Management of Temporomandibular Disorders

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Learning objectives

- Epidemiology
- Anatomy and function
- Etiology of TM disorders
- History and Clinical Exam
- Radiographic Exam
- Diagnosis
- Nonsurgical Management and Treatment
- Surgical Management
TEMPOROMANDIBULAR DISORDERS (TMD)

A collective term used to embrace a number of clinical problems that involve the masticatory musculature and the temporomandibular joint itself

Epidemiology

- The prevalence of temporomandibular joint and muscle disorder (TMD) is between 5% and 12%.
- 1/3 of the population has had TMD symptoms
- 2nd most common musculoskeletal disorder
- Many signs or symptoms do not indicate a need for treatment

Epidemiology

- Age range – 90% of TMD patient population between 15 and 45 years of age.
  - Mean is 34.9 years.
  - Inflammatory disorders more prevalent in older groups
  - Muscular diagnoses more prevalent in younger groups
  - Functional disorders proportionally equal in all groups
- Female : Male = 2 : 1 (as high as 9 : 1 in clinical populations)
Prevalence – Joint Sounds

Clicking = Women 26 – 28 %, Men 17 – 21 %
Crepitations = Women 37 – 40 %, Men 21 – 26 % (using a stethoscope)

ANATOMY
Osseous Structures

Anatomy

Normal Anatomy of the TMJ

1. Condyle
2. Articular Disk
3. External Auditory Meatus
4. Posterior Articular Ligament
5. Articular Eminentce
6. Retrodiscal Tissue
7. Superior Head of Lateral Pterygoid
8. Inferior Head of Lateral Pterygoid
9. Superior Joint Space
10. Inferior Joint Space
Mandibular Condyle

Fibrocartilage

- Lines articular surfaces of both temporal bone and condyle
- Composed of chondrocytes and intercellular matrix of collagen fibers, water, and ground substance
- Few blood vessels in these areas, with cartilage nourished primarily by diffusion from synovial fluid
Ligaments

- Three Functional ligaments
  - Collateral/Lateral ligament = Strongest
  - Joint capsule = 360°
  - Temporomandibular ligament
- Two Accessory Ligaments
  - Stylomandibular
  - Sphenomandibular
    - Limits the range of movement anteriorly and posteriorly

Articular Disc

- Dense fibrous connective tissue
- Non-vascularized
- Non-innervated??!
- Attached to capsular ligament anteriorly, posteriorly, medially, and laterally
  - (also, some fibers of the superior head of the lateral pterygoid insert on the disk at its medial aspect)
Muscles

- **Medial Pterygoid**: Closure + protrusion
- **Temporalis**
  - Anterior portion = Closure
  - Posterior portion = Retrusion + ipsilateral closure
- **Masseter**
  - Superficial layer: Protrusion + contralateral closure
  - Deep layer: Retrusion + ipsilateral closure
- **Lateral Pterygoid**
  - Inferior head: Protrusion + Contralateral opening
  - Superior head: Retrusion + Ipsilateral closure

TMJ Anatomy - Innervation

- **Trigeminal nerve**
  - **Mandibular branch**
    - **Auriculotemporal branch** (predominant innervation)
    - Deep temporal
    - Masseteric
TMJ Anatomy – Adjacent structures

Facial nerve (CN VII)

Color Atlas of TMJ Surgery – P. Quinn

TMJ Anatomy – Blood supply

- External carotid
  - Superficial temporal artery
  - Middle meningeal artery
  - Internal maxillary artery
Venous

Foramen Ovalle:
- Lesser superficial petrosal nerves (CN IX)
- Mandibular nerve (V3)
- Accessory middle meningeal artery
- Emisary veins (from cavernous sinus to pterygoid plexus)
- Otic ganglion is inferior to foramen ovalle

Foramen Spinose:
- Middle meningeal artery & vein
- Nervus spinosus

Carotid Canal:
- Internal carotid artery
- Carotid nerve plexus

Jugular foramen:
- Jugular vein
- Glossopharyngeal, Vagus & Accessory nerves

Outer & Middle ear
- Brain
- Roof of fossa = 0.2mm - 4mm
Anatomy

Synovial Fluid

Produced by:
- Synovial lining – upper & lower joint spaces
- Synovial fringe at the anterior border of the retrodiscal tissue

Functions:
- Provides metabolic nutrients to nonvascular tissue
- Lubrication
  - Boundary lubrication (Primary mechanism)
    - Fluid in the border recesses is forced onto the articular surfaces during function
  - Weeping lubrication (metabolic exchange)
    - Functional forces drive a small amount of fluid into & out of articular tissues
Synovial Fluid

- Constituents:
  - Water
  - Collagen & proteoglycans
  - Hyaluronic acid (HA)
    - Glycosaminoglycan from type B synovial cells
    - Molecular weight 800-1900 kDa
    - Synovial fluid viscosity depends on quantity & quality of HA
  - Surface active phospholipids (SAPLs)
    - Predominantly Dipalmitoyl phosphatidylcholine (DPPC)
    - Mostly responsible for boundary lubrication
    - Synergistic with HA
  - Lubricin (PRG4 or Superficial zone protein)
    - A mucinous glycoprotein
    - Also involved with boundary lubrication

Breakdown of lubrication

- Reduced quantity and quality of HA in TMJ disease states.

- Hypoxia reperfusion produces free radicals that induce the breakdown of the lubrication system (Nitzan 1994)

- Numerous inflammatory cytokines and active molecules have been found in synovial samples from diseased TMJs
  - IL-1β, IL-6, IL-8, TNF-α, MMP’s, TIMP, MIP, PLA-2
Etiology of TMD

“Initiating factors” - factors that cause the onset of temporomandibular disorders
- Initiating factors lead to the onset of the symptoms and are related primarily to trauma or adverse loading of the masticatory system.

“Perpetuating factors” - interfere with healing or enhance the progression of temporomandibular disorder
- Behavioral factors (grinding, clenching and abnormal head posture)
- Social factors (could effect perception and influence of learned response to pain)
- Emotional factors (depression and anxiety)
- Cognitive factors (negative thoughts and attitudes which can make resolution of the illness more difficult).

Etiology

“Predisposing factors” - factors that increase the risk of temporomandibular disorders and orofacial pain
- Systemic factor- medical conditions (rheumatic, nutritional, metabolic disorders)
- Psychological- personality
- Structural-occlusal discrepancies, dento-skeletal deformities, poor dental treatment
Caries are diagnosed primarily by examination
Pain is diagnosed primarily by history

- TMJ questionnaire
- Presenting complaint (e.g. Pain, noises, function)
- Onset & evolution of the problem
- Initiating factors
- Pain
- Joint noises
- Exacerbating and relieving factors
- Parafunctional habits
- Treatment so far

“I’m not really sure what it is but five or six thousand dollars of tests should help me figure it out.”

History

- PMH, PSH, Meds, Social history, ROS

IMPORTANT – PMH, PSH, Meds,
History - Pain

- Location & radiation
- Severity (analog scale)
- Quality
- Timing (intermittent/constant/variable)
- Duration
- Associated symptoms (HA, tinnitus, visual)
- Exacerbating factors
- Relieving factors

Clinical Examination - Muscles
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Clinical Examination - Muscles

If the patient reports pain on palpation (indicating myalgia)

- localized to the point of palpation (local myalgia)
- spreading beyond the point of palpation but within the muscle boundary (myofascial pain)
- radiates outside the muscle boundary (myofascial pain with referral)

2014 Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) for Clinical and Research Applications

Clinical Examination - Joint

Swelling
Tenderness
Hinge & translation
Symmetry of motion and jaw deviation
ROM – subluxation / dislocation
Clicks or Crepitations
Timing of click
Clinical Examination - Joint

Clinical Examination - Joint
Clinical Examination - Joint
Clinical Examination - Function

Clinical Examination - Function
Clinical Examination - Function

Intraoral exam:
- Signs of parafunction
  - Tooth wear
  - Tooth or restoration fracture
  - Tongue scalloping
  - Buccal mucosal ridging
- Occlusion
  - Open bite
  - Cross bite & midline deviation
- Skeletal relationship
Radiographic - MRI

Internal derangement - Anteriorly displaced disc with reduction

Radiographic - MRI

Internal derangement - Anteriorly displaced disc without reduction & Superior joint space effusion
Bone Scan
Clinical Examination – Diagnostic Block

- 2% Lidocaine or 3% Mepivicaine
- Auriculotemporal nerve as it passes behind the condyle & into the superior joint space

Diagnosis

- Muscle disorder
- Joint disorder
- CNS component
Diagnosis

- Intra-Articular TMD
  - within the joint to include all tissues of the joint
  - Demonstrable indications for invasive management
  - Incidence - 5% of patients with TMD signs and symptoms

Diagnosis

- Extra-articular TMD
  - Not primary to the TMJ itself
  - Masticatory and cervical myalgia
  - Non-invasive management
  - Incidence
    - 95% of patients with TMD signs and symptoms
    - 45% have extra-articular TMD
Diagnosis

- Intra-articular
  - finger pointing directly to the joint
  - bite on tongue blade = contralateral pain

- Extra-articular
  - hand to the side of the face
  - bite on tongue blade = ipsilateral pain
Muscle Disorders

- Myalgia
- Myofascial Pain
- Tendonitis/Myositis
- Spasm/Trismus
- Contracture
- Hypertrophy
- Neoplasm
- Movement disorders

Myogenous pain

- Local Myalgia (ICD-9 729.1, ICD-10 M79.1)
  - Muscle pain located in palpation site only

- Myofascial pain (ICD-9 729.1, ICD-10 M79.1)
  - Muscle pain spreading from palpation site but within the muscle boundary

- Myofascial pain with referral (ICD-9 729.1)
  - Muscle pain spreading from palpation site outside muscle to another site

Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) for Clinical and Research Applications: Recommendations of the International RDC/TMD Consortium Network* and Orofacial Pain Special Interest Group

Myofascial pain and dysfunction

- Regional dull, aching pain, pain aggravated by mandibular functional when the muscles of mastication are involved

- Symptoms
  - Diffuse, poorly localized muscle tenderness
  - Cyclic ie hurts for couple days then it goes it way
  - Worse in morning
  - Sleep disturbance
  - Bruxism/Sore teeth
  - Tiredness/fatigue
  - SPASM, PAIN, DYSFUNCTION

Myofascial pain and dysfunction

- Treatment
  - Soft diet
  - Moist heat
  - Gentle range of motion exercises (Physical Therapy)
  - Rx Management- two weeks
    - Cyclobenzaprine (Flexiril) 5-10mg QHS
    - Diazepam (Valium) 2mg TID
  - Splint Therapy
Myofascial pain and dysfunction
Pharmacotherapy

Cyclobenzaprine/Flexiril

- Mechanism of action
  - Centrally acting (alpha motor neuron) muscle relaxant
- Side effects
  - Headache
  - Tiredness
  - Xerostomia

Diazepam/Valium

- Mechanism of action
  - Enhances GABA mediated chloride current leading to hyperpolarization of the neuron and reducing excitability
  - Anxiolysis and amnestic
- Side effects
  - Impaired
  - Tiredness
  - Respiratory depression

Myositis

- Acute inflammation with weakness, pain, edema, and decreased range of motion due to overuse, secondary to trauma and infection
- Treatment
  - NSAIDS
  - Medrol dose pack?
  - Rest
  - Diet Modification
CNS

- Chronic pain
- Neuroplasticity
- Overlapping conditions:
  - Chronic fatigue syndrome
  - Fibromyalgia
  - Irritable Bowel
  - Interstitial cystitis
  - Chronic tension-type headache
  - Chronic pelvic pain
  - Chronic low back pain

Fig. 2. Central sensitization. With the induction of central sensitization in somatosensory pathways with increases in synaptic efficacy and reductions in inhibition, a central amplification occurs enhancing the pain response to noxious stimuli in amplitude, duration and spatial extent, while the strengthening of normally ineffective synapses recruits subliminal inputs such that inputs in low threshold sensory inputs can now activate the pain circuit. The two parallel sensory pathways converge.
Pain Paradigms

- Internal derangement (disc displacement)
- Subluxation / dislocation
- Idiopathic condylar resorption
- Inflammatory Arthritis (Primary & Secondary)
  - Polyarthritis
  - Rheumatoid, JIA, psoriatic, HLA-B27, Infectious (Chlamydia)
- Osteoarthritis
- Osteoarthrosis
- Inflammatory
  - Synovitis and capsulitis
  - Retrodiscitis
- Ankylosis
- Pathology
Diagnosis – Joint disorders

Wilkes Classification

Table 47-3 Wilkes Classification

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>Clinical</th>
<th>Imaging</th>
<th>Anatomic Pathology</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Early reducing disk displacement</td>
<td>Painless clicking</td>
<td>Slightly forward disc, reducing*</td>
<td>Normal disc form</td>
</tr>
<tr>
<td>II</td>
<td>Late reducing disk displacement</td>
<td>Occasional painful clicking</td>
<td>Slightly forward disc, reducing</td>
<td>Slight anterior displacement</td>
</tr>
<tr>
<td>III</td>
<td>Nonreducing disk displacement: acute/subacute</td>
<td>Intermittent locking</td>
<td>Early disc deformity</td>
<td>No bone changes</td>
</tr>
<tr>
<td>IV</td>
<td>Nonreducing disk displacement: chronic</td>
<td>Frequent pain</td>
<td>Anterior disc displacement</td>
<td>Degenerative remodeling of bony surfaces</td>
</tr>
<tr>
<td>V</td>
<td>Nonreducing disk displacement: chronic with osteoarthritis</td>
<td>Chronic pain, headache</td>
<td>Anterior disc displacement</td>
<td>Gross degenerative changes of disc and hard tissues; Perforation</td>
</tr>
</tbody>
</table>

*Reducing = displaced disc returns to its normal position when the mouth is opened, accompanied by a popping sound
**Nonreducing = displaced disc does not return to the normal position and acts as an obstacle during attempted mouth opening
Diagnosis – Joint disorders-Internal Derangement

Closed mouth | Open mouth

- Normal disc position
- Anterior disc displacement with reduction
- Anterior disc displacement without reduction
Disc displacement

- Elongation of the collateral and discal ligaments (Inferior lamina) with associated thinning of the disc
- Anteromedial > lateral > posterior

- Retrodiscal tissue is inflamed causing pain
- Adaptation and fibrosis occurs over time
- But may perforate

Chronic closed lock
Osteoarthritis (noninflammatory degenerative)

- Pain and tenderness in joint and masticatory muscles
- Jaw fatigue and stiffness
  - Less in the morning as opposed to myofascial pain and may or may not have involvement of other joints
- Reduced range of motion
- Crepitus
- ***80-100% of patients >70yrs

Hypermobility/ Subluxation

- Subluxation (Hypermobility)
  - Condyle translates to a position anterior to the peak of the eminence
  - Patient reports a “thud” or lock but is able to spontaneously close
  - NOT a pathologic condition
- Treatment:
  - Usually no treatment needed
  - Patient education
  - Restrict mouth opening
Hypermobility/Dislocation

- Dislocation (Open lock)
  - Condyle translates anterior to the peak of the eminence
  - With disc dislocation (anteriorly or posteriorly)
  - Associated muscle contraction
- Treatment:
  - Acute - Requires manipulation to close, then restrict opening
  - Surgical indications for open joint
  - Chronic recurrent dislocation requiring manipulation
  - Fail sclerosing agent x1
  - Surgical procedure: Articular eminectomy
    Or post attachment sclerosis via arthroscopy
Idiopathic Condylar Resorption

- Sex: Females 9:1
- Age: 10 – 40
- High occlusal and mandibular plane angles
- Class II skeletal and occlusal relationships
- Often bilateral and symmetrical but may be unilateral
- Progressive mandibular retrusion
- Burn out usually after 6 – 12 months
- Etiology ????
  - Low estrogen

Estrogen

- 17β-estradiol
  - Down-regulation of MMP transcription
  - Reduces cytokines and inflammatory mediators
  - Reduces bone loss in women
  - Up-regulation of RANKL in estrogen deficiency (Osteoclast activation)

- Ethinyl Estradiol (Contraceptive pill & HRT)
  - Suppresses endogenous 17β-estradiol

<table>
<thead>
<tr>
<th></th>
<th>Inflammation</th>
<th>Bone resorption</th>
</tr>
</thead>
<tbody>
<tr>
<td>17β-estradiol</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>Ethinyl Estradiol</td>
<td>↑</td>
<td>↑</td>
</tr>
</tbody>
</table>
Goals of Nonsurgical TMJ Therapy

- Alleviate pain
- Decrease/Eliminate Jaw dysfunction
- Lifestyle/Behavioral modification
- Physical Therapy - Passive Jaw Exercises- Therabite?, Tongue blades
- Warm compresses
Goals of Nonsurgical TMJ Therapy

- Pharmacotherapy
- Soft Diet
  - Decreases muscle activity and loading forces on TMJ
  - Controls range of motion—hinge and sliding
  - Ranges from liquid diet to elimination of hard chewy food; involves cutting food into small pieces
  - Eliminate gum chewing

Non-Surgical Management

- **Physical therapy**
  - Posture training
  - Mobilization / manipulation / joint distraction
  - Massage / muscle conditioning
  - Physical Agents or modalities:
    - TENS, Ultrasound, Iontophoresis, Phonophoresis, Electrogalvanic stimulation, Thermal

- **Stress reduction**
  - Psychologist
  - Counselor
  - Psychiatrist
Acute Pharmacotherapy

- **NSAIDS**
  - Naproxen
  - Ibuprofen
  - Diclofenac
  - Meloxicam
- **Steroid**
  - Medrol Dosepak
- **Muscle relaxants**
  - Flexeril
  - Robaxin
  - Baclofen

- **Topical Compounds**
  - Lidocaine
  - Ketoprofen
  - Diclofenac
  - Capsaicin
  - Menthol
  - Methyl Salicylate
  - Icy-Hot
    - Menthol
    - Methyl Salicylate

Botox
Goals of Splint Therapy

- Muscle relaxation
- Condyles in CR
- Aids in diagnosis
- Protects the teeth
- Normalizes PDL Proprioception

Types of splints

- Stabilization splints/ Muscle relaxation appliance
- Anterior bite plane
- Anterior repositioning appliance
- Mini anterior appliances
- Neuromuscular appliances/Neuroprosthetic device
- Posterior bite plane appliances
Oral appliances – what they can and cannot do

Can do

• Protect teeth/restorations from fracture due to bruxism/clenching
• Reduce/change the loading of the TMJ by reducing intensity, frequency and duration of bruxism/clenching
• Adding a foreign body into the occlusion briefly reduces muscle activity
• Reduces headaches related to bruxism/clenching
• Reduce internal derangement symptoms related to bruxism/clenching upon awakening
• Change the neuromuscular engrams "de-programming"

Can’t do

• Unload the disc by pivoting the mandible on the molars and distracting the condyle
• Retrain muscle to be less active upon cessation of the appliance
• Recapture and reposition discs
• Permanently reduce bruxism/clenching
• Relieve headaches that are neurovascular or vascular in origin


Hard or Soft NG?


Occlusal Appliances (Orthotics)

Appliance type

- Full Coverage
  - Stabilization
- Full coverage anterior positioning appliances
  - Herbst
  - Modified stabilization
- Partial Coverage
  - Anterior (NTI)
  - Posterior (Gelb)

Appliance use

- Full coverage appliances
  - Long term based on use
  - Can be used in all conditions
- Partial Coverage
  - Short term only
  - Extrusion of non-covered teeth
  - Intrusion of covered teeth
  - No evidence of pain difference at 3 months when compared with a full coverage stabilization
30 yo ASA I female presents for with 8/10 pain. CC: “I have TMJ”. Patient reports it has been hurting for over two years. Painful all day but not debilitating. Points to the joints, inside the ears, head, and cheeks. Reports occasional headaches. Denies any trauma. Vitals are normal. Patient wants the joint pain and headaches to go away.

What are you going to do?
A. Referral to OMS
B. Referral to Pros
C. Referral to Psych/pain management
D. Perform a comprehensive focused exam and treat the patient within your comfort and scope
E. Referral to ENT
**TMD protocol**

- Step 1: Thorough exam
- Step 2: Radiographs
- Step 3: Conservative management within your scope
  - NSAIDS/Muscle relaxants
  - Splint Therapy
  - Warm compress
- Step 4: Reevaluate
- Step 5: Refer as needed

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**Treatment**

- **Non-surgical**
- **Surgical**
Arthrocentesis
Arthrocentesis

- Long-Term Evaluation of Arthrocentesis for the Treatment of Internal Derangements of the Temporomandibular Joint; Carvajal, Laskin; JOMS 58:852-855, 2000
  - 26 patients
  - prearthrocentesis mean MIO = 25.3mm
  - Immediately s/p arthrocentesis, mean MIO = 43.8mm
  - Long-term follow-up (10-96 mos) mean MIO = 37.1mm
Long-Term Evaluation of Arthrocentesis for the Treatment of Internal Derangements of the Temporomandibular Joint; Carvajal, Laskin; JOMS 58:852-855, 2000 (continued)

“The short- and long-term postoperative VAS values for pain and dysfunction showed a significant decrease...”

- 14 of 26 patients (54%) had no pain s/p arthrocentesis
- 9 patients had less pain s/p arthrocentesis
- 3 patients initially had less pain, which returned to baseline later

Level I Arthroscopy
- Single puncture & outflow needle
  - Lysis & lavage
  - Diagnostic sweep
  - Needle / scope adhesiolysis

Level II Arthroscopy
- Double puncture & outflow needle
  - Level I
  - Instrumentation port (laser, grasper, probe etc)

Level III Arthroscopy
- Triple puncture & outflow needle
  - Level II
  - Discopexy (suture/screw)
Intraoral Vertical Ramus Osteotomy/Modified Condylotomy

- Indications
  - TMJ pain
  - Stable occlusion
  - Wilkes 2, 3 (closed lock)
- Provides sag for disc to “reposition”
- DO not do bilaterally in the same surgery → higher chance of a malocclusion (most common complication)

Hall, HD. Prospective study of modified condylotomy for treatment of nonreducing disk displacement. OOOOE, 2000 Feb;89(2):147-58.

“A prospective study on 43 joints; 87% favorable outcome for treating pain and improving function”

Hall, HD. One- and three-year prospective outcome study of modified condylotomy for treatment of reducing disc displacement.

A prospective study of 48 consecutive patients (79 joints) 94% favorable outcome
Disectomy as the Primary Surgical Option for Internal Derangement of the Temporomandibular Joint

Michael Miloro, DMD, MD,* and Brent Henriksen, DDS, MD†

Purpose: The goal of this study was to evaluate outcomes of patients who underwent temporomandibular joint (TMJ) disectomy without replacement as the primary treatment for internal derangement after failure of nonsurgical therapy.

Patients and Methods: Thirty consecutive patients with TMJ internal derangement were treated with disectomy from 2001 to 2007. Four patients were lost to follow-up, and 2 were excluded because of prior joint surgery. Using the standardized Helkimo Anamnetic and Clinical Dysfunction Indexes, 24 patients, or 32 joint surgeries, were evaluated postoperatively, with an average follow-up of 30.8 months (range, 2 to 60 months).

Results: All 24 patients showed improvement in mandibular mobility and joint function, as well as reduction in TMJ and muscular facial pain, represented by a clinical dysfunction index of DIO, Dil, or DII. Preoperatively, all patients had an anamnetic index of AII, which represented moderate to severe pain in the TMJ and masticatory muscles, and/or locking of the joint before surgery. Postsurgically, 20 of the 24 patients scored an index of DIO or Dil, which correlated with a clinically symptom-free state or only a small, minor dysfunction. TMJ pain, muscle pain, and pain with mobility scored the lowest point index, indicating a subjectively successful outcome.

Conclusions: Disectomy of the TMJ as a primary surgical option significantly reduces pain and improves function.

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Custom Total Joint

Custom Total Joint