Determining the location of the cervicomedullary junction (pyramidal decussation) in relation to the eces using DTI

Background
- Crossing of nerve tracts is a common pattern in the CNS through decussations or commissures.
- Many genetic and developmental disorders involve crossing defects or mirror movements.
- These pathways are also involved in recovery after CNS lesions, compensatory.

History
- Hippocrates (460 BC – 380 BC) is often considered.
  - First to deduce to the crossed function of motor pathways
  - If the wound be situated on the left side of the body, the contralateral attacks the right side of the body.
  - Encouraging primitive practices, reminds me of how we sometimes feel about surgeons.

History
- In 1710, Gall and Spurzheim did upward dissection of the fibers from the pyramidal decussation to the cerebral cortex.
- This is despite the two being best known as the founders of phrenology.

History
- Aristaeus the Cappadocian
  - First detailed description of the pyramidal tract

Background
- Our specific focus is the pyramidal decussation, marking the cervicomedullary junction.
- But before proceeding to the mumb junction, a poor attempt at Wymeresque history lesson...mine is at least related (...or at least more directly) to what I am talking about...and less theatrical.
Ronald Quisling, MD, aka “Q”, aka “the man, the myth, the legend”

Department of Radiology

• Obex/nucleus gracilis position: its role as a marker for the cervicomedullary junction. Published in Pediatric Neurosurgery, 1993.
  • Utilized anatomic specimens to establish the normal morphologic relationship between the position of the obex and the pyramidal decussations.
  • Purpose was in the setting of cerebellar tonsils and cervicomedullary junction in those being considered to be diagnosed with a Chiari malformation.
  • The obex/nucleus gracilis (O/NG) was found to be 5-6 mm rostral to the pyramidal decussation.
  • The O/NG was 10-12 mm above the foramen magnum.

Patient’s with Chiari malformations, specifically Chiari II, tonsillar and O/NG positions were well below the plane of the foramen magnum.

• More useful: patients who exhibit minimally low cerebellar tonsils but essentially normal O/NG position; should be considered normal (cerebellar tonsil heterotopia)
• Remaining patients exhibit evidence of both intermediately low tonsillar and low O/NG positions, suggesting an underlying anomaly of brainstem development.

Our Research

• Will begin by duplicating Q’s research using only MRI, basically normative MRI data.
  • This will be done by using a technique developed in the 1990’s called DTI, diffusion tensor imaging. This will allow us to see the axonal tracts and where they cross at the pyramidal decussation.
  • We will use MP RAGE with DTI for anatomic localization

DTI

• Isotropy versus anisotropy

A VERY brief word on DTI

Okay, how the heck can that tell me direction

• Well, put simply, it cannot…..yet
• If we performed diffusion in thousands of different of planes, this could give us directional information.
• This would tell us that water is moving in one plane, and another plane, but not a third and not a forth, and perhaps it will in the fifth...
• This is very impractical, this would take forever, including quite the computing power to put it all together.

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So we link the two and everyone is happy?
Well, we could, but that is not as fun as....
Extension of Preliminary Research