Styloid Process Length May Be Related to Craniovertebral Alignment in Chiari

Researchers in Japan identified a possible relationship between the length of the styloid process, age, and craniovertebral alignment in patients with Chiari I malformation.

The styloid processes are thin projections of bone extending downward from the skull near the ears. They serve as attachment points for several muscles and ligaments involved in swallowing and movement of the tongue and jaw.

The researchers used CT scans to measure styloid process length in 18 Chiari patients and 65 controls, all younger than 50. They also measured the clivo-axial angle (CXA), which describes the alignment between the skull base and the upper cervical spine. A smaller CXA can indicate abnormal craniovertebral alignment, although it does not necessarily indicate instability.

Overall, there was no statistically significant difference in styloid process length between the Chiari and control groups. However, the researchers identified an interesting age-related pattern.

Among participants younger than 30, styloid length did not differ significantly between groups. Among those aged 30 or older, the median styloid length was 30 mm in Chiari patients compared with 24.5 mm in controls, a statistically significant difference.

Styloid length was also positively associated with age, and this relationship was stronger in Chiari patients. In addition, the relationship between age and styloid length was strongest among participants with a CXA below 140 degrees. The median CXA was 138 degrees in Chiari patients compared with 150 degrees in controls.

The researchers suggested that differences in craniovertebral alignment might alter mechanical forces on the muscles and ligaments attached to the styloid process, potentially contributing to bone remodeling and elongation over time.

What Might This Mean for Chiari?

One interesting aspect of these findings is that the difference in styloid length appeared only among participants aged 30 or older. This overlaps with the period of adulthood when many Chiari patients develop symptoms or are diagnosed.

Although this may be coincidental, it raises a question about whether changes in craniovertebral anatomy over time could contribute to the development of symptoms in some patients.

One possibility is that altered craniovertebral mechanics lead to gradual elongation of the styloid process. The styloid lies close to the first cervical vertebra (C1), with the internal jugular vein passing between them. In certain anatomical configurations, these structures can compress the vein and restrict drainage of blood from the brain.

If progressive styloid elongation contributed to venous compression, it could potentially alter intracranial pressure regulation and cerebrospinal fluid dynamics. This might help explain why some individuals with Chiari become symptomatic during adulthood despite having anatomical abnormalities that presumably existed for many years.

However, this explanation remains speculative. The study did not evaluate craniovertebral instability, jugular venous compression, blood flow, or CSF dynamics. It also did not establish that styloid length increases over time in individual patients.

The small number of Chiari patients (18), differences between the study groups, and retrospective design further limit the conclusions.

Nevertheless, the findings suggest an additional avenue for investigating the relationship between craniovertebral anatomy and Chiari symptoms. Future studies could examine styloid length and orientation, the distance between the styloid and C1, venous drainage, and changes in these measurements over time.

Source: Sano N, Mineharu Y, Yamamoto-Hattori E, et al. Craniocervical alignment and age-related elongation of the styloid process: A computed tomography study of the clivo-axial angle in Chiari malformation type I. World Neurosurgery. 2026. https://doi.org/10.1016/j.wneu.2026.125523

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