Posterior Atlanto-Occipital Membrane Altered In Pediatric Chiari

The posterior atlanto-occipital membrane (PAOM) is a wide, fibrous structure that connects the bottom of the occipital bone (back of the skull) to the back arch of the top vertebra (aka the atlas). Its function is not entirely clear but some have speculated that it works to stabilize the atlanto-occipital joint along with other ligaments and the suboccipital muscles. With Chiari decompression surgery the PAOM is commonly removed to gain access to the dura underneath.

In an interesting study out of Utah, researchers preserved PAOM specimens removed during pediatric Chiari surgery and compared their composition and structure to specimens removed from children undergoing surgery for a posterior fossa tumor. Twenty-four Chiari children and eleven control (tumor surgery) children were included in the study.

The researchers used a number of techniques to examine the specimens, including creating a novel score from 0-3 to rank the level of 'disorganization'. Normally, tissue such as this is composed of collagen fibers that run parallel to each other and that is what a score of 0 (none) represented. A score of 1 (mild) indicated some local areas of collagen fibers going in different directions. A score 2 (moderate) meant more widespread variations in fiber orientation, but only minimal levels of fat tissue interspersed with collagen. Finally, a 3 (severe) indicated high levels of variation in the collagen orientation plus a significant amount of fatty tissue mixed in with the collagen.

The group found that the samples from both groups on average contained about the same percent of collagen fibers, but there was a significant difference in the disorganization score (Table 1). Specifically, in the Chiari group, 75% scored at the moderate or severe level (2 or 3) compared to only 36% in the control group. Also, none of the samples from the control group were in the severe category.

Table 1: PAOM Disorganization Score

	CM (24 Total)		Controls (11 Total)	
	#	%	#	%
None	1	4%	0	0%
Mild	5	21%	7	64%
Moderate	7	29%	4	36%
Severe	11	46%	0	0%

Although there weren't many subjects in this study, the findings are similar to other studies on adults which have found alterations in the PAOM, and other stabilizing ligaments and connective structures in the cervical area. The researchers raise the question of whether the abnormal PAOM contributes to symptomatic Chiari or is in response to it. Although they lean towards the PAOM altering in response to it, their reasoning is not entirely clear and at the moment it seems more like trying to answer the age old question of which came first, the chicken or the egg.

Source: Morphological and ultrastructural investigation of the posterior atlanto-occipital membrane: Comparing children with Chiari malformation type I and controls. Ravindra VM, Robinson L, Jensen H, Kurudza E, Joyce E, Ludwick A, Telford R, Youssef O, Ryan J, Bollo RJ, Iyer RR, Kestle JRW, Cheshier SH, Ikeda DS, Mao Q, Brockmeyer DL. PLoS One. 2024 Jan 16;19(1):e0296260. doi: 10.1371/journal.pone.0296260. eCollection 2024. PMID: 38227601

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