Taste and chorda tympani

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**Taste**

Four taste:

- **Salts** and **acids** (ionic stimuli) interact with ion channels in the membrane
- **sweet** and **bitter** substances (usually organic compounds) interact with receptors in the membrane

![Fig. 8. Schematic representation of receptor sites for taste substances.](image)

**Four types of papillae:**

1. **filiform papillae:** no role in taste, cat: shaped like the rasps on a file and assist in licking
2. **fungiform papillae:** small red structures, most distributed on the tip and the edges of the anterior two-thirds of the tongue
3. **foliate papillae:** edges of the base of the tongue
4. **circumvallate papillae:** rear of the tongue, inverted V

Tongue Map: Wilhelm Wundt in Leipzig in 1901, not useful
Innervation:

- Taste is mediated by three cranial nerves: VII, IX, and X.
- CN VII: the chorda tympani and the greater superficial petrosal nerve, nervus intermedius.
  - taste information from the fungiform papillae, foliate papillae, anterior to 2/3 of the tongue
- Glossopharyngeal nerve (IX): pharynx and base of the tongue, circumvallate papillae at the junction of the posterior third and anterior two-thirds of the tongue as well as the foliate papillae at the rear edge of the tongue.
- CNX: The superior laryngeal nerve, a branch of the vagus (tenth) cranial nerve, innervates taste buds on the laryngeal surface of the epiglottis.

![Diagram of the innervation of the tongue and pharynx](image)
Central connection: solitary fasciculus → rostral half of the nucleus solitarius in the medulla → medial thalamic ventroposteromedial nucleus → anterodorsal insula, operculum on the ipsilateral frontal lobe

Central gustatory system in humans is largely **ipsilateral**

**Interactions among Taste Nerves**

Inhibition and taste phantoms

**Type of taste disorder**

Hypogeusia - diminished taste  
Dysgeusia - distorted taste  
Aliageusia - altered taste, usually pleasant  
Phantogeusia - persistent abnormal taste in the absence of a stimulus  
Ageusia - no taste (rare)
Dysgeusia

Nihon hospital experience
Norihisa Hamada et al 2002, 2278 patients

Taste Loss or Intensification

Typical stimuli used are NaCl, sucrose, citric acid, and quinine hydrochloride or quinine sulfate.

The simplest “standard” is the use of descriptive adjectives. For example, one can
ask patients and controls to assign a number from 0 to 9 to the intensity of tastants where 0 = no taste, 5 = medium taste, and 9 = very strong taste.

**Venous Taste**

- **Saccharin** is injected into a vein, a sweet taste is perceived in about 13.5 seconds.
- **Dehydrocholic acid** will produce a bitter taste.
- occurs as the result of stimulation of receptor sites that are on the bottom of the taste cell

**FPD(filter paper disk)**

**Strength:**
1. first taste quality for each area
2. Soft palate taste function test

**Limitation:**
1. Long time of test
2. Narrow range of test
EGM (Electrogustometry)

**Strength:**
1. Quantitative control
2. Short period of time
3. Detective mild taste disorder
4. Useful for topognosis
5. The only way to detect the glossopharyngeal nerve function
6. Range of measurement can be kept constant

**Limitation:**
1. Not useful in dissociated taste, heterogeusia
2. Not useful in following the progression of taste disorder
Topognositc diagnosis

**A**
- Taste Bud: Senile Degeneration, Drug Induced, Zinc Deficiency, Iron Deficiency Anemia, Pellagra, Vitamin A Deficiency, Psychogenic: Conversion Hysteria, Depression, Congenital: Ectodermal Syndrome, Riley-Day's Syndrome
- Central Part of the Gustatory Tract: Cortical Lesion (ipsilateral?)
- Thalamus: Head-Holmes Syndrome
- Pons: Ipsilateral Hemorrhage
- Nucleus tractus solitarii: Tumor of the IV Ventricles, Base of Skull, Garin's Syndrome

**C**
- Internal Auditory Meatus: Acoustic Tumor, Cerebellopontine Angle Tumor, Arachnoiditis, Transverse Petrous Bone Fracture, Geniculate Ganglion: Hunt's Syndrome

**G**
- Faber-Jung's Syndrome, Henkin's Syndrome, Cronkhite-Canada Syndrome

Objective measure of taste

1. **Ground**
2. **Recording system**
3. **To tongue**
4. **Electromagnetic valve**
5. **Trigger pulse**

(A) Distilled water V

(B) Taste solution V

Flow in → Tasting stimulation → Taste in → Flow out

Electromagnetic valve

Impedance

Opening (1.5 x 4 mm)

Opening (2 x 6 mm)

Flow in → Flow out

Papilla vallata

Taste substance in the jet to tongue (g/l)

Water

Sweat

Sugar

Tartrate

Gluconate-HCl 0.454

HCl 0.454

NaCl 0.454
PET scan
Functional MRI:
Magnetoencephalographic study (MEG)
Automated regional taste-testing systems
University of Pennsylvania

Effect of unilateral damage
- Loss of a single nerve not associated with significant taste loss
- Bull 1965: 20% no symptom
- 1994 John F. Kveton: acoustic neuroma patient

Why?
1. Release of inhibition: CN VII and CN IX
2. Reinnervation
3. Cross? CNS and tongue
Long term f/u after middle ear surgery

Takehisa 2001:
Group 1: no touch n=109
Group 2: touch n=149
Group 3: served n=113

**TABLE V.**

<table>
<thead>
<tr>
<th></th>
<th>No Symptoms</th>
<th>Symptons Occurred But Resolved (No. [%] of cases)</th>
<th>Symptoms Persisted</th>
</tr>
</thead>
<tbody>
<tr>
<td>No touch (group 1; n = 109)</td>
<td>106 (97.2)</td>
<td>3 (2.8)</td>
<td>0</td>
</tr>
<tr>
<td>Touch (group 2; n = 149)</td>
<td>111 (74.5)</td>
<td>34 (22.8)</td>
<td>4 (2.7)</td>
</tr>
<tr>
<td>Severed nerve (group 3; n = 113)</td>
<td>69 (61.1)</td>
<td>38 (33.6)</td>
<td>6 (5.3)</td>
</tr>
</tbody>
</table>

**TABLE VI.**

<table>
<thead>
<tr>
<th>Nerve gap defects</th>
<th>6M</th>
<th>1Y</th>
<th>1Y6M</th>
<th>2Y</th>
<th>2Y6M</th>
<th>3Y</th>
<th>4Y</th>
<th>5Y</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>End-to-end anastomosis</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3 (100)</td>
<td>0</td>
<td></td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>1 - 3 mm</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>2 (12)</td>
<td>3 (20)</td>
<td>15 (100)</td>
<td>3 (20)</td>
<td>15</td>
</tr>
<tr>
<td>4 - 6 mm</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>7 (76)</td>
<td>2 (22)</td>
<td>9 (100)</td>
<td>1 (11)</td>
<td>17</td>
</tr>
<tr>
<td>7 mm -</td>
<td>9</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>16 (94)</td>
<td>1 (6)</td>
<td>17 (100)</td>
<td>1 (6)</td>
<td>38</td>
</tr>
<tr>
<td>Total (No. [%] of cases)</td>
<td>20</td>
<td>8</td>
<td>5</td>
<td>1</td>
<td>43 (86)</td>
<td>6 (14)</td>
<td>44 (100)</td>
<td>6 (14)</td>
<td>69</td>
</tr>
</tbody>
</table>

**TABLE VII.**

<table>
<thead>
<tr>
<th></th>
<th>No Threshold Change on EGM</th>
<th>EGM Threshold Elevated (No. [%] of cases)</th>
<th>EGM Showed No Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>No touch (group 1; n = 109)</td>
<td>100 (91.7)</td>
<td>4 (3.7)</td>
<td>5 (4.6)</td>
</tr>
<tr>
<td>Touch (group 2; n = 149)</td>
<td>32 (55.1)</td>
<td>26 (17.5)</td>
<td>41 (27.5)</td>
</tr>
<tr>
<td>Severed nerve (group 3; n = 113)</td>
<td>0</td>
<td>0</td>
<td>113 (100)</td>
</tr>
</tbody>
</table>

EGM = electrogustosmetry.
Rate of recovery with special type of disease
Sakagami 2003:

Why?
CTN function was damage in COM patient
Thickening of the perineural and epineural connective tissue, proliferation of fibroblast in endoneurium

Age and recovery rate
Mieko Sone 2001:

Conclusion
1. Unilateral CTN injury not associated with significant loss
2. Release inhibition and CNS cross over
3. EMG is a good tool for dysgeusia
4. Topognostic examination promotion
5. CTN in COM and cholesteatoma patients were more resistant to injury and recovery better
6. Young age patient recover faster and better
Reference
2. Sone M. Younger patients have a higher rate of recovery of taste function after middle ear surgery. Arch otolaryngol Head Neck surge. 2001 Aug;127(8):967-9.