

# Clinically integrated neuroanatomy modules using neurosurgery and intraoperative MRI/DTI tractography: their contribution to long-term retention of neuroanatomical knowledge

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Neuroanatomy is often considered the part of the human anatomy syllabus students find hardest to study. To motivate them and boost their learning, clinical cases and neurosurgical images, mainly DTI tractographies produced using an intraoperative magnetic resonance imaging apparatus (MRI/DTI), were presented and discussed during integrated second-year neuroanatomy, neuroradiology and neurosurgery lectures over the five-year 2007-2012 period. Anonymous questionnaires, rated on the Likert scale, showed that the students appreciated this teaching procedure. The academic performance (exam marks for neuroanatomy) of those who attended all the integrated lectures, was slightly, though significantly higher than for students who attended the lectures only occasionally or not at all ( $p=0.04$ ). Moreover, significantly better results were obtained at the 2012 national progress test (focusing on morphology) by students who attended the MRI/DTI-assisted lectures, compared to those who did so in part or not at all and compared to the national average. These results were obtained by students attending the second, third and, in particular, the fourth, fifth and sixth year ( $p\leq 0.0001$ ) courses during the five above-mentioned academic years.

The early study of real medical cases, including the relative surgical and post-operative phases, if illustrated by a good collaborative interdisciplinary team, can help direct the students positively towards their future professional reality, without any extra expense to the university. In conclusion, interactive learning tools, like our intraoperative MRI/DTI, motivate students and enhance their learning of neuroanatomy. Most probably it improves long-term retention, which appears to prove helpful during the clinical phase of their undergraduate careers.

## Key words

Anatomical sciences, anatomy teaching, neuroanatomy teaching, DTI tractography, neurosurgery, neuroradiology.