CERVICAL BIOMECHANICS

Cervical Intersegmental Motion Testing
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Disclosures

I have no relevant financial relationships or conflicts of interest to disclose.

Cervical Functional Anatomy

The cervical region can be separated into three (3) distinct biomechanical areas:

1. Occipito-Atlantal (C0-C1)
2. Atlanto-Axial (C1-C2)
3. Typical (Oblique) (C2-C7)
“OMM: Cervical Biomechanics”
Alexander S. Nicholas, DO

Upper Cervical Segments

- **Atypical**
  - Occipito-atlantal
    - C0-C1
  - Atlanto-axial
    - C1-C2
- **Function as an integrated unit!**

Principles of Physiologic Motion

- **Model of Harrison Fryette, D.O.**
  - *Not* included in the cervical region because of:
    1. Atypical facets in the upper segments
    2. Oblique plane of the facets in the lower segments
    3. Shape of the vertebral bodies, ligamentous attachments, and muscular insertions
Occipito-atlantal Articulation
( OA or C0-C1 )

- Two articulations formed by the:
  1. Occipital condyles (are convex)
  2. Superior articular facets of the atlas (are concave)
- Primary motion is forward and backward bending
- Smaller amount of coupled sidebending-rotation

OA Motion

- Loss of symmetrical coupling is **clinically significant!**
  - Sidbending component is ~ 5º
  - Rotation is ~ 5º
- OA Coupling...
  - of rotation and sidebending is to opposite sides!

Coupling at the OA

- Atypical!
  - Exhibits 1st law of physiologic motion coupling (opposite) whether neutral or non-neutral because of:
    1. Lateral atlanto-occipital ligament (membrane)
    2. Relationship of the slope of the side of the superior facets of the atlas, and the divergence posteriorly
Atlanto-Axial Articulation (AA or C1-2)

- Has **four** articulations
  - Right and left zygapophysial joints
  - **Anterior odontoid** articulates with a small facet on the posterior aspect of the anterior arch of the atlas
  - **Posterior aspect of the odontoid** is an articulation with the transaxial ligament

AA Motion

- **Primary motion is rotation!**
  - Cephalad to caudad translatory movement accompanies rotation!
  - Smaller amounts of
    - Forward and backward bending
    - Sidebending
  - **Dysfunctions are interpreted as rotational!**

C2

- Functions as a transitional segment
  - **Atypical** superior surface articulates with the atlas
    - And to occiput through ligamentous and muscular attachments
  - Inferior surface is similar to the typical segments below (oblique)
Typical Cervical Segments

C3-7
- Articulate at the vertebral bodies with disc
- Vertebral bodies

Joints of Luschka
- Found at posterolateral corners of disc
  - Helps in gliding movements during forward and backward bending
  - Protects from posterolateral disc herniation
  - Prone to degenerative changes (lipping)
    - Occasionally causes encroachment at anterior aspect of the lateral intervertebral canal

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C3-7 Facets
(Inferior facet C2 to Superior Facet C7)

- Superior facets
  - Face Backward, Upward, and Medial (BUM)
    - At angle approximating 45º
    - OBLIQUE IN PLANE

C3-7 Motion

- Because of the above oblique facets, shape of vertebral bodies, and disc, motions are:
  - Flexion-Extension
    - (Forward-backward bending)
  - Coupled sidebending-rotation to the
    - SAME SIDE
      - Follows 2nd law of physiologic motion

C2-7 Somatic Dysfunction

- Tends to be Type II
- Single segment, non-neutral
  - Several segments may be dysfunctional!
    - But not as true group like Type 1
Vertebral Artery

- **Major significance in manipulation of the cervical spine!**

- Begins its relationship at C6-7

Vertebral Artery

- Runs through transverse foramen and exits at superior C1
- Turns posteriorly over posterior arch of atlas
  - Penetrating posterior occipitoatlantal membrane
  - Then enters foramen magnum

Vertebral Artery

- Normal vertebral arteries can narrow as much as 90% of their luminal size on the contralateral side to cervical rotation
  - This is exacerbated in extension (backward-bending)!
Regional Testing
(Clinical Pearls)

- If flexion-extension limitation with less sidebending/rotation loss, think OA
- If a patient presents with neck pain and on physical exam demonstrates only rotational limitation, think A-A dysfunction
- If mostly sidebending limitation with some limitation of rotation, think C2-7

Cervical Motion Conclusion

- The cervical area is made up of three motion centers
- Their movement patterns somewhat atypical as compared to the thoracic and lumbar regions
- The important vascular and neurologic relationships must be kept in mind whenever performing OMT!

Translation Left to Right =>
Left Sidebending
How Can Tenderpoint Location Relate to Motion Dysfunction!
(E.G., Counterstrain Technique)

- Tenderpoint @ posterior, right articular process region of C5
  - If associated with articular dysfunction, C5, SLRL
    - Treatment positioning would include SLRL, which follows mnemonic 'ESARA' as relates to TP.

Facilitated Positional Release ‘FPR’

- Indirect
  - Modification of myofascial release techniques
- Patient Passive
- Treatment of:
  - Abnormal muscle tension
  - Somatic dysfunction
FPR: Intervertebral Motion Restriction Treatment

EX: C3 ESRRR
- Cervical lordosis is flattened to engage C3-C4 articulation
- Extend, sidebend right & rotate right C3 in relation to C4
- Compression or traction to add freeplay (loosen)
- Hold for 3-5 Seconds; Release may be palpable
- Facilitation = addition of a few quick articulatory pulses
- Re-assess

Cervical lordosis is flattened to engage C3-C4 articulation. Extend, sidebend right & rotate right C3 in relation to C4. Compression or traction to add freeplay (loosen). Hold for 3-5 Seconds; Release may be palpable. Facilitation = addition of a few quick articulatory pulses. Re-assess.