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Journal of Neurological Surgery Part B: Skull Base

2026

10.1055/a-2949-3959

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Georg Thieme Verlag KG,
Oswald-Hesse-Straße 50,
70469 Stuttgart, Germany
ISSN 2193-6331

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Letter to the Editor

Osseous Grooves Are Not Venous Sinuses: Terminology and Denominators in a Dry-Skull Study of the Posterior Cranial Fossa

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Keywords transverse sinus groove, sigmoid sinus groove, dural venous sinuses, posterior cranial fossa, dry skull, anatomical terminology

received July 29, 2026 | **accepted** August 31, 2026 | **article published online** 2026

Bibliography J Neurol Surg B Skull Base **DOI** 10.1055/a-2949-3959 **Art ID** JNLS-B-26-Jul-0156
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The recent article of Triantafyllou et al on the transverse and sigmoid sinus grooves,[1] the letter of Cardona et al, and the authors' reply concern a region of the posterior cranial fossa that has indeed been little studied.[2,3] I write because all three texts share a difficulty that is easy to overlook: what was observed in dried skulls are osseous impressions, yet they are discussed as though they were the dural venous sinuses themselves, with consequences drawn for hemodynamics and for disease risk.

Terminology is where this starts. In their reply, Triantafyllou et al described "specific bony landmarks—such as the torcular Herophili, transverse–sigmoid junction, and jugular foramen."[3] Of these, only the jugular foramen is an osseous landmark. A dried skull shows the internal occipital protuberance, the groove related to the confluence of sinuses, and the point at which the transverse groove becomes the sigmoid groove. It does not show the confluence or the junction. Their positions can be inferred from the bone, but neither can be observed or measured in the absence of dura and venous channels. The same applies to the caption of the original article describing a bony prominence "on the sigmoid sinus"[1]: the image shows an osseous feature of the sigmoid sinus groove, or overlying it, and not a feature of the sinus.

The distinction is not merely terminological. It fixes what was measured and what another observer could reproduce. Groove presence, width, bony projections, and emissary foramina are osteological variables that a dry skull can yield. Sinus caliber, patency, dominance, stenosis, thrombosis, collateral drainage, and flow are not. An osseous correlate may support a cautiously stated anatomical inference, but it cannot by itself establish a functional venous condition.

The unit of analysis raises a second question. Ninety skulls yielded 180 sides. The transverse sinus groove confluence categories are reported as symmetrical (68), right-dominant (46), bifurcated (28), left-dominant (22), and absent (16), summing to 180, and Table 1 states that the percentages were calculated from 180 sides.[1] Yet symmetry, right or left dominance, and bifurcation at the confluence are properties of a whole skull, or of a pair of sides, rather than of one side taken alone. If each hemiconfluence was classified separately, the method used and the way bilateral configurations were reconstructed need to be explained. If it was not, the denominator for confluence patterns should be 90 skulls.

The absence category does not reconcile with itself. The Results describe 16 cases as "bilaterally absent"; Table 1 labels the same category "unilateral absent" and gives 16/180 (8.9%).[1] Sixteen skulls with bilateral absence would account for 32 absent sides, whereas transverse sinus groove absence is reported separately on 35 of 180 sides. No reading of these figures makes them agree without a cross-tabulation at both skull and side level. Reporting bilateral presence, unilateral absence, and bilateral absence per skull, with the side counts that follow from them, would settle the matter.

The analytic sample needs the same treatment. Sex is given in the Methods for all 120 screened skulls, as 28 male, 25 female, and 67 undetermined, although only 90 skulls entered the study.[1] The sex distribution of those 90 is never stated directly, even though sex comparisons are made and it is said later that sex was known in 53 of 90 specimens. It would help to state the numbers entering each analysis, and what became of the 30 excluded specimens.

Cardona et al were right to point out that the segmental locations of the groove-width measurements were not reported.[2] The reply acknowledges the limitation, but an appeal to landmarks said to be stable is not a measurement protocol.[3] What is needed is the measurement level, the orientation of the caliper, whether the maximum or a standardized width was recorded, how irregular or incomplete grooves were treated, and whether intra- or interobserver reliability was assessed. Since the two sides belong to one skull, the analysis should also account for within-skull dependence. For the reported correlation between transverse and sigmoid groove widths, the coefficient type, the sample actually analyzed, the treatment of absent transverse grooves, and the handling of clustering should all be given.

The clinical interpretation is where the study travels furthest from its material. Triantafyllou et al state plainly that their specimens allowed no soft tissue analysis, no venous flow data, no systematic radiological correlation, and no direct vascular

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confirmation.[1] The observations are nonetheless carried through to venous outflow impairment, thrombosis, stenosis, idiopathic intracranial hypertension, pulsatile tinnitus, turbulent flow, and population-tailored risk assessment.[1–3] These are reasonable hypotheses. They were not tested, and testing them would require matched osseous and venous data from contrast-enhanced computed tomography or magnetic resonance venography, from injected cadaveric specimens, or from some other validated multimodal design.

It would be safer to keep the levels apart. What was measured is osseous morphology, and the study supports it. The topography of the corresponding venous structures is inferred from that morphology and needs to be stated as an inference. Any hemodynamic or clinical consequence is a hypothesis, and it will remain one until vascular data are brought to bear.

The morphology of these grooves has been neglected and is worth documenting. Precise terminology and transparent denominators are what will allow the observations to be used clinically. I would ask the authors to state the observational unit, resolve the unilateral-versus-bilateral discrepancy in the absence category, report the composition of the final sample and the measurement protocol, and refer to osseous grooves or impressions rather than to the torcular Herophili and the transverse–sigmoid junction as "bony landmarks". Until then, the functional and risk-stratification claims are best presented as hypotheses.

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Statements and Additional Information

Conflict of Interest The author has previously coauthored publications with George Triantafyllou, an author of the article discussed in this correspondence. The author declares no financial conflict of interest or other competing interests relevant to this Letter.

Contributors' Statement M.C.R.: conceptualization, data curation, formal analysis, investigation, methodology, project administration, software, supervision, validation, writing—original draft, writing—review and editing.

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