

Quantification of Cerebellar tonsils in Three-Dimensions

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Purpose

This study was focused on developing a semi-automated technique to quantify the cerebellar tonsils in three-dimensions (3D). This morphometric analysis may act as an alternative to mid-sagittal tonsillar descent alone for the evaluation of Chiari malformation type 1 (CMI).

Methods

The 3D segmentation of the cerebellum was performed in ITK-snap and the segmented geometry was then exported to MATLAB for further analysis. An in-house code calculated the tonsillar position (TP), tonsillar volume and percent tonsillar volume. Left and right tonsils were compared in terms of volumes and lengths. One CMI patient and one control cerebellum was segmented as proof of concept.

Results

Six parameters were evaluated from the segmented 3D cerebellum geometry:

- Left tonsillar position was **13.3 mm**
- Right tonsillar position was **15.5 mm**
- Total tonsil volume was **2942.9 mm³**
- Left tonsil volume was **1361.4 mm³**
- Right tonsil volume was **1581.5 mm³**
- Percent volume of the tonsils compared to the cerebellum was **2.18%**

Conclusions

For the first time, this study quantified morphometric measures of 3D tonsillar position. From segmenting one Chiari and one control cerebellum, the presence and absence of tonsillar descent is clearly visible. The right tonsillar position was found to be larger in the Chiari subject, both in length and volume as compared to the left tonsil. Neurosurgeons have, over the years, made surgical decisions based on a qualitative assessment of the crowding in the CMI brain. These results provide a quantitative understanding of the nature of tonsillar descent in CMI. Future research will be focused analyzing the shape of the tonsils.

