Introduction

Otalgia: pain localized in ear, broadly classified into two groups

- Primary otalgia:
  - Pain resulting from diseases of the ear
  - Most often infection in origin
- Secondary otalgia, referred otalgia
  - Arises from non-otological disease
  - Incidence: up to 50% of adult patients who consult a general physician for ear pain [Al-Sheikhli A.R.J., 1980]
  - Require further assessment to identify the source of referred pain
  - Need a systematic approach to the head and neck examination

Sensory innervation of the ear and referred pain

- The ear receives a cutaneous innervation through
  - four cranial nerves: trigeminal (V), facial (VII), glossopharyngeal (IX) and vagus (X)
  - two branches of the cervical plexus: lesser occipital nerve(C3), and great auricular nerve(C2+C3)

<table>
<thead>
<tr>
<th>Major nerve</th>
<th>Area Innervated</th>
<th>Sensory nerves</th>
<th>Sensory ganglia</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2-3</td>
<td>Medial and lateral skin of auricle and lobule</td>
<td>Great auricular nerve</td>
<td>Dorsal root ganglia</td>
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<tr>
<td>CN V3</td>
<td>Small portion of concha and anterior auricle</td>
<td>Auriculotemporal branch of the mandibular branch of the trigeminal nerve</td>
<td>Trigeminal ganglion</td>
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<td></td>
<td>Anterior external ear canal</td>
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<td></td>
<td>Anterior of external tympanic membrane</td>
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<tr>
<td>CN VII</td>
<td>Portion of external ear canal, external tympanic membrane (and small contribution to the tympanic plexus)</td>
<td>Auricular branch (inconstant) of the facial nerve</td>
<td>Geniculate ganglion</td>
</tr>
<tr>
<td>CN IX</td>
<td>Internal tympanic membrane</td>
<td>Typanic nerve of Jacobson (branch of glossopharyngeal) and tympanic plexus</td>
<td>Superior glossopharyngeal ganglion</td>
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<tr>
<td>CN X</td>
<td>Middle ear</td>
<td></td>
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<tr>
<td></td>
<td>Concha</td>
<td>Auricular nerve of Arnold (branch of vagus)</td>
<td>Superior vagal ganglion</td>
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<td>Posterior external ear canal</td>
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<tr>
<td></td>
<td>Posterior external tympanic membrane</td>
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<td></td>
<td>Small postauricular strip of skin</td>
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Theories and scheme of referred pain

- Types of pain: visceral and somatic
  - Visceral pain: dull, hard to pinpoint, sensed centrally
  - Somatic pain: sharp, localized, sensed throughout the body

- Schemes of the referred pain [Sarborough et al, Am J Cl onco, 26(5)2003]
  - Somatic-masquerading-as-visceral (SMAV) or visceral-masquerading-as-somatic (VMAS)
    - nucleus tractus solitarius (NTS): general visceral afferent (GVA)
    - spinal trigeminal nucleus (SpTN): general somatic afferent (GSA)
    - **Crosstalk** through NTS-SpTN communication would produce referred pain sensations
  - Somatic-masquerading-as-somatic(SMAS)
    - **Overlap** of afferent synapse **within a region**
    - May explain the phenomenon: anterior tongue lesion leads referred otalgia

Source of referred otalgia

**Oral cavity**

- Innervation: the auriculotemporal branch of the trigeminal nerve(CNV3)
- Cause:
  - Most offending teeth: the mandibular molars, cause by caries
  - In children: most are erupting teeth and gingival irritation
  - Others: include trauma, abrasion, erosion from acidic substances…
- Pathophysiology: Decay extending through dentine into the tooth pulp leads to pulpitis
- Character: poorly localized, often radiates to the ear and cheek, throbbing
- Treatment
  - Referral to a dentist for root canal treatment (endodontics) or tooth extraction
  - Broad-spectrum antibiotic such as amoxicillin should be commenced initially, with anaerobic cover added if symptoms fail to improve
  - Early drainage to avoid complications of deep neck space infections
  - If left untreated, pulp necrosis → inflammation spreads around the tooth apex → periapical periodontitis → development of a dental abscess

**Oral ulcers**
- Character: pain locally
- Pathophysiology: tissue damage often affects the posterior third of the tongue (CNX), the tonsils or the pharynx (CNIX)
- Cause: trauma, viral and bacterial infections, malignancy, nutritional deficiencies and autoimmune…
- Treatment: failure to heal within 3 weeks is an indication for biopsy

**Temporomandibular joints dysfunction (TMD)**
- Epidemiology: all ages, most in young adult and female
- Otological symptoms:
  - Otalgia, aural fullness, tinnitus and perceived hearing loss
  - Prevalence of otalgia: 16%~53% [Kuttilae, 1999 and Cooper, 1993]
- Innervation: **auriculotemporal n.** travels posterior, lateral, inferior to condylar head
- Characters:
  - otalgia with other positive clinical signs
  - tender point most at the area anterior to tragus
  - superficial earache, not deeply pain
  - Response to auriculotemporal nerve block
- TMD occurs in three recognized pathophysiological states:
  - Myofascial pain and dysfunction
    - The most prevalent in TMD, producing diffuse pain in the head and neck region, particularly in the masticatory muscles
    - Usually associated with teeth clenching and bruxism → pain is more pronounced in the morning
- Other findings: muscle tenderness, restricted jaw movements, anxiety, depression or other psychological disorders

- **Internal derangement**
  - **Displacement of the meniscus** anteriorly or medially
  - Producing continuous pain, and clicking and restriction of jaw movements
  - Produce most aural symptoms

<table>
<thead>
<tr>
<th>Table. Distribution of patients</th>
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<tbody>
<tr>
<td>Group</td>
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<tr>
<td>-------</td>
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<tr>
<td>1 (MPD) (n = 22)^a</td>
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<tr>
<td>2 (ID) (n = 15)^b</td>
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<tr>
<td>3 (MPD-ID) (n = 24)^*</td>
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<tr>
<td>4 (Control) (n = 50)^a</td>
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</table>

- **Osteoarthrosis**
  - Crunching on mouth opening and closing
  - Crepitus on joint palpation
  - Joint tenderness, temporal and frontal headaches
  - Plain radiograph: joint degeneration

- Treatment [*BMJ Vol317 July, 1998*]
  - Non-surgical therapy is an effective modality in 80% of patients, no single drug is proved to be effective:
    - NSAIDs: benefit for inflammatory joint, esp for acute pain
    - Short course of opioids: for severe pain
    - **Low dose TCA**: relief of chronic facial pain
    - Occlusal splint

### Drug treatment for temporomandibular disorders

<table>
<thead>
<tr>
<th>Indications</th>
<th>Active ingredient</th>
<th>Proprietary name (dose)</th>
<th>Prescription</th>
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<tbody>
<tr>
<td>Acute pain (≤3 months): inflammatory conditions of masticatory muscles and temporomandibular joints</td>
<td>Ibuprofen</td>
<td>Brufen (400 mg)</td>
<td>400 mg 3 times daily for 7 days</td>
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<td>Naproxen</td>
<td>Naprosyn (250 mg)</td>
<td>250 mg 3 times daily for 1 month</td>
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<td>Diclofenac sodium</td>
<td>Voltaren (25 mg)</td>
<td>Up to 150 mg daily in 3 divided doses for 1 month</td>
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<td>Diazepam</td>
<td>Valium (2.5 mg, 10 mg)</td>
<td>2.5 mg 3 times daily for maximum of 10 days</td>
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<td>Dothiepin hydrochloride</td>
<td>Prothaland (25 mg, 75 mg)</td>
<td>Begin with 75 mg; increase to 200 mg in 3 daily divided doses for 1–3 months</td>
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<tr>
<td></td>
<td>Norfiprofen</td>
<td>Avertyn (10 mg, 25 mg)</td>
<td>Begin with 25 mg; increase to 100 mg in 3 daily divided doses for 3 months</td>
</tr>
<tr>
<td></td>
<td>Imipramine hydrochloride</td>
<td>Tofranil (10 mg, 25 mg)</td>
<td>25 mg three times daily for 1–3 months</td>
</tr>
<tr>
<td></td>
<td>Tranylcypromine sulphate</td>
<td>Parostol (10 mg)</td>
<td>10 mg twice daily</td>
</tr>
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</table>

- Behavior therapy: encourage to reduce the stress on the TMJ and masticatory muscles by eating a soft diet, avoiding teeth clenching, and hard chewing
Neoplasms
- Incidence and etiology with earache [Escribana et al 2001]
  - 56.8% of patients with nasopharyngeal carcinomas
  - 26.0% of patients with hypopharyngeal cancers
  - 16.7% with malignant lesions of the oropharynx
  - Outside the upper aerodigestive tract: rare
  - Acoustic neuroma: 4.2% of cases presenting with ear pain [G.A.J Morrison, clin otology, 1996]
- Determination of the pain location offer a clue of the site of lesion
  - Pain to some of ear canal and concha, and external tympanic membrane
    - anterior tongue or floor of mouth
    - Through the lingual branch of mandibular division of trigeminal nerve
  - Intense pain and deep in ear
    - Lateral base of tongue, tonsillar area, lower 2/3 of nasopharynx
    - Through along the glossopharyngeal nerve to sup glossopharyngeal ganglion
  - Less severe or superficial pain from concha and ear canal
    - Lesion over supraglottic area
    - Through vagus nerve (share same ganglion as Arnold’s nerve)

Infections
- Etiology:
  - Acute/chronic tonsillitis, peritonsillar abscess, pharyngitis, parapharyngeal abscess, or retropharyngeal abscess
  - Post tonsillectomy: adults > children
    - Through glossopharyngeal nerve
  - Supraglottitis
    - Through vagus nerve and glossopharyngeal nerve

Laryngopharyngeal reflux.
- Extra-esophageal or laryngopharyngeal reflux (LPR)
  - retrograde flow of gastric contents beyond the upper esophageal sphincter and into the larynx and pharynx
  - Irritation of the respiratory epithelium by gastric acid stimulates the glossopharyngeal and vagus nerves producing ear pain
- Symptoms: hoarseness, sore throat, dysphagia, lumping throat, chronic cough.

- Pathophysiology:
  - [Poelmann, 2002] Upper airway mucosa is more sensitive to tissue damage from acid exposure → causing E tube dysfunction → chronic serous otitis media or chronic refractory feeling pressure of ear → response to antireflux therapy
  - [Gibson et al, 1994]: children diagnosed as “recurrent acute otitis media” may resolved by the use antireflux medication confirmed the etiology

- Diagnosis:
  - Nasopharyngolaryngoscopy: typically mucosal edema and hyperemia of vocal folds, posterior glottis and subglottis, mucosal hypertrophy, granulation tissue and excess mucus production
  - Gold standard: Ambulatory dual-probe pH monitoring
  - Response to omeprazole

- Treatment: lifestyle modifications, pharmacological agents and surgical intervention, stage by stage [Am Fam Phys, 1999, 59(5)]
  - Dietary advice includes the avoidance of large meals and the reduction of alcohol, caffeine and fatty food
  - Raising the head end of the bed by 6 inches, avoiding lying down within 3h of eating, and cessation of smoking, combined with antacid or H2 blocker
  - Proton pump inhibitors and histamine antagonists, studies suggest regimens of 2–3 months duration
  - Laparoscopic fundoplication for refractory case

**Foreign body**
- A laryngeal foreign body is a unusual cause of ear pain [D Lau, Case report, 1998]
- Commonly found in the pharynx, specifically in the tonsils, base of tongue, vallecula and also the piriform fossa

**Parotid glands**
- Mumps parotitis
  - Most in children
  - Usually affecting both glands
- Bacterial parotitis
  - elderly or immunocompromised patient
Unilateral parotid swelling
S. aureus and Pseudomonas aeruginosa

Cervical spine
- Skeletal conditions: osteoarthritis, trauma or tumors of the cervical spine
  - Earache over the pinna and mastoid region by nerve root irritation
  - Pathophysiology: sensory fibers from C2 and C3
  - In a study of 100 patients with ear pain, 22% were found to be arising from cervical spine pathology → the most cause of secondary otalgia [Al-Sheikli, 1980]

Neurological disorders
- Most on distribution of trigeminal and glossopharyngeal nerves
  - Character:
    ◆ Intermittent, superficial, lancinating in nature
    ◆ Unilateral sensory distribution
    ◆ Evoked when ‘trigger zones’ on the skin are stimulated by light touch, but neurological examination reveals no focal deficit
  - Trigeminal neuralgia:
    ◆ Incidence: ~4-15/100000 per year, female prominent
    ◆ Etiology: compression of the trigeminal nerve root entrance zone by vessel(90%) or tumor(< 10%), lead to demyelization
    ◆ mimic that of TMD, but absence of TMJ signs or muscle tenderness
    ◆ Diagnosis:
      1. MRI or MRA can identify demyelization area, a mass lesion in the cerebellopontine angle, or an ectatic blood vessel
      2. High-resolution MRI: vascular compression of the trigeminal nerve in 59% of case [Brisman, 2002]
  - Glossopharyngeal neuralgia: rare, producing pain in the posterior tongue, tonsil, lateral pharyngeal wall, ear and nasopharynx
- Treatment
  - Anticonvulsant, ex Carbamazepine: 100 to 200 mg twice daily initially, maintenance dose of 600 to 1200 mg
- Surgical procedures: microvascular decompression, removal or separation of various vascular structures (often ecstatic superior cerebellar artery) → 90% success rate
- Percutaneous radiofrequency rhizotomy: destroy to unmyelinated fiber of Gessarian ganglion, 70% success rate, but often recurrence

**Styloid process**
- Eagle’s syndrome, styloid pain syndromes and styalgia: cervicofacial pain arising from the styloid process
- Pathophysiology:
  - Congenital elongation and post-traumatic overgrowth of the styloid process
  - Ossification and degenerative changes of the stylohyoid ligament
  - Influence of the trigeminal, glossopharyngeal or vagus nerves, or the carotid artery
- Prevalence:
  - 4% of normal population, 4% are symptomatic
  - more common in women
  - peak incidence in 20- to 40-year olds
- Symptoms: pharyngeal pain, foreign body sensation in the throat, odynophagia or dysphagia
- Diagnosis:
  - Palpation of a tender bony spicule through the tonsillar fossa
  - Plain radiograph
    - Elongated styloid process in only 15–20% of cases
- Treatment: surgical excision via a transoral or external approach

**Thyroid**
- Been described in cases of acute bacterial and subacute thyroiditis
- Mediated through the vagus nerve
- Diagnosis
  - Thyroid function, which is temporarily abnormal in subacute thyroiditis, and by isotope imaging, the uptake of which may be severely reduced
  - Ultrasound or CT imaging may demonstrate an abscess in acute bacterial thyroiditis
Chest

- Myocardial ischaemia producing pain radiating

Reference