# Applications of Ascending Reticular Activating System Reconstruction with DTI Tractography in Neurosurgery. Case-Based Illustrations

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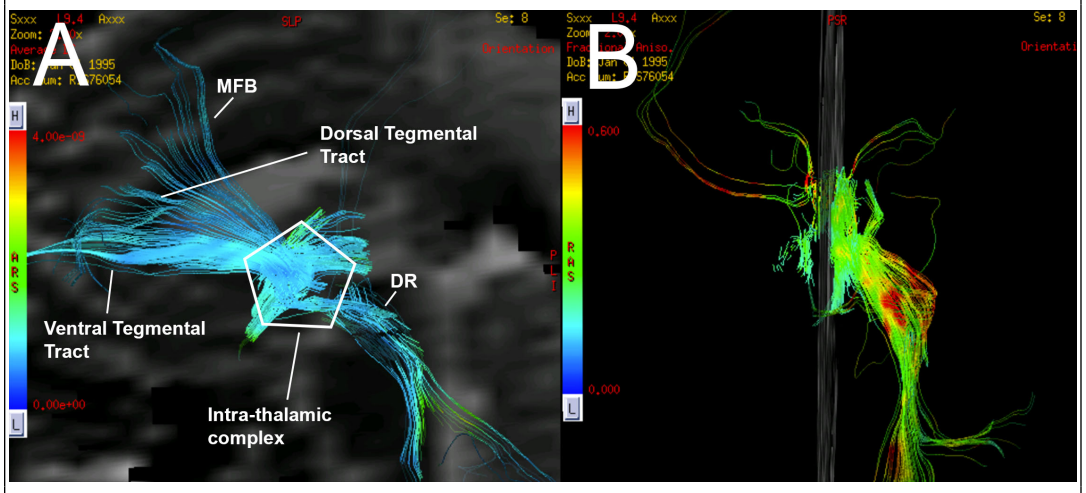
## Introduction

Different applications of white matter tracts with DTI tractography have been demonstrated in the past 2 decades. Depuration of withe matter tracts anatomy has made a more precise approach to different pathways in the brainstem. The beautiful depiction of the Ascending Reticular Activating System (ARAS) with DTI tractography has allowed us to define different aspects of consciousness in neurosurgical pathologies. This work aims to describe different uses of this reconstruction in neurosurgical cases.

## Methods

Different patients with brainstem tumor and trauma lesions with impaired consciousness were selected. Complete reconstruction of the ARAS with 1.5 and 3 tesla were performed. Post-processing of images was performed with GE Functool (General Electric).

**Average diffusion coefficient and fractional anisotropy fiber tracking of the ascending reticular activating system (ARAS) in a patient after TBI with impaired consciousness**




Reconstruction of deterministic tractography is observed. (A) A lateral view of the tractography demonstrates the left ARAS fiber tracts. A considerable decrease in the number of the fibers of the DR tract is noted. A partial disconnection between the intra-thalamic complex and the DR tract is also noted. (B) A destruction of the right fibers of the ARAS is observed, including a destruction of the ventral tegmental tract, the dorsal tegmental tract and of the MFB tract. MFB = Middle Forebrain Bundle, DR = Dorsal Raphè, ARAS = ascending reticular activating system.

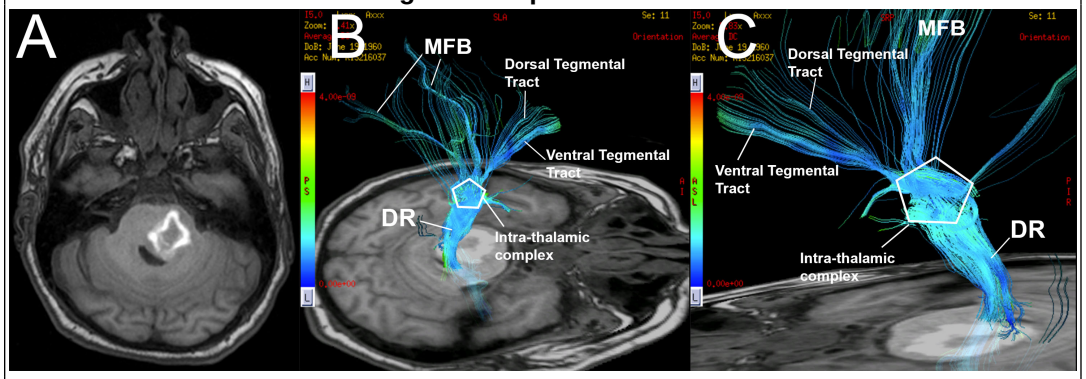
## Learning Objectives

By the conclusión of this session, participants should be able to describe the uses of ARAS fibers reconstruction with tractography in neurosurgery, describe the use for brainstem cavernomas and the use for patients with difusse axonal injury after TBI.

## Results

Surgical and non-surgical cases are shown, demonstrating the use for determining whether to operate or to lead conservative management in patients with impaired consciousness. Trauma patients showed destruction of fibers, leading patients to conservative management. In the other hand, patients with brainstem cavernomas showed patency of the ARAS fibers, and posteriorly showed improvement of the altered consciousness.

**Fusion of an axial T1 non-enhanced MRI with Tractography tracing of the ascending reticular activating system (ARAS) in a patient with a brainstem cavernoma hemorrhage with impaired consciousness**




An axial non-enhance T1WI showing a left pontine cavernous malformation with hemorrhage. Left (B) and right (C) superior-lateral views of the fusion of the tractography and the T1WI demonstrating the hemorrhage displacing posteriorly the dorsal raphè fiber tracts. The ventral and dorsal tegmental tracts remain intact, as well as the middle forebrain bundle tracts bilaterally. DR = dorsal raphè, MFB = middle forebrain bundle.

## Conclusions

The reconstruction of the ARAS with tractography allows neurosurgeons to determine the patency of the fibers, decide which approach would be more safe for brainstem cavernomas resection and verify the patency of ARAS fibers in patients with diffuse axonal injury after TBI.

## References

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