V3 Vertebral artery segment

(atlantic or extradural): from C2 to the dura

V3 Vertebral artery segment, found in the suboccipital triangle, courses posteromedially around the lateral mass to lie in a groove on the posterior arch of the atlas, ultimately coursing beneath the posterior atlantooccipital membrane to enter the skull. Although not always present, any muscular branch that emanates from this segment to supply the suboccipital muscles is called the suboccipital artery of Salmon.

There is a paucity of literature on this artery despite its clinical relevancy. D'Antoni et al. found the suboccipital artery of Salmon in 10 (67%) of 15 embalmed adult cadavers. This frequency is considerably higher than that in previous reports. Two (20%) of the 10 cadavers demonstrated bilateral and symmetrical suboccipital arteries of Salmon (one artery on each side). Four (40%) of the 10 cadavers had an arrangement of two parallel suboccipital arteries of Salmon on one side, and one on the contralateral side. Three (30%) of the 10 cadavers displayed an asymmetrical unilateral arrangement (only one artery). One (10%) of the 10 cadavers displayed the unique arrangement of three arteries of Salmon on one side and one artery on the contralateral side. This study adds to a limited, but growing, body of knowledge by providing photographic evidence of the course and arrangement of these arteries and, therefore, can be of value to surgeons and other clinicians whose procedures focus on the suboccipital region [1)]

The frequency of suboccipital injections to treat headaches has increased. The third segment of the vertebral artery is located in the suboccipital triangle and its main muscular branch, the suboccipital artery of Salmon (SAS), supplies blood to the suboccipital muscles. The purpose of this study was to radiographically investigate the morphology and territory of distribution of SAS.

Computed tomography angiographs of brains of 50 subjects (25 female, 25 men, mean age 70.2 years) were analyzed.

SAS was present in 48% of subjects. The vessel was present bilaterally in 37.1%, and had a mean (SD) luminal diameter of 1.71 (0.34)mm and mean (SD) length of 36.42 (17.1)mm. SAS was found to have two morphologic patterns: (1) a single main trunk with collateral branches (52.6%) and (2) a short common trunk that divided into two branches (48.4%). The SAS supplied the obliquus capitis inferior, semispinalis capitis, and splenius capitis muscles. When the SAS was absent, the suboccipital muscles were supplied by a branch of the occipital artery. No anastomoses were found between the SAS and occipital artery.

The suboccipital muscles are vascularized by the SAS and occipital artery. The detailed course of the SAS is important for clinicians and surgeons who perform procedures in the suboccipital region [2)]

Variants

see Triantafyllou G, Papadopoulos-Manoralarakis P, Tudose RC, Rusu MC, Tsakotos G, Piagkou M. Prevalence of suboccipital and intradural vertebral artery variants: a systematic review with meta-analysis. Neuroradiology. 2025 Jun 16. doi: 10.1007/s00234-025-03674-2. Epub ahead of print. PMID: 40522487 [3)]

 Common Variants of the V3 Segment Persistent First Intersegmental Artery (FIA):

The vertebral artery ascends medial to C1, rather than passing over the posterior arch.

Surgical risk: unexpected medial trajectory → risk during posterior C1-C2 fusion.

Extradural Origin of the Posterior Inferior Cerebellar Artery (PICA):

PICA originates before the artery enters the dura (i.e., in V3 segment).

Clinical relevance: risk of ischemia if mistaken for a small muscular branch during surgery.

Fenestration of the Vertebral Artery:

A single artery splits into two lumens over a short distance and rejoins.

Most commonly in the V3 segment.

Embryological origin: incomplete fusion of the longitudinal neural arteries.

Risk: association with aneurysms or dissections.

Medial Looping or Kinking:

Aberrant course across the midline or excessive redundancy.

May mimic or contribute to compressive pathologies (e.g., cervicomedullary compression).

High Entry into the Foramen Magnum:

The vertebral artery enters the skull at a more superior point.

Implication: potential confusion during exposure of the posterior fossa or foramen magnum.

C1-C2 Anomalous Course:

Variants in the relationship with C1 posterior arch (e.g., beneath the arch instead of over it).

May complicate screw placement (C1 lateral mass or transarticular).

 Prevalence (from recent meta-analysis): FIA: ~1.8%

Extradural PICA: ~1.6%

Fenestration: ~0.7%

(source: Huang et al., 2024 – systematic review)

1)
D'Antoni AV, Battaglia F, Dilandro AC, Moore GD. Anatomic study of the suboccipital artery of Salmon with surgical significance. Clin Anat. 2010 Oct;23(7):798-802. doi: 10.1002/ca.21037. Epub 2010 Aug 27. PMID: 20803571.
2)
Macchi V, Porzionato A, Morra A, D'Antoni AV, Tubbs RS, De Caro R. Anatomico-radiologic study of the distribution of the suboccipital artery of Salmon. Clin Neurol Neurosurg. 2014 Feb;117:80-85. doi: 10.1016/j.clineuro.2013.11.020. Epub 2013 Dec 7. PMID: 24438810.
3)
Triantafyllou G, Papadopoulos-Manoralarakis P, Tudose RC, Rusu MC, Tsakotos G, Piagkou M. Prevalence of suboccipital and intradural vertebral artery variants: a systematic review with meta-analysis. Neuroradiology. 2025 Jun 16. doi: 10.1007/s00234-025-03674-2. Epub ahead of print. PMID: 40522487.