Basic Functional Anatomy of the Gnathostomomatic System and its Clinical Implications

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NOTHING IS MORE FUNDAMENTAL TO TREATING PATIENTS THAN KNOWING ANATOMY

Jeffery P. Okeson
Topics to be Discussed

Revisit the anatomy of the GSS, more in a sense of clinical importance to the study of sleep medicine

Functional anatomy of the TMJ

Functional anatomy of muscles of mastication

Review internal oral structures

Review of the nose, the carburetor of the body it’s anatomy and function
Muscles Of Mastication

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Muscles

* Play a key role in masticatory functions, speaking and swallowing

* May exhibit differential regional action due to complex movements of the TMJs

* "Muscle" really is not just a contracting entity
Actions of Muscles

Functional:
- speaking
- swallowing
- mastication

Parafunctional:
- bruxing
- clenching
Lateral Pterygoid Muscle

Has two origins:

one head originates on the outer surface of the lateral pterygoid plate
an upper or superior head originates on the greater sphenoid wing
Lateral Pterygoid Muscle

Has two insertions:

- The inferior head inserts on the anterior surface of the neck of the condyle.
- The superior head inserts some fibers to the capsule of the joint and to the anterior aspect of the articular disc.
* Superior head active during jaw closing movements. Positions the disc at final closure

Example: chewing, clenching and swallowing
Lateral Pterygoid Muscle

- Inferior head active during jaw opening movements and protrusion
- Retro-orbital pain
- Deviation to contralateral side
Lateral Pterygoid Muscle

Suited for:

1) Protraction
2) Depression
3) Contralateral Abduction
4) May be active during other movements for joint stabilization
Superior head positions or stabilizes the condylar head and disc against the articular eminence during mandibular closing. 80% of the muscle is composed of slow movement fibers, resistant to fatigue.
* Inferior head assists in the translation of the condyle downward, anteriorly, and contralaterally during opening.
Masseter Muscle

* Extends from the zygomatic arch to the ramus of the mandible.
* Insertion of the muscle is broad, extending from the second molar to the posterior lateral surface of the ramus
*Muscle hypertrophy
*Glenoid notch
* The superficial part of the muscle is separated only from the deeper layer at the posterior upper portion

Masseter Muscle

Covered by parotid tissue
Masseter Muscle

- Active during forceful jaw closing and may assist protrusion. 250 lbs/sqin
- Deviation to the affected side

Innervated by V cranial nerve
Medial Pterygoid Muscle

* Arises from the medial surface of the lateral pterygoid plate and from the palatine bone
Medial Pterygoid Muscle

* It functions in elevation and lateral positioning of the mandible

* It is active during protrusion

Innervated by V cranial nerve
Medial Pterygoid Muscle

Injection

Trauma
The temporalis muscle is fan-shaped and originates in the temporal fossa.

Muscle contraction can cause headaches.
On passing to the zygomatic arch it forms a tendon that inserts into the anterior border and the mesial surface of the coronoid process of the mandible and the anterior border of the ramus.
* The muscle appears to have three component parts and appears to behave that way.
Temporalsis Muscle

- The posterior part is active in retruding the mandible - may act as a antagonist to the masseter
- Scalp and hair tenderness
Temporalsis Muscle

- The anterior part is active in clenching - may act as a synergist with the masseter
- Muscle contraction headache
  - Rule out Migraine, Face plant

Innervated by the temporal branch of the fifth cranial nerve
Temporalis Muscle

* The temporalis muscle is the principle positioner of the mandible during elevation

*Muscular seating sequence
Digastric Muscle

* Attachment of the anterior digastric is at or near the lower border of the mandible and near the midline

* There is a tendon between the anterior and posterior portion attached to the hyoid bone by a looplike tendon.
Digastric Muscle

* Anterior part is covered by the platysma muscle, and beneath lie the mylohyoid and geniohyoid muscles - all are active during jaw opening
Mandibular Movements

Relationship of TMJ and Associated Structures
Disc Adaptability
Fixed Axis of Rotation
The Articular Disc

Anteriorly it is fuses with the capsule and with the superior lateral pterygoid muscle.
The Articular Disc

* Consists of dense connective tissue

* It is avascular and devoid of nerves in the area where articulation normally occurs
Arteriovenous Shunt
(vascular knee)

Closed position

Open position
What Is Above And Below The Disc

Superior and inferior to the articular disc are two spaces:

1) superior synovial cavity
2) inferior synovial cavity
Synovial Cavities

Are bordered peripherally by the capsule and the synovial membranes and are filled with synovial fluid which provides metabolic supply to the nonvascular articular surfaces.
The surface of the condylar processes and fossae are covered with avascular fibrous tissue (in contrast to most other joints, which have hyaline cartilage)
Both joints can be described as capable of both a hinging and a gliding articulation.
During the first stage of jaw opening, the condylar process rotates around an imaginary horizontal hinge axis. This movement takes place in the lower joint compartment.
In the second stage of opening, the condyle slides forward along the articular eminence and abuts the articular tubercle, with some additional hinging. This movement takes place in the upper joint compartment.
What Happens During Mandibular Movement?

Because of its firm attachment to the poles of each condylar process, the disc follows condylar movement during both hinging and translation.

CR 15-20 mm
Pure Rotation
Ligaments Of The TMJ

The TMJ is supported by three functional ligaments along with two accessory ligaments that offer passive restraint and limit border movements.

1) collateral
2) capsular
3) temporomandibular
4) sphenomandibular
5) stylomandibular
Eagles Syndrome
Posterior ligament prevents anterior over rotation
Superior elastic stratum

Binds the disc to the temporal bone
Anterior force supplied by the inferior belly of the lateral pterygoid muscle
At the start of opening the condyle is in the most Superior – Anterior position against the disc on the slope of the eminence as far as the PL allows with the muscles in a stabilized position.
At maximum opening
the non elastic PL becomes lax
During closing the disc is pulled forward as the condyle returns to CR
At the closed position CR is regained with the disc in its stabilized position.
Fibers of the superior lateral pterygoid which are attached to the disc and condylar head promotes harmony of movement.
Mechanisms Of The TMJ

It is possible for the condylar process and disc to slide too far forward, beyond the articular tubercle, “locking” the jaw in an open position. SUBLUXATION

Forced Opening
Basic Functional Anatomy of the Gnathostomatic System and it’s Relationship to Dental Sleep Medicine

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Hypoglossal Nerve / Genioglossus muscle / InSpire Implant
Figure 9. Mallampati Scale

Class I: Full visibility of tonsils, uvula, and soft palate

Class II: Visibility of hard and soft palate, upper portion of tonsils and uvula

Class III: Soft and hard palate and base of the uvula are visible

Class IV: Only hard palate visible
Mallampati Score / OSA

One point increase in Malampati score results in 5 additional AHI events per/hr
One point increase adds 2 fold chance for OSA
These findings are irrespective of BMI, airway anatomy or medical history

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FRIDEMANS TONGUE POSITION CLASSIFICATION
Tongue - Clinically

Surface coating
Size in relation to maxillary/mandibular space
Border, smooth or scalloped
Oropharynx, visible or obstructed
Mallampati, Friedman, classification
Tongue Anatomy, Crenation

Presence of scalloping relates to Mallampati score.
Specific for decreased sleep efficiency 71%
Specific for abnormal AHI 70%
Specific for O2 desaturation of >4%, 86%

Hypoglossal / ventral
Oropharyngeal Observations

Tongue position classification/ Freidmans
Soft palate classification, Mallampati
Uvula, elongated, enlarged
Tonsils, classification, 0 – 4+
Tongue posture, upon opening, back/down
- full dentures?
Suprahyoid muscles
Hyoid bone
Infrahyoid muscles
Sternocleidomastoid muscle
Posture

Forward head posture/airway encroachment
Loss of lordic curve, effect on C 1,2,3
Limited neck ROM
Omohyoid /// Infrahyoid
WHY IS IT IMPORTANT TO BE KNOWLEDGEABLE OF AIRWAY ANATOMY
BASIC CONSIDERATIONS OF NOSE BREATHING VERSES MOUTH BREATHING
What’s the Big deal? Nose vs Mouth Breathing

Babies are born obligate nose breathers, which can change to mouth breathers with dire effects:

- Dryness of the oral and pharyngeal tissues leading to inflamed tonsils, tonsil stones, swollen tongue, halitosis, gingivitis, caries.

T. O’Hehir, speareducation.com/spear-review
Respiration Factoids

Normal nasal breathing, 10-12 /minute
Mouth breathing 12-20 / minute
Breathing brings O2 to cell, CO2 released
CO2 needed to release O2 from hemoglobin
Triggers breathing, maintains blood pH
Prevents smooth muscle spasms
All the above reduced in mouth breathers

T O’Hehir, spear education . Com/spear-review
Nasal Airway Functions

Humidifies the air to a 80% level
Warms the air
Filters the air
Sense of smell
Oxygen absorption by the lungs is greatly enhanced by these effects

Nose – Basic Factoids

Humidifies inspired air ~80 %

Warms inspired air to ~90 degrees
Filters the air

Nitric Oxide, as a gas, is released by the paranasal sinuses. Vasodilator which increase uptake of O2 by the blood. (mouth breathers)
Tongue, Palate, Nasal Breathing

Nasal breathing:
- tongue against palate
- passive pressure stimulates stem cells in palatal suture to normal palatal growth
- healthy arch form counters the inward pressure of the buccinators
Tongue, Palate, Mouth Breathers

Mouth breathers:
- tongue is down and forward
- lacks passive pressure to stimulate stem cells for active palatal growth
- buccinators can now push the dentition inward resulting in a narrow palate and Androidial face appearance

T. O’Hehir, speareducation.com/spear-review
Normal Airway Anatomy

Nose is divided into left/right chambers by the septum
Alar rims surround the nasal opening
Columella joins the rims at the center
Turbinates, lateral wall across from the septum
Nasal valve is the opening between the septum and the turbinates
Nasal Valve

Nasal valve is the opening between the septum and the turbinates
Size greatly effects the air flow
NV size is greatly effected by allergies, colds, deviated septum, and pathology (polyps)
Breath Rite Strips
Poiseuille’s Law

The inspiratory pressure required to draw air through the nose is impacted by the fourth power of the radius.

Small changes in the area of the nasal valve have a significant effect on air flow.
Front view of nose and mouth

- Septum
- Turbinate
- Soft palate
- Uvula
- Tonsil
- Tongue

Patent nasal airway
An increase in airway obstruction yields an increase in inspiratory pressure which can collapse the airway and increase the risk of Obstructive Sleep Apnea.
Relationship of the Nose and Sleep Disordered Breathing

SDB can worsen by nasal obstruction
Nasal Occlusion decreases nasal patency and increases intra-thoracic pressure
any cause of nasal congestion predisposes SDB
Oral breathing in children leads to facial structure abnormalities

CHEST 2003
Relationship of Nasal Obstruction and OSA

Nasal Airway Resistance

Increased Respiratory Pressure

Increased Intra-Thoracic Pressure

Airway Collapse (Snoring & Sleep Apnea)
Deviated septum

Swollen turbinate
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