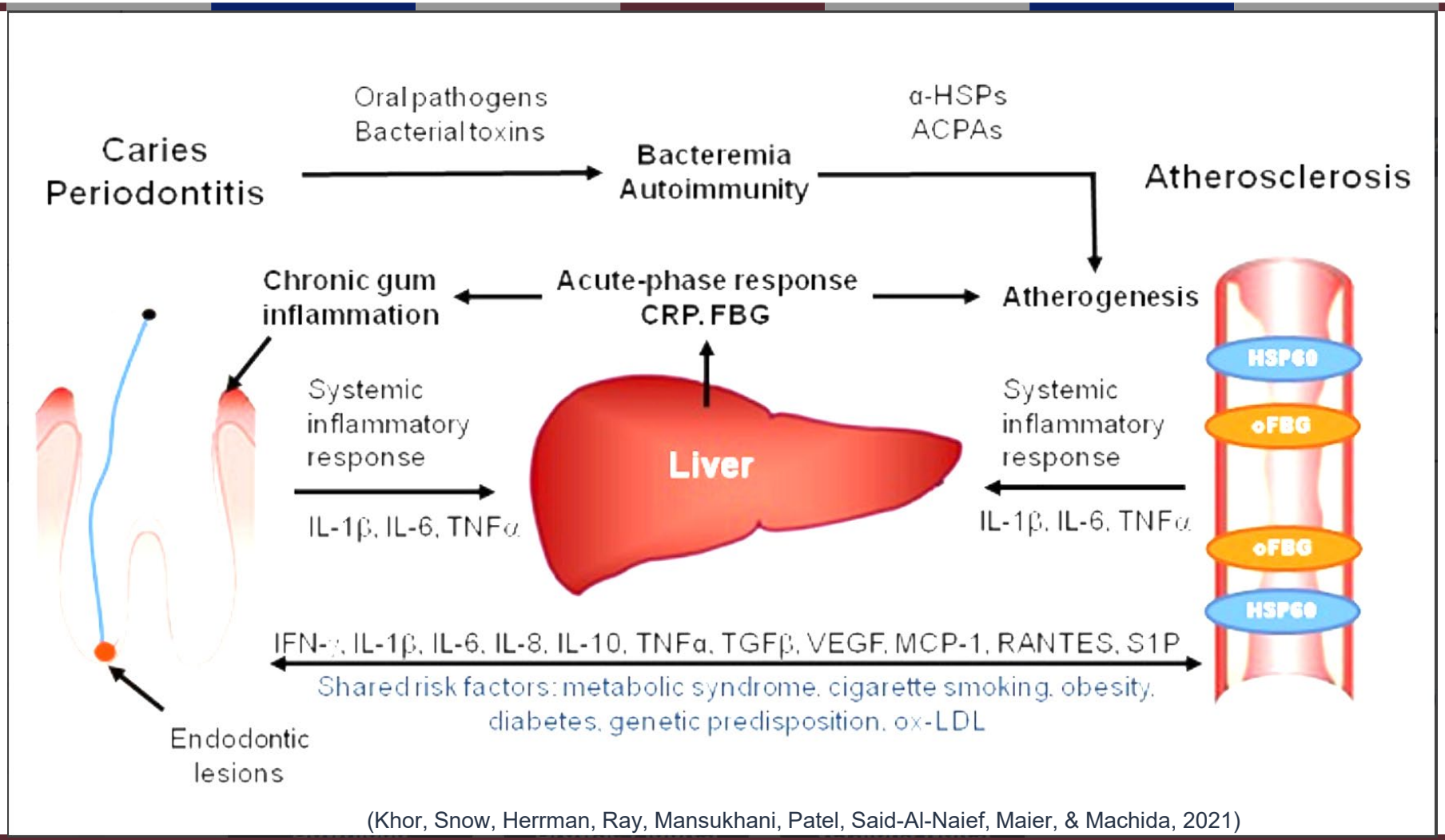
Oral inflammation and atherosclerosis

Proposed potential pathogenic mechanisms:

- Low level bacteremia by which oral bacteria enter the blood stream and invade the arterial wall
- Systemic inflammation induced by inflammatory mediators released from the sites of the oral inflammation into the blood stream
- Autoimmunity to host proteins caused by the host immune response to specific components of oral pathogens
- Pro-atherogenic effects resulting from specific bacterial toxins that are produced by oral pathogenic bacteria
- ”In populations with multimorbidity, for example chronic kidney disease with comorbid diabetes and periodontitis, periodontitis is associated with significantly reduced survival from all-cause and cardiovascular mortality. It appears therefore that periodontitis may be a modifiable non-traditional risk factor for CVD.”

(Khor, Snow, Herrman, Ray, Mansukhani, Patel, Said-Al-Naief, Maier, & Machida, 2021; Sanz et al., 2020)

Oral inflammation and atherosclerosis



(Khor, Snow, Herrman, Ray, Mansukhani, Patel, Said-Al-Naief, Maier, & Machida, 2021)

Oral inflammation and CVD

- "The highly pleiotropic genetic locus CDKN2B-AS1 (chromosome 9, p21.3) associated with coronary artery disease, type II DM, ischemic stroke and Alzheimer's disease is also consistently associated with periodontitis."
- Thrombotic factors; Significantly higher levels of fibrinogen in periodontitis patients vs healthy controls, and in CVD and periodontitis patients compared with either condition alone. Periodontal treatment reduces fibrinogen levels.
- "The presence of anti-cardiolipin antibodies has been significantly associated with periodontitis patients, which reversed following periodontal therapy." Strong association with arterial and venous thrombosis and recurrent miscarriages. Anti-phospholipid syndrome.

(Sanz et al., 2020; Bustamante et al., 2023)

Periodontitis and diabetes

- Having Type II DM increases risk of periodontitis by 34%
- Having severe periodontitis increases risk for Type II DM by 53%
- Risk of Type II DM increases with increasing severity of periodontitis
- Periodontitis, Type II DM and dyslipidemia share common genes; IL10 positive correlation, IFNG negative correlation
- Strong connection, therefore, must treat one to treat the other

(Wu et al. 2020; Păunică et al. 2023)

Pregnancy Gingivitis

- Vascular permeability increases in the gingival tissue = circulating bacteria and their products can diffuse through tissues more readily than in normal health
- First case of stillbirth due to oral bacteria, 2010
- Fusobacterium nucleatum isolated from placenta and infant
- Mother had a respiratory infection, weakened immune system, transition from mouth to uterus
- Periodontitis increases the odds of pre-term birth/low birth weight by six

(Han et al., 2010; Uwambaye et al., 2021; Vidhalea, Purib, Bhongade, 2020)

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Poll Question #3

Yes or no – Do you lie to your dentist about flossing habits?

Clean Happy Healthy Mouth

https://woodburyclinic.co.uk/stain-removal-service/

Plaque

- Plaque – soft, live bacteria that start forming as early as two hours after you brush and floss. Initiates an inflammatory response but is removed by brushing and flossing.

https://meadfamilydental.com/2011/11/plaque-vs-biofilm-and-the-research-that-could-change-dentistry-as-we-know-it/

Calculus

Images courtesy of Dr. Mackatiani

Calculus

- Calculus – due to minerals in our saliva, plaque becomes hardened, dead, festering bacteria that initiate an inflammatory response, which DOES NOT come off with flossing or brushing. Your body sees this as a foreign invader and is chronically inflamed trying to fight it off. Mineralization of plaque starts as early as 24 hours!
- Only way to remove calculus is a professional cleaning, which means that you will maintain a nidus of inflammation and infection on your teeth until your next cleaning.

What procedure is being done here?

(Images courtesy of CDR Ayesh)

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(Images courtesy of CDR Ayesh)

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(Images courtesy of CDR Ayesh)

Dental Myths

- "I have soft teeth."
- "I inherited bad teeth from my parents."
- "The baby took my calcium from my teeth while I was pregnant and that's why I have so many cavities."
- "We're all going to lose our teeth and end up in dentures anyway."
- "I don't eat candy, so I won't ever get cavities."
- "Fluoride in the water is poison."
- "You don't need fluoride as an adult."
- "Baby teeth just fall out, so take them out if they get cavities."

Risk factors

- Smoking
- Auto-immune disease
- Certain medications
- Obesity
- Stress
- Genetics
- Poor diet consisting of simple carbohydrates
- Poor oral hygiene

However, if you employ good oral hygiene, you don't have to succumb to disease

(Gasner & Schure, 2022)

Proper Oral Hygiene Protocol

- Immediately after eating or drinking, drink or rinse with water
- Brush/floss the food out of your teeth 30 minutes after eating to allow acid to neutralize
- Rinse with an alcohol-free Fluoride mouthwash
- String floss once a day/every 24 hours
- Brush for two minutes, spit out fluoride toothpaste, DO NOT RINSE, EAT or DRINK for at least 30 minutes
- If you can't brush/floss, chew sugar-free gum
- Tap water when possible; bottled or filtered water lacks Fluoride

Dental Clearance: Why and When

- Stabilize sources of infection/inflammation
- Educate patients regarding acute and chronic oral manifestations during therapy
- Discuss mitigation strategies
- Prior to radiation and/or chemotherapy; bone marrow suppression = immunocompromise, poor wound healing, high risk for opportunistic infections, exacerbation of existing oral conditions
- Head and neck radiation (HNRT) = > 60 radiotherapy data – dose (Gy) life-time risk of osteoradionecrosis of the jaw (ORNJ)

(Yong, Robinson, & Hong, 2022)

Dental Clearance: Why and When

- ORNJ risk 3-7%; higher risk in the mandible, with existing comorbidities (diabetes, excessive EtOH), poor oral hygiene, invasive dental procedures, ill-fitting prostheses
- Permanent salivary gland hypofunction and trismus can occur at radiation doses as low as 20 and 50 Gy, respectively

Post-HNRT = high risk of rapidly progressing dental caries

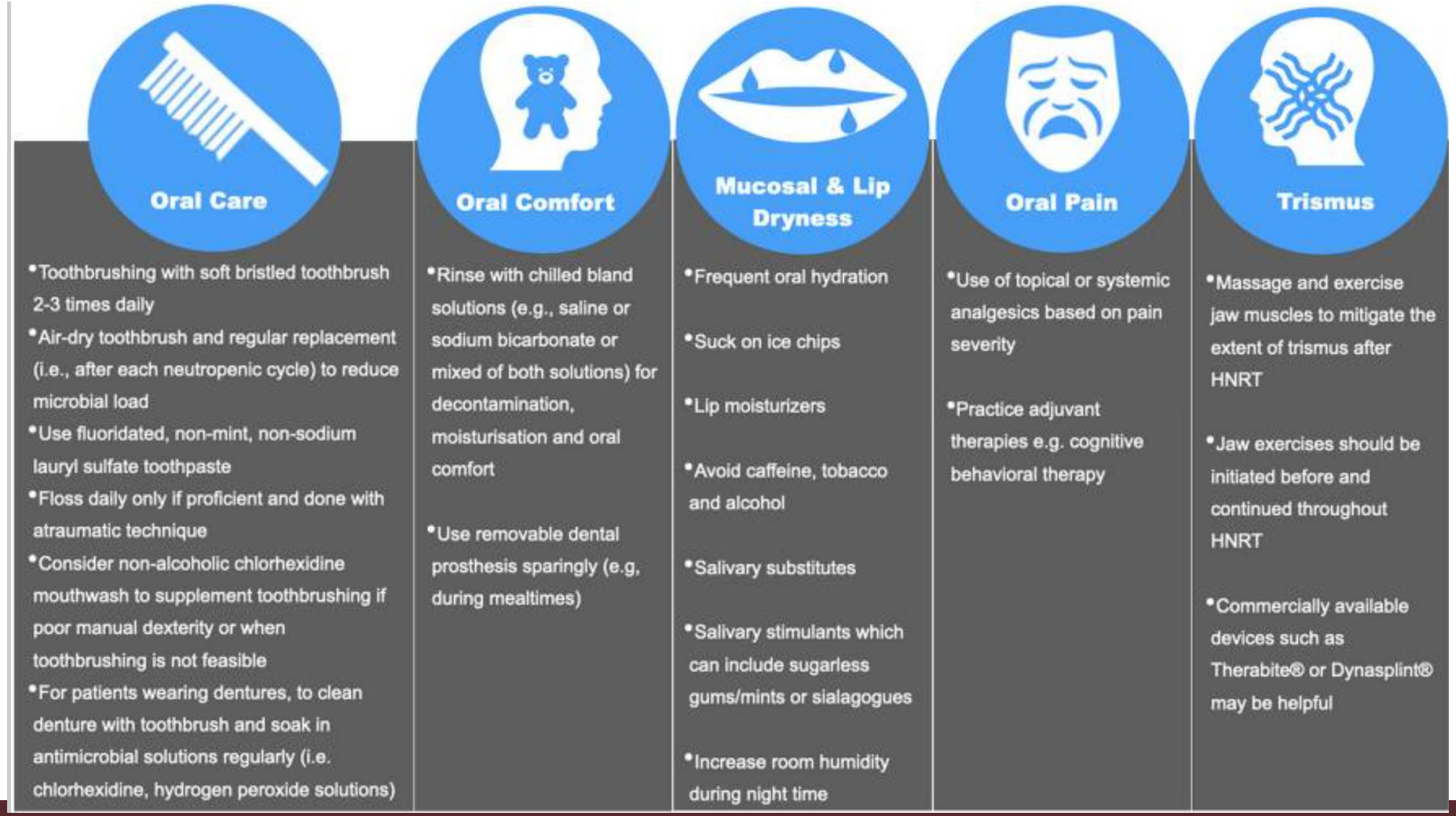
(Yong, Robinson, & Hong, 2022)

Dental Clearance: Why and When

- Bisphosphonates-Related Osteonecrosis of the Jaw changed to Medication Related Osteonecrosis of the Jaw (MRONJ)
- MRONJ in cancer patients on ARAs or AAAs = 0-18%
- 40% of cases of infective endocarditis (IE) are likely caused by oral bacteria
- IE risk post-transcatheter aortic valve replacement (TAVR) > surgical prosthetic valve replacement (SVR)

(Yong, Robinson, & Hong, 2022; Carasso et al. 2019; Cahill et al. 2022)

Mitigation strategies before and after HNRT



(Yong, Robinson, & Hong, 2022)

Pediatric Guidance

https://medical.gerber.com

Ingredients
Whey Protein Concentrate (from Cow's Milk, Enzymatically Hydrolyzed, Reduced in Minerals), Vegetable Oils (Palm Olein, Soy, Coconut, and High-Oleic Safflower or High-Oleic Sunflower), Lactose, Corn Maltodextrin, and less than 2% of: Potassium Citrate, Potassium Phosphate, Calcium Chloride, Calcium Phosphate, Sod Magnesium Chloride, Ferrous Sulfate, Zinc Sulfate, Cop Potassium Iodide, Manganese Sulfate, Sodium Selenat C. cohnii Oil**, Sodium Ascorbate, Inositol, Choline Bita Tocopheryl Acetate, Niacinamide, Calcium Pantothenat Vitamin A Acetate, Pyridoxine Hydrochloride, Thiamine Acid, Phylloquinone, Biotin, Vitamin D3, Vitamin B12, Ta Nucleotides (Cytidine 5'-Monophosphate, Disodium Uri Monophosphate, Adenosine 5'-Monophosphate, Disodi Monophosphate), Ascorbyl Palmitate, Mixed Tocophero lactis Cultures, Soy Lecithin.

*A source of arachidonic acid (ARA).
**A source of docosahexaenoic acid (DHA).

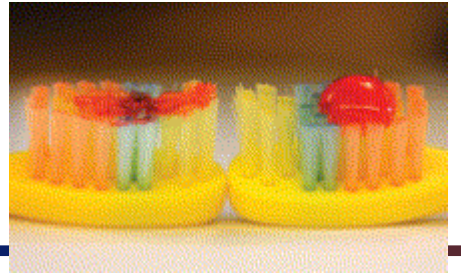
Human Breast Milk	
Calories	172
Fat	11 grams
Protein	3 grams
Carbohydrates	17 grams

Nutrition Facts per 100 Calories
(5 fl oz, prepared as directed):

Nutrients:	
Protein	2.2 g
Fat	5.1 g
Carbohydrate	11.2 g
Water	134 g
Linoleic acid	900 mg
Minerals:	
Calcium	67 mg
Phosphorus	38 mg
Magnesium	7 mg
Iron	1.5 mg
Zinc	0.8 mg
Manganese	15 mcg
Copper	80 mcg
Iodine	12 mcg
Selenium	3 mcg
Sodium	27 mg
Potassium	108 mg
Chloride	65 mg

Vitamins:	
A	300 IU
D	60 IU
E	2 IU
K	8 mcg
Thiamine (B_1)	100 mcg
Riboflavin (B_2)	140 mcg
B_6	75 mcg
B_{12}	0.33 mcg
Niacin	1050 mcg
Folic acid (Folacin)	15 mcg
Pantothenic acid	450 mcg
Biotin	4.4 mcg
C (Ascorbic acid)	10 mg
Choline	24 mg
Inositol	6 mg

Pediatric Guidance



https://jada.ada.org/cms/attachment/2035337518/2050802497/gr1.jpg

- Start good habits EARLY so later it's not as much of a daily fight!
- Start wiping your babies' gums with gauze after feedings
- As soon as the first tooth pops up, it's time to start brushing with a smear of toothpaste AFTER each feeding! And if you can't brush, at least give your baby water right after the milk/formula. Night feeding included – sorry! Nighttime is prime time for cavities.
- Do not put anything in a baby bottle that is not water, milk or formula. No soda or fruit juice.
- As soon as they have most of their baby teeth, start using floss sticks. Once they have mostly adult teeth, switch over to string floss.
- Children up until about 12 MUST be supervised while brushing. They don't do a good job and you don't want the younger ones swallowing toothpaste. Please keep toothpaste out of their reach.
- Countries without Fluoride in the water – daily supplement

Pediatric Guidance

- Hold off on introducing them to sweets as long as possible!
- “Infants should be exposed to a wide variety of flavors while mother is pregnant, while mother is nursing and beginning at an early age.”
- Growing evidence states that introducing solid foods into an infant's diet by four months may increase their willingness to eat a variety of fruits and vegetables later in life
- Infants are most receptive to different food tastes and textures between four and nine months
- Also helps decrease allergy incidence and does not increase risk of obesity later in life

(Borowitz, 2021)

Dental Humor

#HumpDayFun #SmileOn #LiveLoveLaugh

(Dental Art and Humor, 2012)

Key Takeaways

- Overall health includes dental health
- Dental conditions affect the body locally and systemically, via inflammatory pathways
- Dentists and physicians are key players in managing health and disease
- Prevention is the BEST way to avoid disease, regardless of dental or medical etiology
- Consider a dental clearance prior to chemotherapy, radiation, valve replacement, etc.
- Every patient interaction is an opportunity to reinforce good habits
- Starting good oral hygiene from the womb increases the likelihood of strong habits for a lifetime
- Patient education and awareness are vital to improving outcomes and reducing the need for interventions

Thank you so much for your time! Any questions please reach out: karima.ayesh.mil@health.mil

(dreamstime.com)

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