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ONLINE CONTINUING EDUCATION FOR THE LIFE OF YOUR CAREER

Dentition: Oral Health, Hygiene and the Swallow (Part One)

Denise Dougherty, MA, CCC-SLP

Moderated by:
Amy Hansen, MA, CCC-SLP, Managing Editor, SpeechPathology.com

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Financial Disclosures
- *SpeechPathology.com Honorarium
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- *Quality Insights of Pennsylvania
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- Dentition – or lack of dentition – is an important consideration when assessing our patient's ability to handle specific diets/foods safely
- The connection between dentition, hearing and perception of texture and taste is often not recognized.
- ***Part One*** of this seminar will provide information to connect the dots regarding impact of aging on dentition, connection between chewing and saliva, impact of dentures/lack of dentition on mastication, and diet selection

Part One :

CONTINUED

Learning Objectives

- Describe changes that occur with aging that impact dentition and mastication.
- Describe challenges due to edentulism and dentures in the elderly population.
- Identify the impact of poor or no dentition in selecting diets within the International Dysphagia Diet Standradization Initiative (IDDSI) framework.

CONTINUED

Part One

- Impact of Aging
- Importance of Saliva
- Dentition
- Natural Teeth vs. Dentures
- Mastication
- Texture & Taste Perception

AGENDA

Impact of Aging

Muscle Mass changes (1)

General age related changes/loss of muscle mass throughout body

- Reduces number/size of muscle fibers, particularly type II
- Impacts chewing ability
- Density of masseter and medial pterygoid muscles reduced by **40%**
- **Loss in jaw muscle negatively impacts bite force**

Aging and Mastication

Increased perception that food texture is **hard!**

- jaw muscle activity decreases w age
- compression bite forces are reduced
- prevalent in denture wearers
- So….food not hard….muscles just weaker! (2)

Elderly and Chewing (3)

Lower muscle activity per chew

- Aging **and** decreased # of functional pairs of post canine teeth

- Extended chewing leads to food bolus being flooded by excessive saliva
  - Increased distance between food particles
  - Decreased cohesive force makes swallow precarious

Elderly and Chewing (3)

Higher viscosity causes

- Delayed oral and pharyngeal bolus transit
- Increased duration of pharyngeal peristaltic waves
- Prolonged UES opening

Hearing [4]

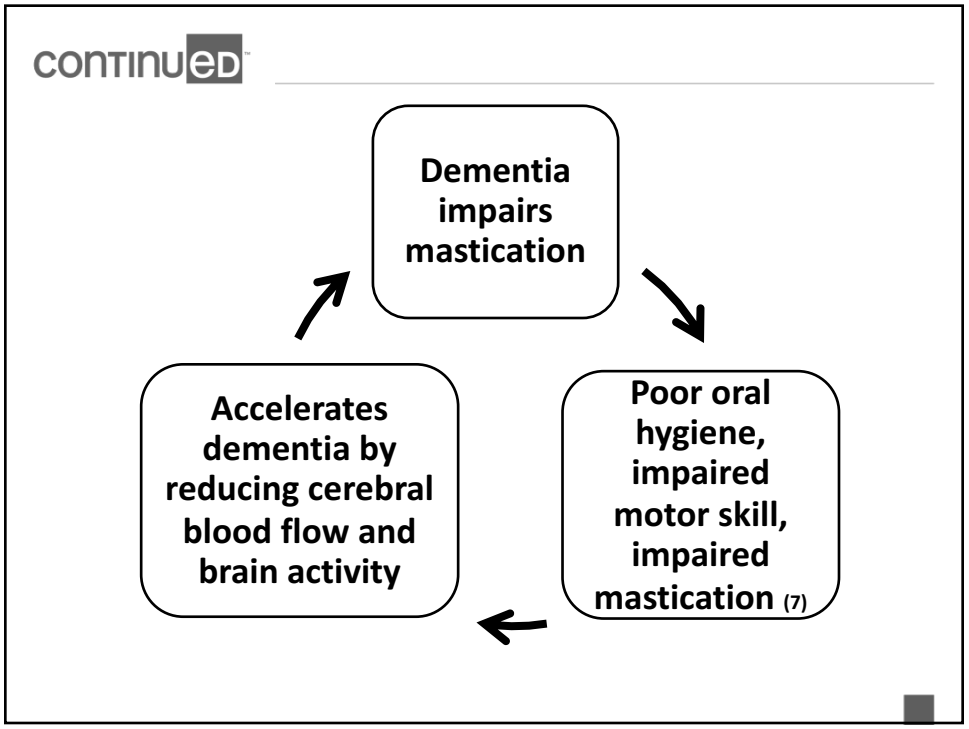
Loss of high frequency hearing

***Why* a Concern?**

- At age 65+, 25-40% have some loss
- 80% loss by age 80
- **Bone conduction** of sounds 2° vibrations through skull w chewing
  - **contributes significantly to texture perception** [5]

Teeth [3]

- Surface flatter from abrasive wear
- Chewing efficiency not fully restored despite even greater increase in chewing strokes and duration [1]
- Food swallowed safely w **2 mm** particle size
- Even soft foods require **14-20** masticatory cycles to produce 2mm particles [6]


Dementia impairs mastication
Poor oral hygiene, impaired motor skill, impaired mastication (7)
Accelerates dementia by reducing cerebral blood flow and brain activity

Saliva

- Significantly reduced & altered salivary secretion
- By age 70, average flow rate almost ½ that of population in their 30's
- Xerostomia – problems w food chewing, swallowing, taste, speech, tolerance of dentures

Saliva & Aging

Why a Concern?

- Required for eating & oral health
- Reduction is natural part of aging & exacerbated by meds
  - Production decreased/increased (6)

Generate relatively large amt. of saliva

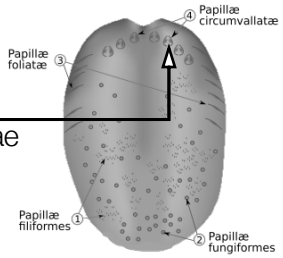
- More than ½ liter per day
- Normal swallow involves
  - unconscious swallowing of saliva approx. once every min. or every 2 min. in younger vs. older individuals (8)

Saliva Glands (3)

	% in Sleep	% without Stimulation	W mechanical stim
Parotid	0%	21%	58%
Submandibular	72%	70%	33%
Sublingual	14%	2%	2%
Minor	14%	7%	7%

Saliva Glands (3)

- Parotid gland – near ear
  - Largest
  - Greatest ***stimulated*** salivary flow
- Submandibular gland – ramus of mandible
  - Submandibular and sublingual contribute significantly to ***resting*** **salivary flow rate**
- Sublingual gland – underneath tongue
- Ebner's glands – surrounding circumvallate papillae
- Minor glands – tongue, cheeks, lips and palate



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Saliva (3)

Have watery (parotid) **AND** viscous/elastic saliva (submandibular/sublingual)

- elasticity helps saliva adhere to surfaces within mouth
- salivary film plays important role in mouthfeel perception

- 98% **water** and 2% organic and inorganic substances
- Mucin imparts slimy character to saliva
  - lubricates food particles against oral surfaces

Elastic Saliva vs. Inelastic (9)

Submandibular/sublingual glands produce elastic saliva

Highly elastic saliva perceived as thick, not moist

Elasticity slows down spreading of saliva

Different beverages, chewing gum and min produce significant differences in flow rate and elasticity

Saliva from parotid glands in cheeks from chewing gum

More closely resembles water - inelastic

Flows more easily

Gives perception of moistness

Saliva flow rate & viscoelasticity (9).

- Depends on stimulus
- Acidic beverages –
  - acid stimulates **highly elastic saliva** from submandibular/sublingual glands
  - defense against acid erosion on teeth
- Flavorless chewing gum
  - mechanical action stimulates **high volumes of inelastic saliva** from parotid gland
  - saliva stimulated more closely resembles water
  - flows more easily giving perception of moistness
- Water is unique refreshing clean beverage – stimulates saliva at the lowest rate and least elastic or viscous

Saliva (3)

Buffering effect

- 5 min. after food intake
  - pH rises
- 15 min. after consumption
  - falls to minimum of about 6.1
  - pH variation protects oral tissues and teeth

Enzymes (amylase and lipase) attack some food components

- Cause **immediate structural breakdown**
- Decreased viscosity (10)

In *less than 10 sec.* of mixing w saliva, custard showed almost ***ten-fold decrease of viscosity*** **(3)**

Salivation

Production influenced by

- Age
- Health status
- Meds – diminishes secretion

Saliva properties influenced by

- Stress
- Caffeine intake
- Medical intervention
- Hunger
- Depression (9)

Flow rate influenced by mastication

- **repeated closure of mandibular muscles**

Greater salivary flow rate w food requiring **higher masticatory bite force**

Soft food

- leads to **reduced salivary flow** (4)
- Doesn't require great deal of mastication

Pts w dentures swallow less lubricated

- Xerostomia contributes to presbyphagia
- Oral dryness assoc. w aging involves mouth, pharynx and **esophagus**
  - reduction in saliva producing cells
  - increase in salivary protein concentration
  - becomes much more viscous
- **Reduced frequency of spontaneous swallow** in older individuals may be related to **reduced salivary flow rate and volume**
  - reduced lubrication/moisture for chew/swallow and reduced taste sensation
  - Negatively affects digestion process, increases risk for impaired mucociliary clearance, oral infections and tooth decay (8)

Dentition

Older adults

- More chewing cycles to break down food
- Longer chewing duration than younger adults
  - More prevalent w dentures
- Loss of chewing efficiency between 50%-85% observed in edentulous individuals (14)
- **Extended chewing leads to food bolus flooded by excessive saliva**
  - Creates increased distance between food particles
  - Decreased cohesive force making swallow precarious (3)

- **minimum of *20 functional teeth* necessary** to guarantee good mastication
  - ***only*** if they are **antagonist pairs**
- **fewer than 13 teeth doubles dysphagia risk** (12)

Kayser suggest 12 front teeth and 8 pre-molars required for adequate chewing function (13) (14)

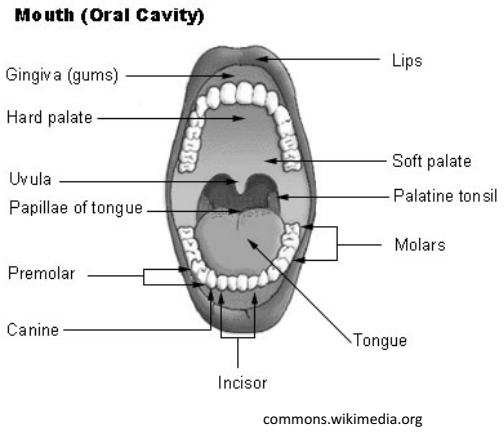
- Absence of posterior teeth and decreased tongue strength in elderly induces
  - poor retention of bolus in posterior mouth
  - **food fragments fall early onto pharynx**
- Loss of **two** molars induced **1.15 fold greater risk** of malnutrition
- Loss of premolar-molar occluding pairs
  - decreases chewing efficacy,
  - induces atrophy of saliva gland,
  - decreases saliva flow,
  - increases risk for candidiasis or dysphagia (15)

Orosensory Exposure Time (16)

- Prolonged orosensory exposure time –
  - 150% or 200% of habitual number of chews shown to reduce postprandial pleasantness of food
  - Doesn't affect appetite or meal size
- Prolongation of orosensory exposure time to foods triggers earlier meal termination and or higher satiety response
- Shorter orosensory exposure might explain increased food intake that occurs at faster eating rate

Teeth (3)

- Incisor teeth – **for cutting**
  - apply smallest force – up to 150 N (Newton)
- Canine teeth – **cutting and tearing**
  - apply medium force – up to 300 N
- Molar teeth – **chewing and shearing**
  - between 500 to 800 N
- Teeth sensitive to vibration
- Maxillary and mandibular incisors are tactile sensitive
  - Probably why pts. w hearing difficulty are able to enjoy crispy, crunchy foods



Teeth (3)

- Pressure exerted on tooth w chewing/biting
- Tooth moves slightly in its socket and stretches the periodontal ligaments
- Nerve fibers send info to CNS for textural interpretation
  - BUT not w dentures

Tooth shape determines function; part you can see

Neck - Narrowest part of tooth between crown & root; also called dental cervix

Root anchors tooth in jaw; susceptible to periodontal disease

Cementum - hard connective tissue covers root; gives attachment to periodontal ligament

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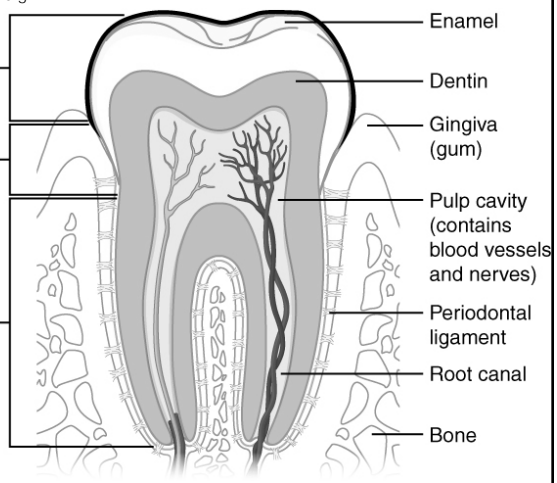

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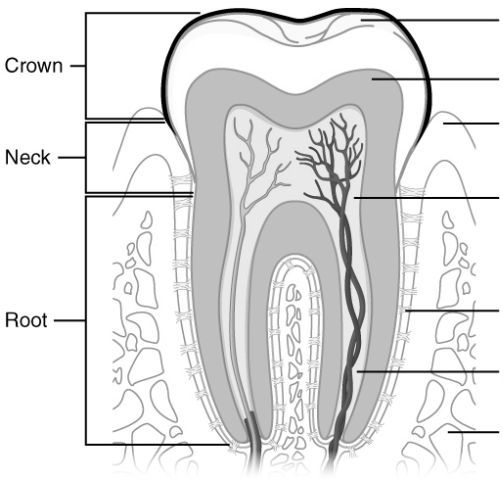


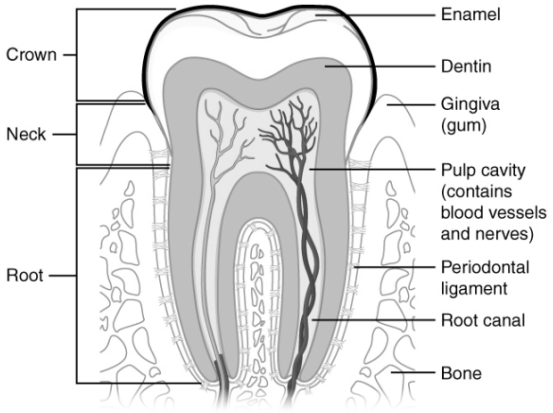
Hardest part of body; protects tooth from extreme temp.& abrasions

Majority of tooth; bone like substance; causes sensitivity & susceptible to bacteria

Attaches tooth To alveolar ridge

CONTINUED

- Teeth connected to periodontal mechanoreceptors
- Mechanoreceptors in ligaments that attach tooth root to alveolar bone
  - Up to **2000** per tooth
  - Signal info about tooth loads
- When teeth extracted, remnants of **periodontal ligament break down**
  - Changes neuromuscular pattern and periodontal sensitivity (17)



In elderly

- Age related tooth loss impacts
  - periodontal sensitivity
  - texture perception
- Decreased muscle strength
  - Impacts perception of
    - tenderness
    - firmness
    - melting
    - viscosity
    - smoothness
    - juiciness
    - astringency
  - Decreased saliva flow impacts taste and texture perception (17)

- Occlusal force (tooth on tooth) most common relevant factor in subjective/objective masticatory force assessments
  - Assoc. muscle mass/function
  - **#** of teeth **AND kind** of teeth (natural vs prosthesis) important for good mastication
- Natural occlusion provides better mastication than dentures (18)

CONTINUED

Dentures vs. No Dentures!

CONTINUED

Edentulism Declining! (19)

Life expectancy increasing

- Natural teeth lost later in life
  - Oral hygiene difficult
  - Poor hygiene accelerates loss

Growing elderly population in U.S. has complete dentures

Dental care for elderly, dependent pt. has challenges
- Transportation logistics
- Coordination of care w team
- Legal context – financial agreements
- Communicating w elderly respecting life course, experiences, values

Edentulous Patients (19)

CT scans reveal

- smaller cross sectional area of masseter and lateral pterygoid muscles
- lower tissue density than age matched dentate peers

- Loss of teeth and periodontal tissues
  - Receptors
  - Parts of alveolar bone
  - Associated gingival tissues
  - Supplying nerves and blood vessels
  - Temporomandibular ligaments loosen over time
  - Chewing muscles lose bulk

Edentulism (20)

- Considered global oral health burden
  - 2020 – 38 million edentulous citizens in U.S.
- Assoc. w poorer diet, lower QOL and higher mortality rates
- Consumption of nutritious food and dietary fibers lower among edentulous and complete denture wearers vs. dentate individuals
- Hazard of death greater in edentulous than those w at least 20 teeth
- Edentulism and tooth loss in older adults significantly assoc. w greater physical and cognitive decline

Dentate Status Associated with Mortality (20)

- 584 nursing facility residents age 60-103; 33% edentulous
- Edentulous people have shorter life span
- Hazard of death greater among those w more missing teeth – 40% greater than dentate individuals
- Might be related to difficulty eating/chewing properly and/or eating more limited variety of food compared to dentate individuals For each additional missing tooth, a 2% greater hazard of death
- May eventually be potential component of comorbidity indices such as the Charlson Index and others validated for their ability to predict mortality in subjects w multiple medical conditions

Absence of Teeth Not ALL Negative! (21)

- Complete extraction may end decades of misery and eating problems
- Not susceptible to dental caries or periodontal attachment loss
- Institutionalized care likely to have fewer orodental complications
- Incremental tooth loss more common than edentulism
- Elderly tend to have coronal caries

Two Major Reasons for Tooth Loss (22)

1. Dental caries
   - Common cause of oral pain w drinking and eating
   - Assoc. w high proportions of acidogenic (acid forming) and aciduric bacteria (can grow in acidic environment) in **supragingival plaque**

- Decreased salivary secretion rate increases # of microorganisms in dental biofilm
  - oral acidic milieu plus diseases affecting general health contribute to frequent colonization of microorganisms in frail elders
  - involved in both oral mucosal infections and aspiration pneumonia in institutionalized elders

2. Periodontitis
   - Gingivitis – most common form of periodontal disease
   - Caused by bacteria accumulating on teeth
   - Reversible disease
   - Inflammation normally subsides after wk. w **proper oral hygiene** (22)

Without Dentures

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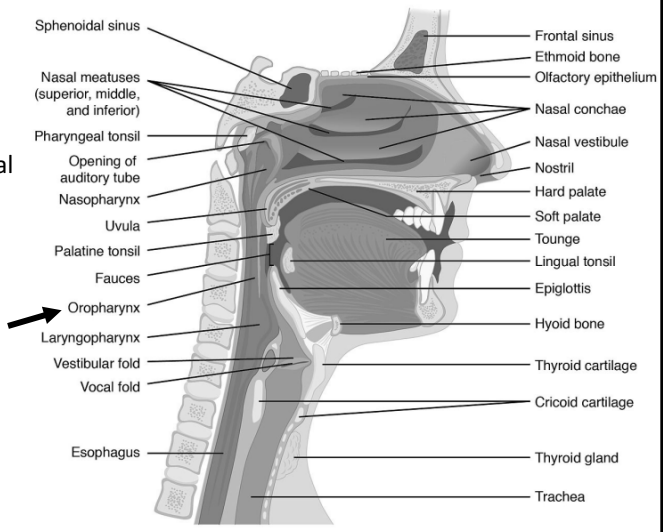
Expansion of hyoid and laryngeal movements 2° anatomical changes in oral cavity (no dentition) & pharynx

anterior mandibular displacement when swallow initiated

- anterior displacement of tongue base in oropharynx results in increased volume of oropharynx (larger space)



So this happens!

Post. Pharyngeal wall → Oropharynx

posterior pharyngeal wall must greatly contract in **anterior direction** and to generate same level of swallow pressure as present when dentures were in place

anterior tongue base displacement in oropharynx results in **increased volume of oropharynx** (larger space)

Because of increased size of bolus in pharynx due to poor bolus formation, UES and PPW work harder to pass scattered bolus through pharynx safely

Without Dentures (23)

- More unstable range of lingual movement during liquid swallowing
- Difficult for tongue to control bolus in oral cavity
  - scattered in oral cavity and pharynx
  - pieces of bolus reached hypopharynx before swallow occurred
- Older individuals compensate for denture absence by enlarging range of oropharyngeal movements during pharyngeal swallow to achieve smooth bolus passage through pharynx

Why Floppy Teeth??

Weight Loss!

Xerostomia
- ◦inadequate saliva
- ◦tongue sticks to palate
- ◦burning sensation mouth/tongue
- ◦dentures need saliva to adhere to gums
- ◦causes
  - •sore gums
  - •pressure sores
  - •lacerations of mucosa

Bone resorption
- ◦**3 years after loss, 50% of alveolar ridge bone GONE**
- ◦earlier tooth loss, quicker process occurs (33)
- ◦Bone atrophies

Denture Adhesive and Zinc

- overuse of zinc adhesive is potential cause of copper deficiency
- overdose is ***toxic***
- copper deficiency results in
  - anemia
  - neurological symptoms
  - affects walking and balance.
  - numbness and movement difficulty affecting feet and legs
  - rapidly progresses to arms
- Limited recovery (24)

- Denture fixative soluble over time
- Small pellets swallowed
- Zinc absorbed in gut (25)

2.4-ounce tube of denture adhesive

- Should last 7 to 8 wks. if pt. has *upper and lower* dentures (26)

Denture Implants

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Fixed implant supported mandibular prostheses
NEED adequate bone!

Substantially improved chewing efficiency, better bite force results in fewer episodes of coughing and choking (27)

Significantly reduced number of chewing cycles required
Maximum bite force increased w dental implants

Masseter muscle thickness is greater w implants than w complete dentures (19)

With Complete Dentures (23)

Swallow function improved

- Decreased risk of laryngeal penetration
- Stabilized swallow movements & tongue palate contact
- Improved bolus transport
- Maintains correct oral and pharyngeal anatomy
- Allows recovery of oral anatomical structures and occlusal support

- Wearing dentures might improve swallow function in older individuals w diminished swallow reserve
  - reserve decreases w age
  - decline of maximum UES opening, prolonged hyoid anterior movement/elevation and prolonged laryngeal elevation

With Complete Dentures (23)

- shortens duration of pharyngeal bolus passage
  - Prevents increase in risk of aspiration in older individuals w dysphagia, requiring nursing care
- assists in oral masticatory function and pharyngeal swallow
- Ill fitting dentures prolonged total swallow duration compared w new well fitted dentures
- Complete dentures may accelerate muscle wasting
  - chewing limited by pain from denture bearing tissues and denture displacement (19)

Dentures require three mechanisms (19)

- First
  - Kept in place by physical suction
    - Good Impressions is key to create posterior palatal seal selective
    - Requires thin film of saliva, mucous consistency
    - Denture bearing bony structures atrophy
    - Rely on learned skills to keep denture in place during function
- Second
  - coordinator
    - Reduced motor coordination in old age, present in chewing muscles
    - Probability of denture use significantly reduced in cognitively impaired institutionalized patients
  - Possible to aspirate complete dentures
- Third
  - Occlusion which repositions denture when upper/lower teeth meet in contact

Replace Existing Dentures is PROBLEMATIC! (19)

- Replace existing well adapted dentures
  - lost or unhygienic, worn or simply insufficient
- Neuroplasticity required to learn new motor skills or adapt existing motor patterns
  - may be compromised
- Need to adapt denture base to denture bearing tissues
- Worn denture teeth should be replaced by new occlusal surfaces
- Well defined cusps w unworn occlusal surface might help w chewing

Dentition!

Chewing and Dentition Go Hand in Hand!

Mastication Concerns (28)

Decreased muscle mass/density of masseter, temporalis, medial pterygoid muscles.

- **Should have bilateral force!**
- Poor amt. of bone for denture support & stability
- Gums pinched between denture/bone
- Chewing dislodges denture
- Decreased biting/chewing

Normal bite force of natural teeth = *162 pounds*

Bite force w dentures = *35 pounds*

Chewing (3)

Two aspects of chewing

- Fragment food particles small enough for cohesive bolus
- Enhanced release of flavor and aroma from food

Tongue senses size and lubrication status of food particles

- Particles of right size pushed by elevated tongue to back of oral cavity
- Large particles selected for further size reduction

- Mylohyoid
  - main muscle involved in generating tongue pressure and flattening tongue against hard palate

- Size reduction crucial for bolus formation
  - Small particle size makes it possible for tongue to press against hard palate and pack particles tightly together
  - Saliva gradually fills gaps between food particles and increases viscous cohesion

Texture and Taste Perception

Touch (10)

- Kinesthesis
  - deep pressure
  - felt through nerve fibers in tendons, muscles and joints
  - contribute to texture sensation through oral musculature
    - **Tongue**
    - ***Periodontal ligament***
    - **Tissues lining oral cavity**
- **Texture** perceived by numerous mechanoreceptors and thermoreceptors underneath oral surfaces in oral cavity

Hearing (16)

- Higher prevalence of hearing loss in those w lower income (29)
- Hair cells in inner ear become damaged or die –
- Diminished hearing takes its toll in **crispiness perception and feeling of freshness**
- **Plays a part in texture and flavor perception**
- Foods w higher pitched sound on biting more often described as crisp than crunchy.
- Loud background noise ***dampens taste of salty and sweet*** foods (30)

Perception of Crispiness

- Chewing crispy food
  - jaw decelerates/accelerates 2° resistance and breakage of food particles
  - characteristic ***sound of breakages of food particle*** is produced
  - Breakage behavior of food and corresponding sound is ***essential for sensory sensation***
- Crispiness of food perceived through auditory, tactile, kinesthetic and visual sensations
  - Hard masticatory force,
  - jaw muscle activity
  - mandibular movement
- Mastication influences perception of
  - Water
  - Fat percentage
  - Hardness (31)

Perception and Hearing (31)

- If crisp food doesn't produce **expected** sound upon biting, it's **considered stale and of poor quality**
- Sounds perceived during sensory eval of foods transmitted to inner ear by air and bone conduction
- Masking of sounds foods make when eaten can impair ability to discriminate textural attributes of foods
- **Perception of moistness of food depends on mastication sounds produced during chewing**
  - Participants less likely to perceive moisture in pretzel if eaten while listening to loud noise

With Complete Dentures (23)

- **Tactile perception not available**
  - Loss of connection w CNS
  - Unable to sense pressure and force exerted on tooth
- Biting and chewing significantly different
- Mastication less adapted to texture of food
  - Apply higher masseter muscle activities to provide improved chewing function
  - Don't adapt to structure changes of food during bolus formation

Dentition Concerns (28)

- **Nutrition**
  - Won't wear dentures for meals
  - Avoid certain foods
  - Decreased ability to process foods
  - **Tooth loss increases bite size pts willing to swallow**
  - **Bite size too large to pass through UES and esophagus**
    - **Decreased elasticity of UES**
    - **POOR/weak peristalsis**

IDDSI – International Dysphagia Diet Standardization Initiative – www.iddsi.org

7. Regular

6. Soft and Bite Sized

5. Minced and Moist

4. Puree

Level 4 Puree Rationale

7. Regular

6. Soft and Bite Sized

5. Minced and Moist

Puree

- NO biting or chewing required
- Easiest to manage if tongue control is significantly reduced
- ANY food that requires chewing, controlled manipulation or bolus formation NOT SUITABLE
- Pain on chewing or swallowing
- Missing teeth, poorly fitting dentures

Level 5 Minced and Moist Rationale

7. Regular

6. Soft and Bite Sized

5. Minced and Moist

Puree

- Biting NOT required
- Minimal chewing required
- Tongue force alone can break soft small particles w this texture
- Tongue force required to move bolus
- Pain or fatigue on chewing
- Missing teeth, poorly fitting dentures
- ADULT BITE – 4mm lump
- Fits through tines on fork!

Level 6 Soft and Bite Size Rationale

7. Regular

6. Soft and Bite Sized

5. Minced and Moist

Puree

- Biting not required
- Chewing REQUIRED
- Tongue force/control required to move food for chewing & keep it in mouth during chewing
- Tongue force required to move bolus for swallowing
- Pain or fatigue on chewing
- Missing teeth, poorly fitting dentures
- ADULT BITE 15 mm or 1.5 cm pieces

Level 7 Regular Rationale

7. Regular

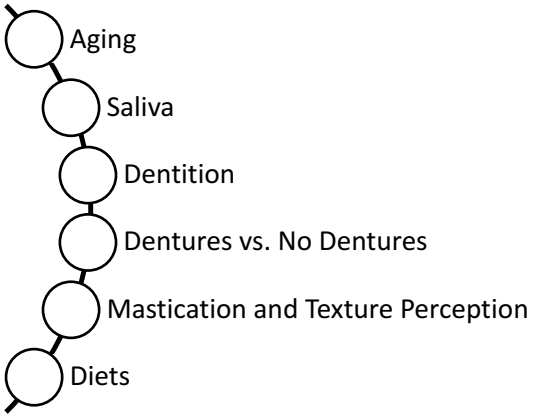
6. Soft and Bite Sized

5. Minced and Moist

Puree

- Ability to bite hard or soft foods, chew long enough to form a "swallow ready" cohesive bolus
- Ability to chew all food textures without fatiguing easily
- Ability to remove bone/gristle that cannot be swallowed safely from mouth
- ADULT BITE – NO restrictions
- Smaller or greater than 15mm or 1.5 cm

Know How to Connect the Dots!



Q&A

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