

Adult Age Differences in Self-Reported Pain and Anterior CSF Space in Chiari Malformation

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Purpose

This study examined how morphometric (structural MRI-based) measures were related to adult age differences in self-reported pain in Chiari malformation Type I (CM). We were particularly interested in the anterior cerebrospinal fluid (CSF) space (see area #7 on Figure 1) and the posterior CSF space (see area #8 on Figure 1) because these CSF passages are the ones most likely to be blocked by the cerebellar tonsils compressing the brainstem and cervical spine areas.

Methods A total of 301 adult CM patients (80% female) who either had ($n = 150$) or had not ($n = 151$) undergone posterior fossa decompression surgery were assessed using morphometric measures derived from magnetic resonance images (MRI). We then correlated these morphometric measures with age and pain (SF-MPQ-2). Anterior CSF space was the only significant morphometric measure that corrected with age and pain. We then used causal modeling (Hayes' process model) to assess mediation and moderated mediation

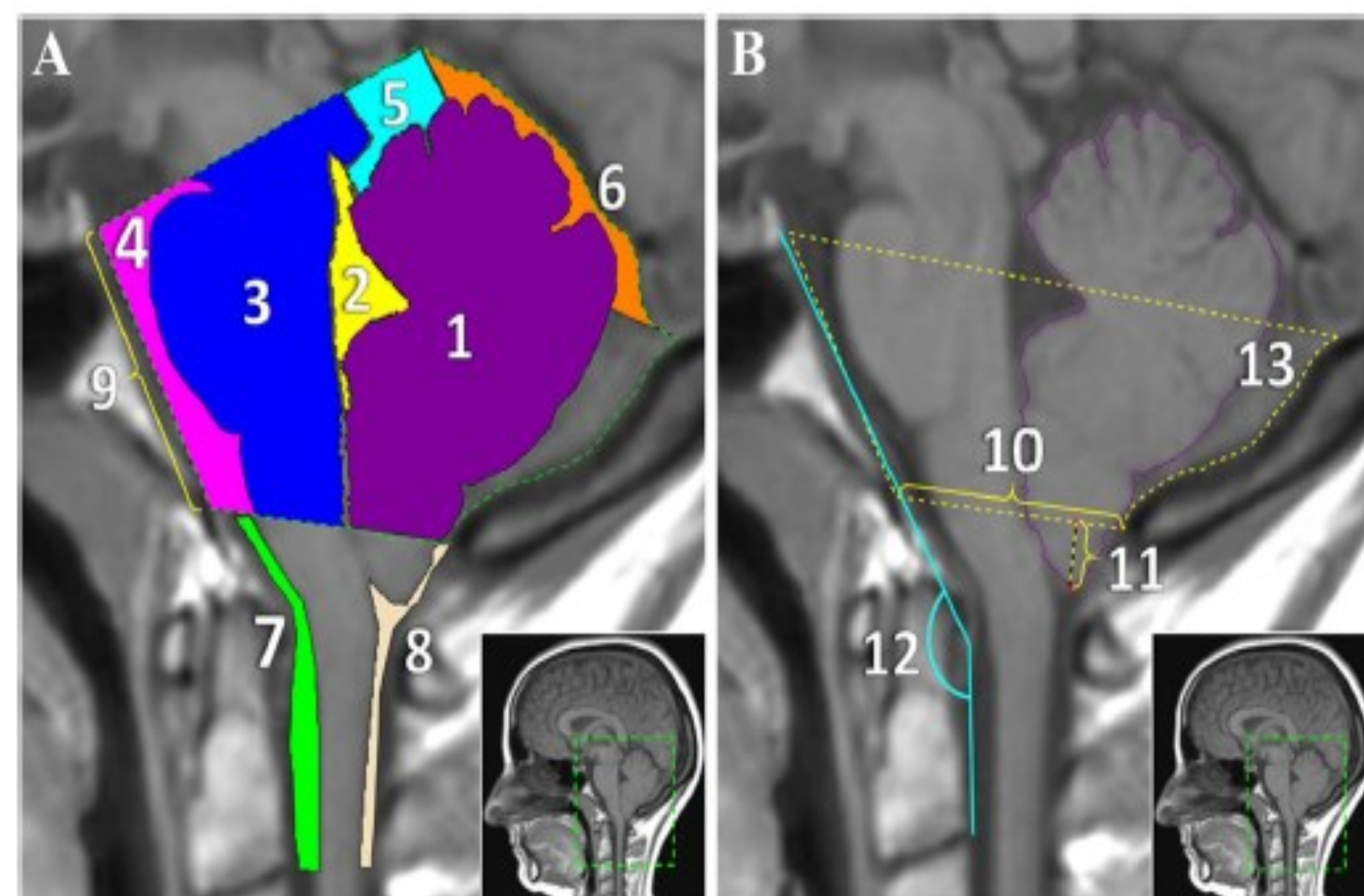
Results

The key results were that anterior CSF space correlated with age at the time of MRI ($r = -.21$). Also, self-reported pain increased with age ($r = .11$) and decreased with anterior CSF space ($r = -.18$). Critically, age differences in self-reported pain were mediated by anterior CSF space in the cervical spine area—and this effect was particularly salient for non-decompressed CM patients (relative to non-decompressed CM patients).

Conclusions

We observed that pain in CM patients increased with increasing adult age—but pain decreased with increased anterior CSF space (see area #7 on Figure 1). Also, anterior CSF space tended to decrease with increasing age. The finding that anterior CSF space mediated age differences in pain means that the direct relationship between age and pain was accounted for by the indirect effect of anterior CSF space. This mediation was significant for three types of pain: total pain, continuous pain, and neuropathic pain (all derived from the SF-MPQ-2). Furthermore, we observed moderated mediation—and this means that the mediating effect of anterior CSF space on the relationship between age and pain was more extreme for non-decompressed than for decompressed CM patients. These results suggests that we need to obtain a better understanding of how anterior CSF space is related to pain in CM.

Figure 1: Morphometric parameters measured on a T1-weighted MR image: (1) cerebellar area within the PCF, (2) CSF area anterior to the fastigium, (3) area of the brain stem, (4) PCF area anterior to brain stem, (5) anterior superior cerebellar cistern area, (6) posterior superior cerebellar cistern area, (7) anterior CSF space caudal to McRae line, (8) posterior CSF space caudal to McRae line, (9) clivus length, (10) McRae line length, (11) cerebellar tonsillar position, (12) Wackenheim angle, and (13) PCF osseous area.



Reference:

Garcia, M., Eppelheimer, M.S., Houston, J.R., Hughes, M.L., Nwotchouang, B.S.T., Kaut, K.P., Labuda, R., Bapuraj, J.R., Maleki, J., Klinge, P.M., Vorster, S., Luciano, M.G., Loth, F., & Allen, P.A. (2022). Adult age differences in self-reported pain and anterior CSF space in Chiari malformation. *The Cerebellum*, 21:194–207, <https://doi.org/10.1007/s12311-021-01289-w>