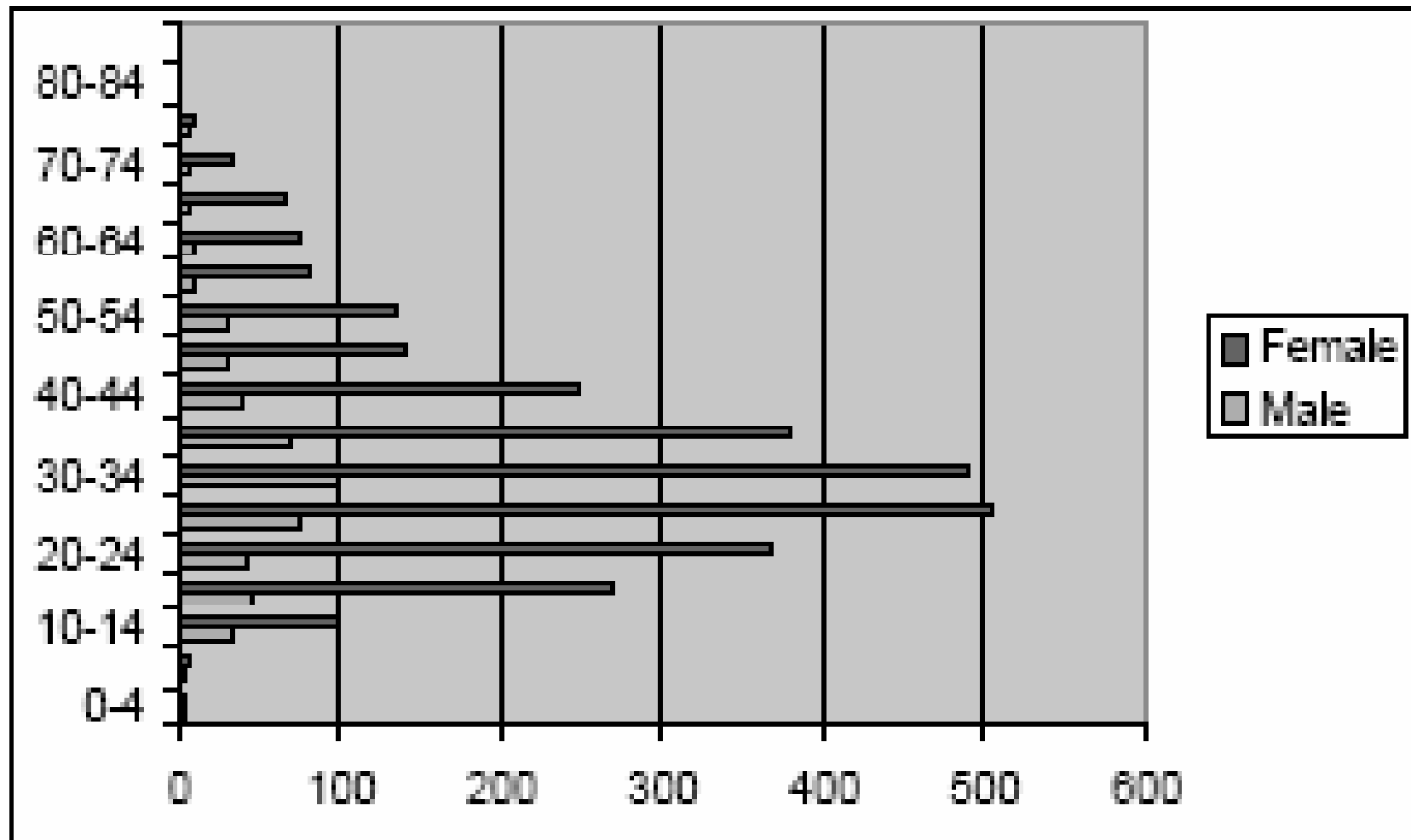


# **Temporomandibular Joint & Orthodontics**

# Epidemiology of TMJ Disorders



## Take Home Message

- TMJ signs and symptoms appear in healthy individuals.
- The signs and symptoms usually increase with age.  
Thus, symptoms occurring during treatment may not be related to treatment.
- Orthodontic Tx does not increase / decrease odds of TMD.
- No specific risk is associated with any particular orthodontic mechanics.  
Not achieving an ideal gnathological occlusion does not result in TMD.
- No method of TMD prevention has been demonstrated.
- TMD signs and symptoms usually are alleviated by simple Tx in most cases.

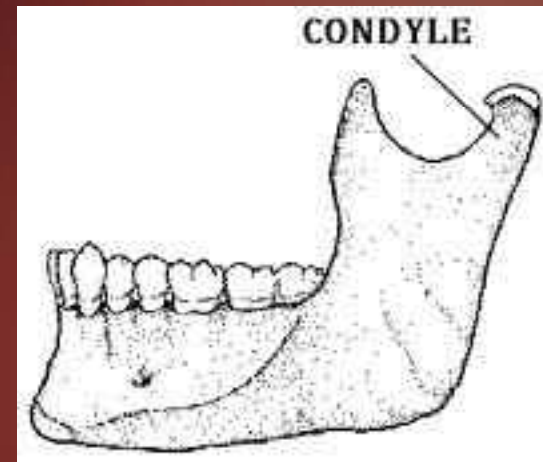
# Questions to be answered

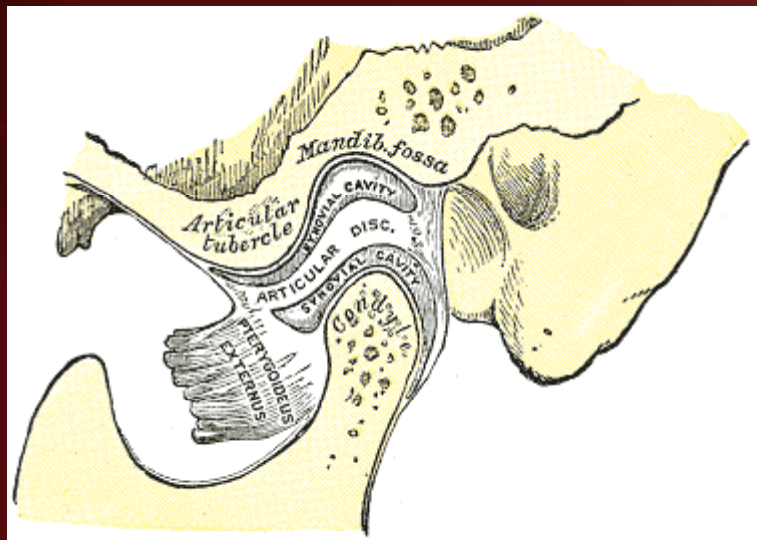
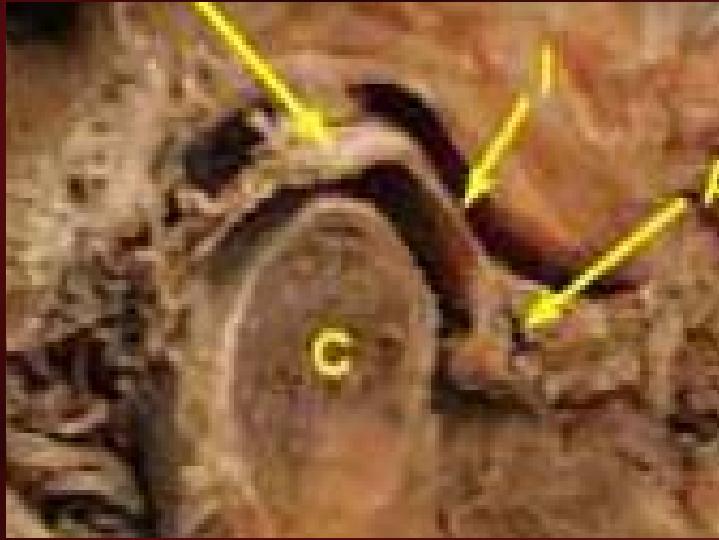
- What impact does occlusion have on TMJ disorders ?
- Does orthodontic treatment cure / prevent TMD ?
- Does orthodontic treatment cause TMD ?
- Can serial occlusal adjustment prevent TMD ?

# Gross Anatomy

- **TMJ**

- Articulation between the mandibular condyle and the mandibular fossa of the temporal bone

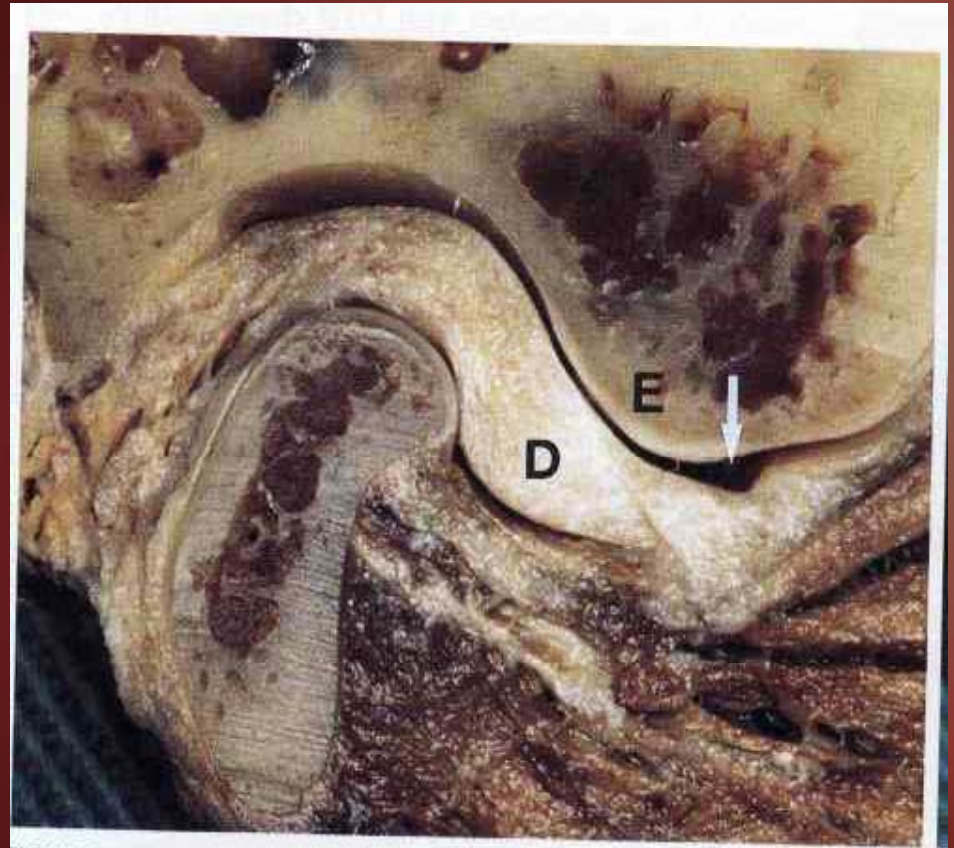




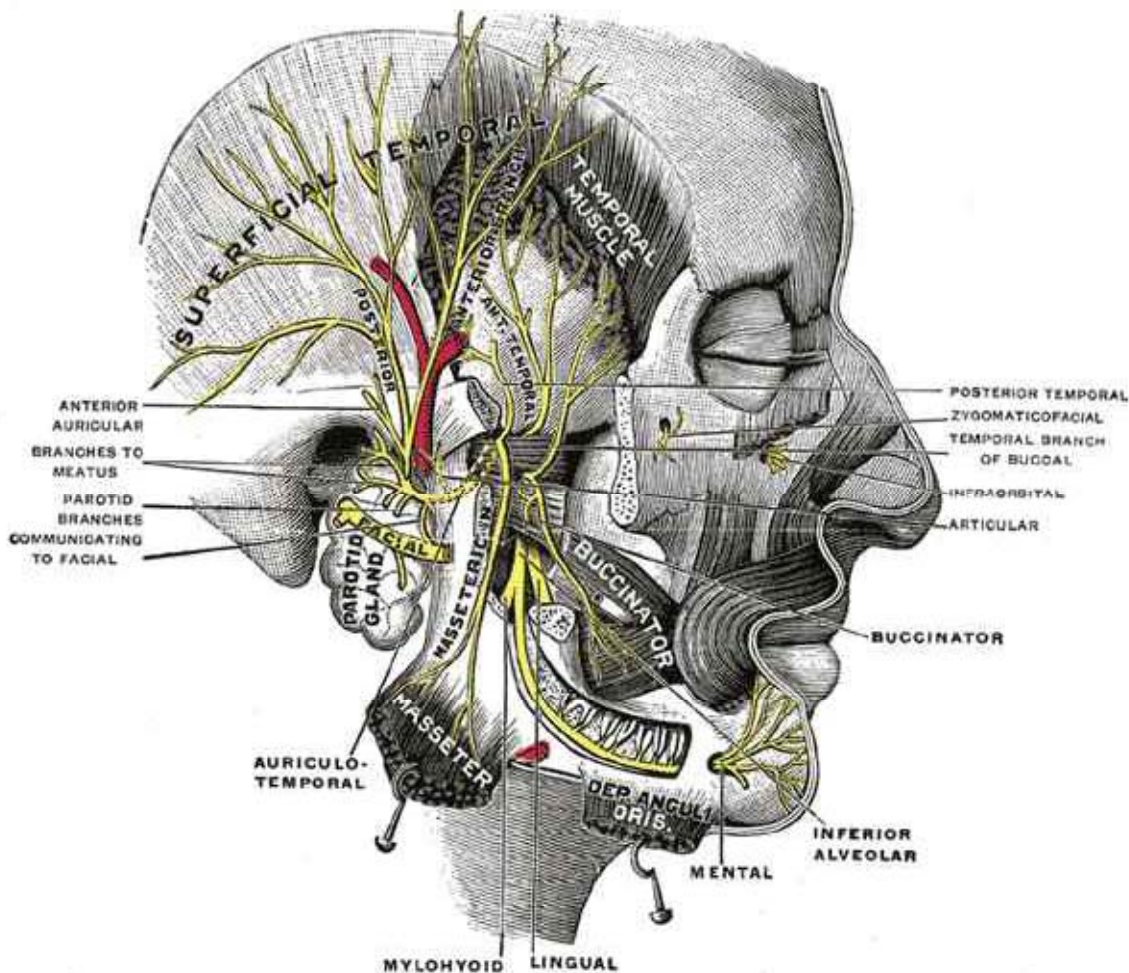
- An articular disc completely divides the joint space into upper and lower compartments
  - Posterior attachment of disc to condyle and temporal bone
  - Loose fibrous connective tissue
  - Vascular and innervated

# Muscle Insertion

- Primary insertion is the **lateral pterygoid muscle** to the anterior aspect of the condyle and a few muscle fibers inserting into the anterior band of the disc



# Innervation

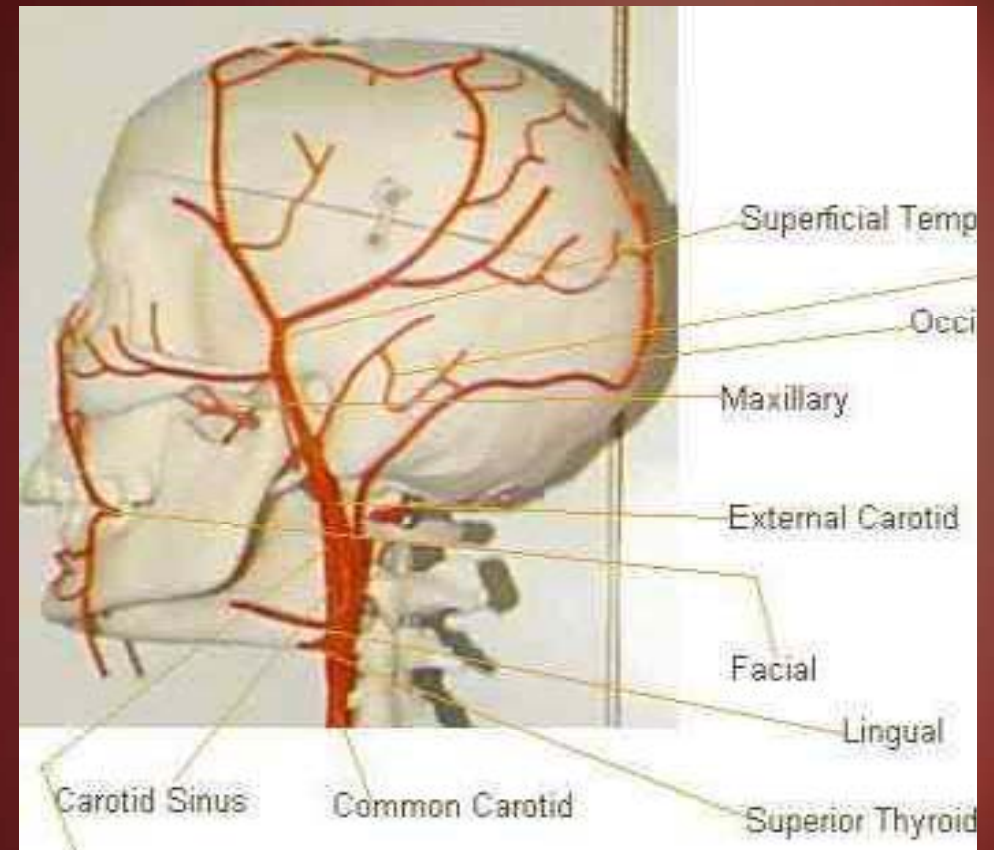


Mandibular division of the **trigeminal nerve** with some primary innervation from the **auriculotemporal nerve** and the **masseteric nerve**



# Blood Supply

- Blood supply is from the maxillary and superficial temporal branches of the external carotid artery



# TMJ – A Synovial Joint

- Load bearing surfaces which are **avascular and not innervated**
- Lubrication by synovial fluid
  - **Less than 1 cc of synovial fluid** per compartment
- Fibrous capsule contains synovial fluid and maintains relationship between joint components during function

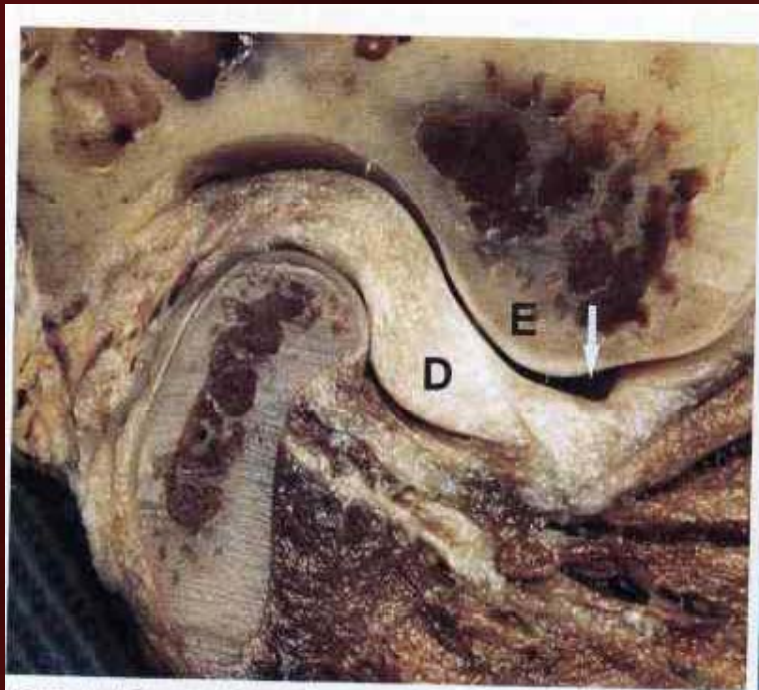
- **Difference between TMJ and other synovial joints**

**Structure:** The TMJ has an articular disc which completely divides the joint space into separate upper and lower joint compartments. Two joints are connected.

**Function :** the TMJ is a Hinge-sliding joint with a hinge action (rotation – lower) and a sliding action (translation – upper)

Complex structure & complex function

# Biomechanics



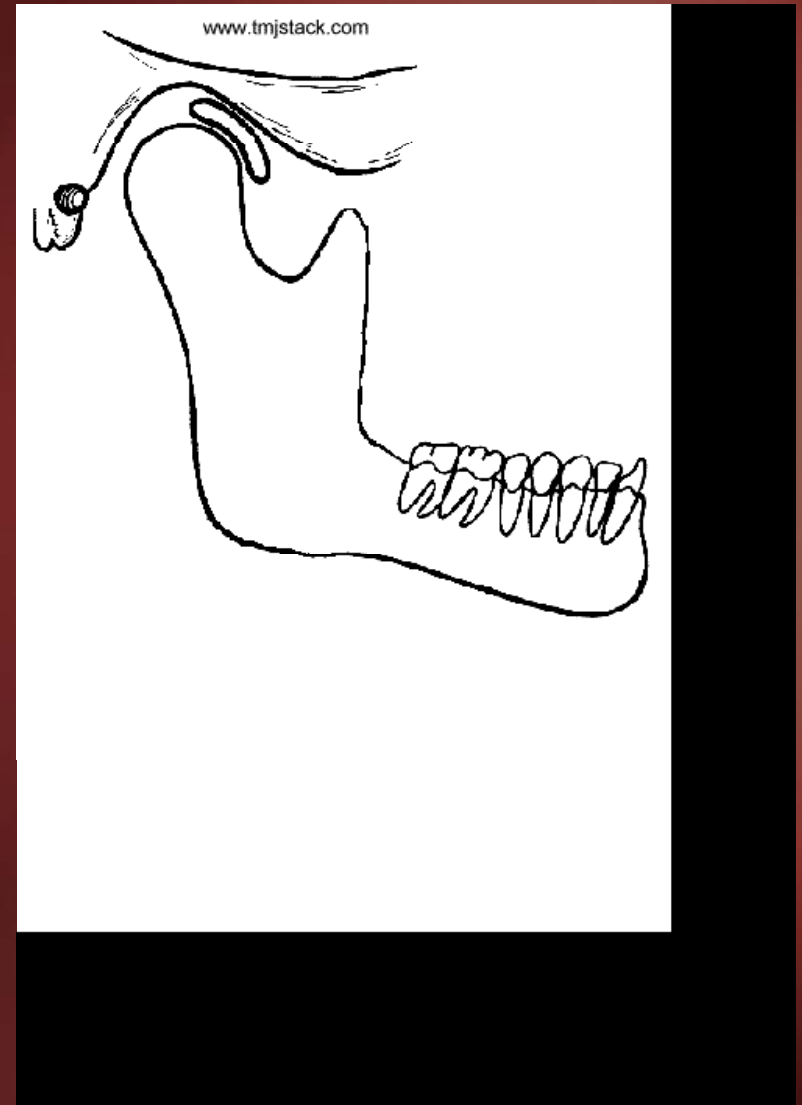
Hinge /sliding joint

- **Rotation** (hinge) between the condyle and the inferior surface of the disc **during early opening**

- **Translation** (sliding) between the disc-condyle complex and the temporal component **during wider opening**

# Biomechanics

- During opening the disc rotates posteriorly on the condyle maintaining stability between the condyle and the temporal component



# Histological Features

- The osseous tissues of the condyle and temporal components are covered by articular “soft tissue” which as the following layers in young adults
  - **Articular zone of fibrous connective tissue - Functional**
  - ***Proliferation zone of undifferentiated mesenchymal cells*** – Progenitor cells of the cartilage layer
  - **Cartilage zone** – Hyaline cartilage which is converted to fibrocartilage

# TUBERCLE COVERING



Dense BONE

OSSIFICATION

CALCIFICATION

FIBROCARILAGE

PROLIFERATIVE

ARTICULAR (FIBROUS)

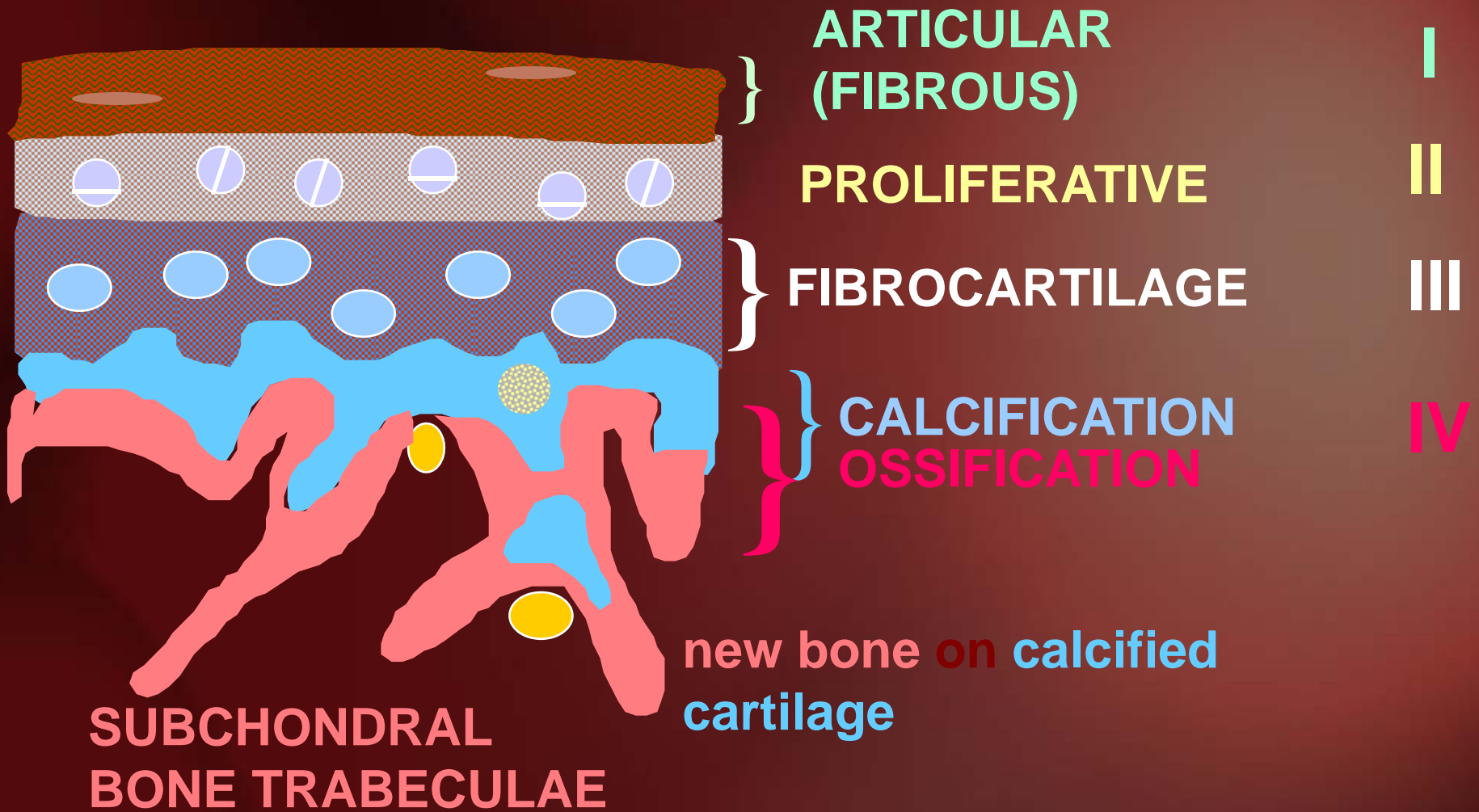
IV

III

II

I

# MATURE CONDYLAR LAYERS





**TMJ**

**ARTICULAR  
TUBERCLE/  
PROTUBERANCE  
/ EMINENCE**

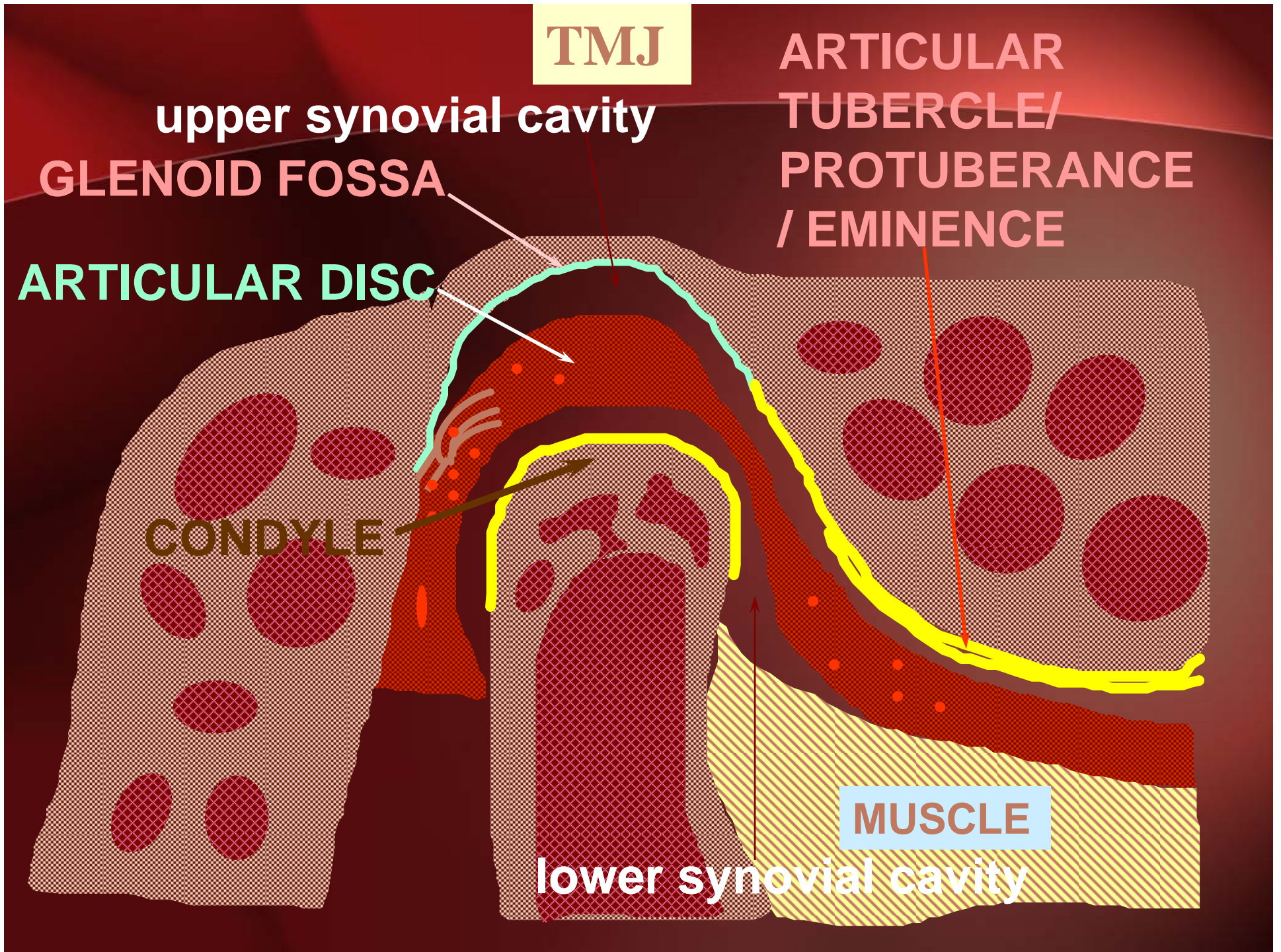
**upper synovial cavity  
GLENOID FOSSA**

**ARTICULAR DISC**

**CONDYLE**

**MUSCLE**

**lower synovial cavity**

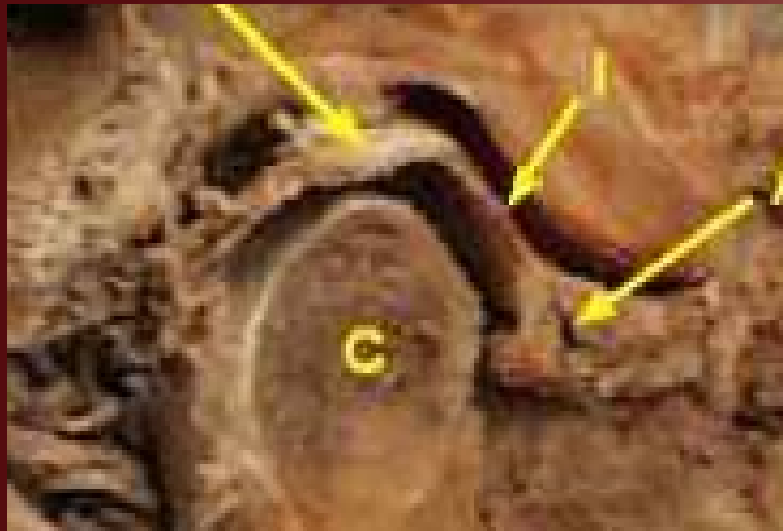


- The articular surfaces of the TMJ are covered with fibrous connective tissue, **not hyaline cartilage**, as in most other synovial joints

MANDIBULAR CONDYLE



- **The posterior attachment is composed of loose fibrous tissue with vascularity and innervation**



# Adaptive variations

- Articular surface irregularities (deviation in form)
- Morphological changes may alter joint biomechanics and/or produce joint sounds such as '**clicking**' or '**crepitation**'

# Adaptive variations

- The apparent potential of the TMJ for adaptation supports a biological rationale for **conservative treatment** approaches directed at reducing pain and disability rather **than correcting altered morphology**

# Embryology

- **TMJ develops between 8 – 14 weeks compared to 5-8 weeks for other synovial joints**

# Embryology – TMJ

- **10 – 11 weeks**

Ossification of the **temporal components** begins independently of the events in the mandible

- **12 weeks**

- the condylar cartilage is present at the most superior aspect of the ramus.
- the embryonic connective tissue (mesenchyme) between the growing condyle and temporal bone condenses **to form the articular disc**

- **13 weeks**

- cavitation forms the lower joint compartment and then the upper compartment

- **14 weeks**
  - **Joint development completed**
- **Persistence of the condylar cartilage as the cartilage zone of the articular soft tissue is presumed to contribute to the adaptation capacity of the adult condyle**



# Pathologic symptoms and signs-TMD

- **Definition:**
  - Collection of medical and dental conditions affecting the temporomandibular joint and/or the muscles of mastication, as well as contiguous tissue components.

# Prevalence of TMD

- **32% of population report at least one symptom of TMD**
  - **Difficulty opening**
  - **Locking**
  - **Pain on movement**
  - **Joint sounds**
  - **Muscle fatigue**
  - **Stiffness of lower jaw**

# Historical Perspective

- **Thompson was the first to note patients with disturbances in vertical dimension more prone to TMD**
  - Advocated the elimination of all interferences in “freeway space” envelope of movement
- **T. Graber was the first to note the multifactorial nature of TMD, occlusion being only one factor**
  - Cited stress and nocturnal parafunctional habits as contributors
  - Advocated psychological counseling as part of therapy

# Questions to be clarified

Occlusal  
Disturbances



Temporo  
Mandibular  
Dysfunction

Orthodontic  
Treatment



Temporo  
Mandibular  
Dysfunction

# Prevalence

## In mixed dentition, 1976

- Prevalence of TMJ symptoms was 20.7%
- Most common symptom was joint noise (7.6%)
- Second most common sign was restricted opening (5.3%)

## In primary dentitions,

- 50% had one or more signs
- Most common signs:
  - Jaw deviation 18%
  - Occlusal Interferences 7%
  - Asymmetric condylar movement 5%
  - Joint sounds 3%
- Most prevalent symptoms
  - Headache 7.07%
  - Jaw Pain 4.04%
  - Ear ache 3%

Boujardim, L. R.; Gaviao, M. B.; Carnesagnani, F. G.; Pereira, L. J., and Castelo, P. M. Signs and symptoms of temporomandibular joint dysfunction in children with primary dentitions. *J Clin Pediatr Dent.* 2003 Fall; 28(1):53-8.

## In adult patients?

Schmitter et al., J Oral Rehabil. 2005 Jul;32(7):467-73

Fifty-eight geriatric patients VS. 44 young subjects

- Geriatric subjects more often exhibited objective symptoms of TMD (38% exhibited joint sounds on opening), but rarely suffered from pain (pain at rest: 0%, joint pain: 0%, muscle pain: 12%).
- In contrast, young subjects rarely exhibited objective symptoms (joint sounds: 7%), but suffered more frequently from pain (facial: 7%, joint pain: 16%, muscle pain: 25%).



## Q 1: Is there prevalence data which shows that one type of malocclusion is more likely to be associated with a TMD?

- There is no association between overbite or overjet and self-reported TMD. N= 3033

**John et al., J Dent Res. 2002 Mar;81(3):164-9.**

- 82 asymptomatic volunteers vs. 263 symptomatic TMD patients

Literature does not suggest that replacement of missing posterior teeth prevents the development of TMDs. However, missing mandibular posterior teeth may accelerate the development of degenerative joint disease.

**Talents et al., J Prosthet Dent. 2002 Jan;87(1):45-50.**

- Few malocclusions except socioeconomic parameters were associated with TMD signs, and these associations were mostly weak.
- Only bilateral open bite up to 3 mm appeared to be clinically relevant and was associated with TMD signs (odds ratio [OR] = 4.0). This malocclusion, however, was of rare occurrence, with a prevalence of 0.3% (n = 9).

Sample size of 4310 men and women aged 20 to 81 years (response 68.8%) was investigated for TMD signs, malocclusions, functional occlusion factors, and sociodemographic parameters using multiple logistic regression analysis

**Gesch et al., Angle Orthod. 2004 Aug;74(4):512-20**

Occlusal  
Disturbances



Temporo  
Mandibular  
Dysfunction

**Q2: Is there any prevalence data which shows that one type of occlusion (for instance, canine guidance) is more likely associated with TMD?**

Pullinger and Seligman (2000)

Looked at **predictive values of occlusal variables in TMD**  
By comparing patients with TMD from asymptomatic normals.

The predictive power of the occlusal values was low (odds ratio of 2:1)

Patients with disc displacement were characterized by **Unilateral crossbite and long CO-CR slides.**

Patients with **osteoarthritis** were related with very long CO-CR slides

**No variable was associated with canine guidance**

Q 2-1 Are canine guidance (CG) and joint clicking related?

Donegan et al., J Oral Rehabilitation 1996 23: 799-804

In non-patients (n=46) and patients (n=46, with clicking)

In non-Pts, 70% without CG and 30% with CG

In Pts, 78% without CG and 22% with CG.

In both Pts and non-Pts,

61% with non-CG and 38% with CG.

No-evidence that both distal (retrusive) and mesial (protrusive) CG was associated with ipsilateral clicking.

Q3, Is there a relationship between disc derangement and occlusion?

Kahn et al., J Prosthetic Dent 1999, 82: 410-5

82 asymptomatics vs. 263 with symptomatic TMDs

**There are no systematic dental occlusal differences that clearly separate symptomatic from asymptomatic patients.**

**Q. 4: How often do post-orthodontic cases show balancing interferences?**

Non-working side contacts occurred in 30% of subjects.  
And posterior contacts on protrusion in 20%.

Is there a correlation between  
orthodontic treatment  
and increased likelihood of getting a  
TMD?



Deguchi et al., 1998. Of 86 chin cup therapy patients, 28 demonstrated one or more symptom(s) of TMD. This rate is 33% of the sample.

Peltola et al, 1995. , looked at condylar findings using panoramic radiographs (N= 39) post-ortho subjects and controls. The subjects had condylar changes noted in post ortho group versus none in controls controls. Post ortho group also had TMJ crepitation significantly more frequently (27%) than controls (8%).

## **Prevalence of ID in TMJ in Asymptomatic Volunteers with MRI**

**Results show a prevalence of disk displacement in 25 of 76 (33%) volunteers and 79 of 102 (77%) patients with a statistically significant difference ( $p < 0.001$ ). No statistical link was noted between a history of prior orthodontic treatment and internal derangement of the TMJ.**

Katzberg et al, 1996

**Questions  
addressed by the NIH technology assessment  
conference, 1996**

- 1. What clinical conditions are classified as TMD and what occurs if these are untreated?**
- 2. What signs and symptoms provide a basis for initiating intervention?**
- 3. What are effective initial therapies?**
- 4. What are effective therapies for persistent TMD?**

# 1. What clinical conditions are classified as TMD and what occurs if these are untreated ?

- **Specific etiology of TMD lacking; therefore, diagnosis depends on signs and symptoms**
- **Conditions affecting muscles of mastication:**
  - **Polymyositis**
  - **Dermatomyositis**
- **Conditions affecting the TMJ:**
  - **Arthritis**
  - **Ankylosis**
  - **Growth disorders**
  - **Recurrent dislocation**
  - **Neoplasias**
  - **Condylar fracture**
  - **Systemic illness**

## **What are classified as TMD and what occurs if these are untreated?**

- **TMD can be either muscle or joint pain or a combination of both**
- **Peak prevalence in young adults (20-40)**
- **Some studies show equal gender predilection, but others show higher number of females**
- **Usually self-limiting if left untreated**
- **Few data to assess long term course in absence of treatment**

## 2. What signs and symptoms provide a basis for initiating intervention?

- **Physical examination:**
  - Pain
  - Limited range of motion
  - Parafunctional habits
  - Muscle tenderness
  - Psychosocial factors
- **Conservative non-invasive treatment**
  - Patient education/awareness

### 3. What are effective initial therapies?

- **Supportive patient education**
  - Most courses of TMD are benign and self-limiting
- **Pharmacologic pain control**
  - NSAIDS (ibuprofen, naproxen)
  - Opiates (oxy- and hydrocodone)
  - Muscle relaxants (amitriptyline)
  - Low-dose antidepressants (amitriptyline)

### 3. What are effective initial therapies?

- **Physical therapy**
- **Intraoral appliances**
  - Stabilization splints
- **Occlusal therapy**
  - Controversial
  - Irreversible
  - Not demonstrated in randomized clinical trials to be superior to reversible therapies



## 4. What are effective therapies for persistent TMD?

- **Pharmacologic therapies**
  - NSAIDS
  - Opiates
    - Major concerns include:
      - Addiction potential
      - Analgesic tolerance
      - Uncontrolled side effects (itching, constipation, nausea)
  - Anxiolytic/Hypnotic drugs (benzodiazepines)
    - Pain disorders can result in sleep disorders
    - Anxiolytic/hypnotic drugs can improve sleep patterns

# Pharmacologic management of TMD

- **NSAIDS**
  - Effective in relieving acute inflammatory pain
  - When prescribed for weeks or months, however, increased risk for GI ulcerations, bleeding and renal toxicity

## COX-2 Inhibitors

- **Selectively inhibit COX-2 enzymes, allowing production of cytoprotective prostanoids**
- **Celecoxib (Celebrex)**
- **Rofecoxib (Vioxx)**
- **Initially popular for the management of osteoarthritis and rheumatoid arthritis**
- **Now popular for chronic orofacial pain**

## Side Effects

- **Drug interactions**
  - May decrease the effectiveness of ACE-inhibitors used to treat hypertension
- **May alter kidney function**
- **Not safe for use during pregnancy**
- **Drug allergies to NSAIDS or ASA**

# Occlusal stabilization splints

- Used often in clinical practice for treatment of TMD
- Monoplane, acrylic appliance
- Either maxillary or mandibular
- Adjust until point contacts
- Relaxes muscles of mastication
- Constructed to place patient in centric relation
- Eliminates tooth guided condylar position



# What does the literature say?

- Article published in JADA, 2001
- Reviewed 10 studies using placebo and treatment groups
- Weaknesses in design:
  - Each study lumped TMD patients all together, regardless of symptoms
  - Need to evaluate effectiveness of splint therapy for each subgroup of TMD (clicking, muscle pain, limited opening, etc)
- Overall, concluded that splints work as behavioral interventions to produce changes in the position of the mandible

**TMD can be treated or caused by Orthodontic Treatment ?**

- Signs and symptoms may occur in healthy persons
- Signs and symptoms increase with age, often start in adolescence
  - Orthodontic treatment and TMD start in adolescence; difficult to say if a true relationship
- Orthodontic treatment during adolescence does not increase or decrease the likelihood of having TMD as an adult



- **Extraction during treatment does not increase risk of TMD**
  - Certain types of orthodontic mechanics does not increase risk of TMD
  - Little evidence orthodontic treatment prevents TMD
    - The role of **unilateral posterior crossbite** correction in the prevention of TMD needs further investigation
    - Pullinger noted that patients with **unilateral posterior crossbite in childhood had an odds ratio for TMD of >2:1 in adulthood**
    - Hypothesized that, in a small percentage of patients, **a mandibular shift** places increased loading on one TMJ, leading to internal derangement and TMD as an adult

# Conclusions

- **TMD is multifactorial in nature**
  - Warrants a multi-faceted approach
- **Self-limiting in nature**
- **Conservative, non-invasive, reversible initial treatment**
- **Pharmacologic therapy for persistent TMD**
  - COX-2 inhibitors important in armamentarium

# Litigations

- **Common**
- **Can occur spontaneously**
- **Record, record, record**
- **Be conservative!**
- **Refer**