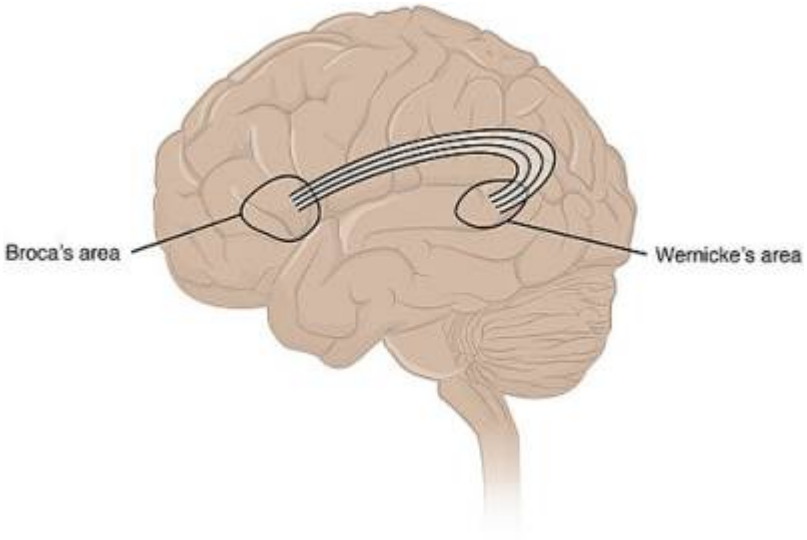
Arcuate fasciculus



The arcuate fasciculus (Latin, curved bundle) is a bundle of axons that forms part of the superior longitudinal fasciculus. The arcuate bidirectionally connects the caudal temporal cortex and inferior parietal cortex to locations in the frontal lobe.

The arcuate fasciculus has been considered a major dorsal frontotemporal white matter pathway linking frontal language production regions with auditory perception in the superior temporal gyrus, the so-called Wernicke's area. In line with this tradition, both historical and contemporary models of language function have assigned primacy to superior temporal projections of the arcuate fasciculus. However, classical anatomical descriptions and emerging behavioral data are at odds with this assumption. On one hand, frontotemporal projections to Wernicke's area may not be unique to the arcuate fasciculus. On the other hand, dorsal stream language deficits have been reported also for damage to the middle, inferior, and basal temporal gyri which may be linked to arcuate disconnection. These findings point to a reappraisal of arcuate projections in the temporal lobe. Giampiccolo and Duffau reviewed anatomical and functional evidence regarding the temporal cortical terminations of the left arcuate fasciculus by incorporating dissection and tractography findings with stimulation data using cortico-cortical evoked potentials and direct electrical stimulation mapping in awake patients. Firstly, they discuss the fibers of the arcuate fasciculus projecting to the superior temporal gyrus and the functional rostrocaudal gradient in this region where both phonological encoding and auditory-motor transformation may be performed. Caudal regions within the temporoparietal junction may be involved in articulation and associated with temporoparietal projections of the third branch of the superior longitudinal fasciculus, while more rostral regions may support encoding of acoustic-phonetic features, supported by arcuate fibers. They then moved to examine clinical data showing that multimodal phonological encoding is facilitated by projections of the arcuate fasciculus to superior, but also middle, inferior, and basal temporal regions. Hence, they discuss how projections of the arcuate fasciculus may contribute to acoustic (middle-posterior superior and middle temporal gyri), visual (posterior inferior temporal/fusiform gyri comprising the visual word form area) and lexical (anterior-middle inferior temporal/fusiform gyri in the basal temporal language area) information in the temporal lobe to be processed, encoded and translated into a dorsal phonological route to the frontal lobe. Finally, they point out surgical implications for this model in terms of the prediction and avoidance of neurological deficit [1].

The aim of the study was to examine the arcuate (AF) and superior longitudinal fasciculi (SLF), which together form the dorsal language stream, using fiber dissection and diffusion imaging techniques in the human brain.

Twenty-five formalin-fixed brains (50 hemispheres) and 3 adult cadaveric heads, prepared according to the Klingler method, were examined by the fiber dissection technique. The authors' findings were supported with MR tractography provided by the Human Connectome Project, WU-Minn Consortium. The frequencies of gyral distributions were calculated in segments of the AF and SLF in the cadaveric specimens.

The AF has ventral and dorsal segments, and the SLF has 3 segments: SLF I (dorsal pathway), II (middle pathway), and III (ventral pathway). The AF ventral segment connects the middle (88%; all percentages represent the area of the named structure that is connected to the tract) and posterior (100%) parts of the superior temporal gyri and the middle part (92%) of the middle temporal gyrus to the posterior part of the inferior frontal gyrus (96% in pars opercularis, 40% in pars triangularis) and the ventral premotor cortex (84%) by passing deep to the lower part of the supramarginal gyrus (100%). The AF dorsal segment connects the posterior part of the middle (100%) and inferior temporal gyri (76%) to the posterior part of the inferior frontal gyrus (96% in pars opercularis), ventral premotor cortex (72%), and posterior part of the middle frontal gyrus (56%) by passing deep to the lower part of the angular gyrus (100%).

This study depicts the distinct subdivision of the AF and SLF, based on cadaveric fiber dissection and diffusion imaging techniques, to clarify the complicated language processing pathways [2)].

Arcuate fasciculus resection

see Arcuate fasciculus resection.

1)
Giampiccolo D, Duffau H. Controversy over the temporal cortical terminations of the left arcuate fasciculus: a reappraisal. Brain. 2022 Feb 10:awac057. doi: 10.1093/brain/awac057. Epub ahead of print. PMID: 35142842.
2)
Yagmurlu K, Middlebrooks EH, Tanriover N, Rhoton AL Jr. Fiber tracts of the dorsal language stream in the human brain. J Neurosurg. 2015 Nov 20:1-10. [Epub ahead of print] PubMed PMID: 26587654.