Movement and Anatomy of the Neck:

Vertebrae and Suboccipital muscles

Cultural, emotional, and poetic ideas influence how we understand our own and other people's anatomy, including spines and necks.

The neck carries the stories of the spine as a whole: the spine can be understood as an internal snake, as armor that protects the central nervous system, as "home" to the emotional self, as the line of stability from which the limbs move and explore the world, and/or as the central player in body movement with the limbs in the role of accessories.

The neck also carries its own stories and cultural viewpoints:
Pain in the neck

Necking

Neck and neck

Won by a neck

Stick your neck out

Millstone around your neck

Put your neck on the line

"The neck starts to go at 43, and that's that." (Nora Ephron)

Neck breaking speed

Hair stands up on the back of your neck

Risk your neck

Foot on your neck

Saved my neck

Where and what is the neck?

Although many of us move as if there is a "neck joint" dividing or uniting our neck to our torsos, that isn't in the design. A common misperception is that the jaw is part of the skull, which leads one to mistakenly believethat the neck begins at the level of the bottom of the jaw. The neck comprises the 7 cervical vertebrae, and their accompanying muscles and tissues. For purposes of this study, the base of the skull, the occiput, is included.

When we are born, the neck is part of the overall "C" shaped spinal curve, and reverses direction as the infant lifts her/his head after birth. The total angle of the curve of the 7 cervical vertebrae is equal to that of the 12 thoracic vertebrae, and equal to that of the 5 lumbar vertebrae.

Skeletal Anatomy

The cervical vertebrae share the same basic functions as the thoracic and lumbar vertebrae: 1) to encase and protect the spinal cord, 2) to balance the 3 main body weights of head, ribs and pelvis, 3) provide a lever for movements of the body via muscular work, 5) to provide both mobility and stability for the body.

Typical structure of a vertebra includes the body, which is anterior, and the vertebral arch which is posterior. Discs are in between each vertebra, and can move with its neighboring vertebra, or can counter that movement. The discs contribute about 25% of the length of the spine, and function as 1) shock absorbers, 2) increase the spine's range of motion 3) add resiliency 4) add flexibility. The disc offers a convex surface to its partnering vertebrae which meet it with a concave surface. The vertebrae excursion around the discs. Vertebrae can move with or against its neighboring disc, with or against its superior neighboring vertebra via adjoining facets, with or against its inferior vertebra via adjoining facets.

The cervical vertebrae are characterized by small bodies, as having foramina (small holes) in the transverse processes for the passing of vertebral arteries (in the case of C7, the foramina are for vertebral veins). The facets, which articulate with vertebra above or below, are more horizontal than those of the thoracic or lumbar vertebrae. The discs in this region are thicker anteriorly, giving them a wedge shape. The cervical vertebrae allow greater movement than the other sections of the spine, thus helping the head move more quickly and more accurately to collect and respond to information of the special senses.

Occiput – though normally considered as part of the skull, it can be helpful to consider the occiput as the top vertebra.
The shape is somewhat like that of a large, slightly melted cervical vertebrae. Condyles (convex bumps) on inferior surface articulate with C1 Atlas.

C1, Atlas- on the level of just inferior to the nose , ring shaped, no body, no spinous (posterior) process, large superior facets (concave) that articulate with the occiput. It has wider transverse processes than the other cervicals, which provide a platform for the skull. Palpation yields an indentation at base of skull, since it has no posterior (spinal) process

C2, Axis – at the level of the mouth. It has a odontoid process, aka dens ("tooth"), around which C1 rotates. It is as if the body of the Atlas left and moved to the Axis. The Axis is the strongest of the cervical vertebrae, and has a long bifid posterior process which can be palpated. Dura mater attaches at this spinal level.

C3-C4-C5-C6 have short bifid posterior (spinal) processes, small bodies. The deepest part of the cervical curve is at C4 and C5. C6 spinous process can commonly be palpated.

C7 has a prominent posterior process which is easily palpated. The first rib articulates with the inferior aspect of C7.

Note: The superior sternum and clavicle are at about the level of the T2.

Suboccipital Muscles (6):

These muscles are deep to semispinalis capitis, and located between the occiput and superior vertebral column. They shift relative position of the head and top of the vertebral column, as well as stabilize posture.
Movements from the suboccipitals include:
Rotation (centered at A/O joint with skull and C1 rotating together as one unit), lateral flexion, flexion, extension, and protraction/retraction of the head on the column.
Notably, this group contains an extremely high density of muscle spindles-up to 36 per gram, compared to 7 per gram for gluteus maximus- which track the work load of the muscles and transmit that information to the central nervous system.

Because of their close proximity to the head and spinal cord, affecting this group of muscles can be seen as a shortcut to affect the central nervous system, and thus to the tone of the entire body.

Rectus Capitis Anterior
Front of C1 to the base of occiput anterior to foramen magnum (view from anterior)
Unilaterally rotates head, bilaterally flexes neck

Rectus Capitis Lateralis
C1 transverse process to inferior lateral occiput (view from anterior)
Lateral flexion

Rectus Capitis Posterior Minor
C1 posterior tubercle to occiput inferior to nuchal line
Mostly postural, but also rotates if unilateral, if bilateral help extend head at A/O, also occipital protraction
Most medial of the 3 suboccipitals that go from occipital ridge
Crosses only the A/O joint
Runs anteriorly, side by side with Rectus Capitis Posterior Major
Is in relationship with posterior a/o membrane and dura mater, tone change of rectus capitis posterior minor appears to change position and tone of dura mater, and fluid changes in pons and cerebellum (likely prevents dura mater from folding when neck extended)

Rectus Capitis Posterior Major
Small triangular, runs mostly vertically and also obliquely
Posterior process of C2 (axis) to lateral inferior nuchal line of occiput
Mostly postural, but also rotates if unilateral, if bilateral help extend head at A/O
Lateral to Rectus Capitis Posterior Minor
Action: bilateral extends head on spine, unilateral rotate head
This is a 2 joint muscle as it covers both A/O joint and Atlanto-Axial joint
Does not have protraction action that Rectus Capitis Posterior Minor has.
Slips of this muscle connect directly to dura mater

Obliquus Capitis Inferior (doesn't attach to capitis)
Small rectangular, is like "reins," is parallel to splenius capitis
From lateral surface of posterior process of C2, runs obliquely and anteriorly to inferior transverse process of C1
Rotates head by pulling on C1 (C1 and skull rotate together as a unit)

Obliquus Capitis Superior
Small triangular, runs horizontal-ish, parallel to rectus capitis posterior minor
From superior surface of transverse process of C1 to smaller lateral impression between superior and inferior nuchal lines of occiput
Most lateral of suboccipital muscles that connect to occiput
Mainly postural, unilaterally helps extend and protract head, bilaterally laterally flex

Note: Medial is rectus capitis posterior minor
Middle is rectus capitis posterior major
Lateral is obliquus capitis superior

Myodural Bridges

Beginning around 1995, there have been articles describing fibers of the suboccipital muscles bridging to the dura mater of the spinal cord. One function of these bridges may be prevention of folding of the dura mater with the various possible consequences of such folding: preventing possible damage to the dura mater itself, keeping the cerebrospinal fluid circulating correctly, and reducing the likelihood of painful headches caused by an irritated (and pain producing) dura mater. Another suggestion is that it stabilizes the spinal cord as the body moves. Myodural bridges may play a role in maintaining subarachnoid space.

In more global sense, these bridges give almost instantaneous information of the angle of the neck to the central nervous system, with specific information as to the changes of tensile forces and muscular contractions. Such information could initiate a cascade of changes downstream, such as shifting the balance of the body's flexor/extensor tone, with the concomitant shifts of attention, emotions and perceptions. Neuronal fibers have been found in these bridges, though their function is unclear.

Alert for working with those with Down's Sydrome:
People with down syndrome sometimes [about 15%] have a more vulnerable neck: "AAI [Atlantoaxial Instability] denotes increased mobility at the articulation of the first and second cervical vertebrae (atlantoaxial joint). The causes of AAI are not well understood but may include abnormalities of the ligaments that maintain the integrity of the articulation, bony abnormalities of the cervical vertebrae, or both."[American Academy of Pediatrics]