White Matter Dissection: Lessons from the United Kingdom National Neuroanatomy Undergraduate Competition 2023

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Abstract

Objective This narrative highlights a student-led initiative that explored white matter dissection techniques within the framework of the National Undergraduate Neuroanatomy Competition 2023.

Materials and Methods The project aimed to enhance neuroanatomical education by developing a novel approach to dissection that deviates from the traditional Klingler's method. Instead, it incorporated contemporary techniques, including diffusion tensor imaging and other radiological tools, to ensure greater anatomical precision and enrich the learning experience.

Results The dissections focused on key white matter structures, such as the uncinate fasciculus and the inferior longitudinal fasciculus, and outlined a step-by-step methodology for creating high-quality specimens. These specimens are designed to serve as educational resources, particularly for students with limited access to formal neuroanatomy courses.

Conclusion This study emphasizes the critical role of hands-on dissection in neuroanatomy education, showcasing its ability to enhance student engagement, deepen anatomical understanding, and inspire interest in clinical neuroscience careers. By introducing innovative educational tools and methodologies, this initiative makes a meaningful contribution to addressing the issue of "neurophobia" in medical education.

Keywords
► dissection
► medical education
► neuroanatomy
► neuroscience
► neurosurgery

Introduction

The term "neurophobia" was first coined in 1994 in response to a trend among medical students' perceptions around the difficulty of neuroscience topics.[1] It remains a prevalent concern among the medical students of today across multiple year groups and institutions.[1–5] Reasons for this remain variable—neuroscience, neuroanatomy in particular, has always been viewed as one of the more difficult topics covered in traditional medical school curricula.[5] Ineffective teaching strategies, insufficient time to spend on learning,

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and the stereotypes associated with the field are all thought to contribute negatively to students' perceptions of neuroscience and by extension its associated career prospects.[3,5,6]

In light of an aging population and increasing burden of neurological disease on a global scale, there is growing concern that "neurophobia" could lead to an insufficient number of specialists in this field, putting ever-increasing pressure on those who do choose it as their career path.[3,5,7] This phenomenon is arguably compounded by pervading stereotypes about which individuals pursue neurosurgical or neurological careers.[6,8] Neurosurgery is understood by medical students to be a demanding specialty, requiring extensive commitment; simultaneously, they are less and less exposed to the field as medical schools are increasingly shifting toward a generalist approach to teaching, so the opportunity to challenge stereotypes and nurture genuine interest is curtailed; it has since been shown that neurophobia is inversely related to the positive influence of lecturers.[3,8–10]

As such, there is an increasing need to address and improve teaching to help combat neurophobia and improve neuroanatomy learning.[2] Globally, it has been acknowledged that the methods used for teaching neuroanatomy are ever evolving. In particular, in the post-COVID-19 pandemic era, there has been increasing use of digital teaching modalities alongside traditional techniques.[11] These include new methods of plastination (which have predominantly been assessed on animal tissue rather than human specimens) and use of artificial intelligence and three-dimensional printing to create learning tools that are accessible, accurate, and beneficial to learners.[12,13] However, although these innovations are undoubtedly valuable, particularly in the instances where dissection or prosected specimens are unavailable, there is also considerable evidence in favor of preserving more traditional approaches.[14–17] One way this could be done is by introducing or promoting dissection, particularly of deeper cerebral structures such as the basal nuclei, which are often seen as more "abstract" concepts to grasp when it comes to initial learning; it has been previously shown that doing so leads to significantly higher retention of knowledge in the long term, from as early as the first year of medical school.[5,15] However, most students do not have the opportunity to perform more complex dissections, often due to the fast-paced nature of university teaching and an overarching shift toward a hybrid teaching model.[9,14] The student experiences detailed in this manuscript hope to highlight how making neuroanatomy a rewarding and engaging process for students helps address this limitation and create meaningful educational opportunities for interested students.

In this article, the authors present their experience of medical student–led white matter dissection without Klingler's method, through their involvement in organizing the National Undergraduate Neuroanatomy Competition (NUNC) 2023 (►**Fig. 1**). Here, we encapsulate, for the first time, the experience of students in creating a singular collection of neuroanatomical specimens outside of their set curriculum—a novel development for their institution and the NUNC organization as a whole.

This experience, in light of the fact that overall time allotted to dissection-based teaching has decreased substantially over time across the United Kingdom medical schools, arguably, has the potential for far-reaching impact on student knowledge and attitude toward learning; on average, students presently get 24 hours of neuroanatomy teaching across their 5 years at medical school.[18] As such, ensuring the time that is allotted is used as efficiently as possible is essential to ensure students benefit from the experience of early exposure. As a result, white matter was chosen as a focus for this experience, in light of evidence that many medical students struggle with learning this particular element of neuroanatomy and have previously benefited from more focused dissection experiences.[14,15] The authors report their experience in creating a unique opportunity for a select group of students to develop as future leaders in neuroanatomy and clinical neuroscience, with three main aims underpinning this process:

- Cultivation of role models and mentors, within and beyond the students' own institution.
- Early career development and guidance.
- Development of early expertise in neuroanatomy.

Discussion

The National Undergraduate Neuroanatomy Competition

The NUNC exists as an annual competition open to undergraduate students in the United Kingdom and Ireland undertaking a degree with a neuroanatomy component, for example, medicine or neuroscience. Over the last decade it has been running, the NUNC has registered a total of 841 students from 29 of 33 United Kingdom medical schools and has become increasingly popular with each subsequent competition. In 2022, the NUNC moved from the University of Southampton to the University of Glasgow and is now being led by the University of Glasgow medical students under the oversight from the professor of anatomy, Scott Border (►**Fig. 1**). The NUNC consists of two examinations focused on neuroanatomy and its clinical considerations, written by the organizing committee, principally the Primary Chair, with the guidance of internal university staff, practicing doctors with an interest in clinical neuroscience, and an external examiner. The examinations are equally weighted; they comprise of a multiple-choice, single best answer examination focusing on clinically applied neuroanatomy and a spotter examination using the specially dissected specimens highlighting less commonly displayed structures; this format of assessment has been previously validated in the literature as a means of allowing students to perform confidently and best showcase their knowledge.[19] The content of both examinations is based on the curriculum framework set out by Moxham et al, which enables competitors to prepare using defined parameters ahead of the event.[20]

The dissections described here focus on white matter dissection, as it has been previously reported that undergraduate students do not achieve a clear comprehension regarding white matter fiber tracts.[21] Shell et al have found that dissection has a direct impact on medical students' motivation and a positive correlation between performance on laboratory-based examinations and overall desire to learn.[17] Klinger's method is widely regarded as the optimal

Fig. 1 The 2023 National Undergraduate Neuroanatomy Competition (NUNC) at a glance. (**A**) Committee members connecting over shared interests. (**B**) NUNC 2023 Welcome Address from Primary Chair Ameerah Gardee. (**C**) The Single best answer examination about to begin. (**D**) Marking underway under the guidance of our external examiner Prof. Ceri Davies. (**E**) Our keynote speaker, Mr. Henry Marsh. (**F**) The NUNC 2023 Committee.

approach to white matter dissection; the process fixes white matter tracts via freezing, following 2 to 3 months of preservation in 5% formalin, which causes the water molecules to expand, helping separate fibers.[21–23] Although widely recognized as beneficial, Klingler's method is time-consuming, so it is not always feasible for medical students to perform the procedure.[14,21] In light of this, neuroanatomy teaching tools are an increasing area of study as there is a clear need to consider new approaches to develop medical education.[11]

Organizing the NUNC provides students serving on the committee with a unique opportunity to garner experience and knowledge far beyond what they would ordinarily be exposed to, which many on the committee members have cited as being a highlight of their NUNC experience. It also serves as an incentive for students interested in neurosciences to improve their own knowledge through self-directed learning and offers recognition for the efforts of the very best. To better understand our participants' preparation process and academic experiences of neuroanatomy, they were asked in a survey to choose, out of a range of potential teaching modalities, a particular modality that was not provided to them but that they would wish to have and 14% of the respondents cited dissection.

The overwhelming majority of the 2023 NUNC attendees view neuroanatomy as highly important to their future career aspirations (►**Fig. 2**), which aligns with trends in the existing literature detailing that students are eager for more neuroanatomy teaching, despite established "neurophobia."[2–4] As the majority of neurological disease presentations will be seen first by a non-neurological doctor, it is arguably essential that all clinicians are familiar with initial diagnosis and management of neurological disease, for which an initial grasp of neuroanatomy is arguably key. It has been found that final-year medical students and junior clinicians occasionally struggle with neuroanatomy due to inadequate exposure and deficiencies in teaching.[3,24] Subsequently it has been highlighted that there is a growing need for alternative strategies to make neuroanatomy teaching more accessible and engaging, with greater integration of clinical and preclinical concepts.[2–4] The latter aspect is arguably of most significance, as it has been shown that neurophobia is associated with a lack of knowledge combined with limited clinical exposure during medical school.[3,4] Simultaneously, the pervading stereotypes about clinical neuroscience careers may further hamper student enjoyment and engagement with neuroanatomy; hence, opportunities to connect with senior professionals and like-minded individuals (which happen through initiatives such as the NUNC) are of significant importance alongside innovative teaching strategies.[5,6]

At a more specialist level, La Rocca et al[16] highlight neuroanatomy as the "initial step of all neurosurgeons' education" and advise detailed planning based on textbook guidance ahead of dissection, as has been performed by the 2023 NUNC committee (►**Fig. 3**). The planning approach is viewed as the hardest step and full details of the process undertaken by these authors is detailed in ►**Supplementary Material** (available in the online version); thus, this narrative aims to serve as a guide for any institution or student group

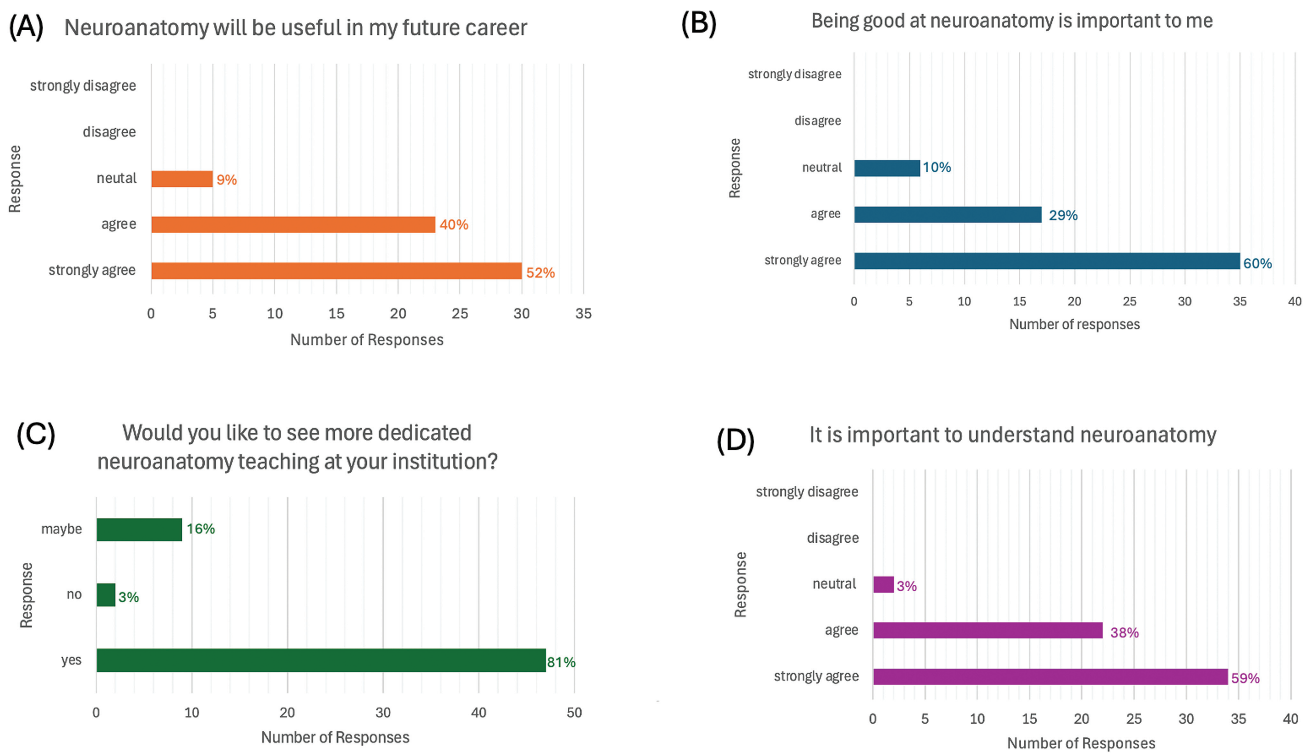

Fig. 2 Results of the 2023 National Undergraduate Neuroanatomy Competition (NUNC) participant survey. (**A**) Bar chart showing the majority of students believe neuroanatomy will be useful to their future career (strongly agree, $n = 30$; agree, $n = 23$; neutral, $n = 5$; disagree, $n = 0$; and strongly disagree, $n = 0$). (**B**) Bar chart demonstrating students' feelings toward the importance of neuroanatomy (strongly agree, $n = 35$; agree, $n = 17$; neutral, $n = 6$; disagree, $n = 0$; and strongly disagree, $n = 0$). (**C**) Bar chart illustrating the majority of students' wish for more teaching on the subject of neuroanatomy (yes, $n = 47$; no, $n = 2$; and maybe, $n = 9$). (**D**) Bar chart showcasing that students view understanding neuroanatomy as important (strongly agree, $n = 34$; agree, $n = 22$; neutral, $n = 2$; disagree, $n = 0$; and strongly disagree, $n = 0$).

keen to fill this void, as there is increasing evidence that cadaveric central nervous system (CNS) dissections are key in bridging the gap between neuroanatomy and clinical neuroscience, but are rarely done due to a combination of factors discussed here.[14,16]

Student Experience

White matter anatomy is, in general, a topic undergraduate students do not get to learn through dissection for reasons previously outlined. Dissecting for the NUNC was an exercise in precision, patience, and diligence; above all else, it offered a unique chance to develop an ability to translate the two-dimensional images students become intimately familiar with from textbook learning to the three-dimensional, variable reality of human tissue. For more details on the stepwise method prepared by the lead author (A.G.) ahead of dissection, see ►**Supplementary Material** (available in the online version).

In the beginning, these authors made a thorough study of Klinger's dissection methods, in order to appreciate how it became to be the "gold standard" for white matter dissection, all the while knowing that due to time constraints for delivering the NUNC, we would be unable to replicate it on this occasion. Images of prosections were crucial at all stages of this process'; however, it was difficult at times to bridge the gap between the finished dissections and how the specimen must have looked in the process of performing it. Due to the extracurricular nature of the NUNC, all dissections had to be performed in stages, when the anatomy department were able to accommodate extra student activity. In some ways, this proved both beneficial and detrimental, as it meant that there was a loss of continuity of activity at times, which slowed the process, but also facilitated time to reflect on the process as it unfolded, allowing for continuous revision and deep learning, which, in these authors' view, greatly enhanced the final results.

The fact that all research and preparation for dissection are done in students' personal time is a testament to the dedication of the NUNC committee and a commendable way of demonstrating commitment and interest in neuroanatomy and, by extension, clinical neurosciences. Giving students the freedom to choose and plan dissection was an empowering experience that challenged these authors profoundly; as we worked with a limited number of specially retained specimens, there was a need for judicious planning in order to maximize the potential of our resources and prevent inadvertent damage to fragile white matter tracts. Use of radiological imagery, particularly diffusion tensor imaging (DTI), is valuable as it highlights the structures of interest in vivo, while still allowing for the identification of neighboring structures useful in orientating the approach.[25] By examining DTI and other radiological medium's images of the structures chosen for dissection, these authors were able to estimate the depth of these structures and appreciate their orientation alongside neighboring structural landmarks

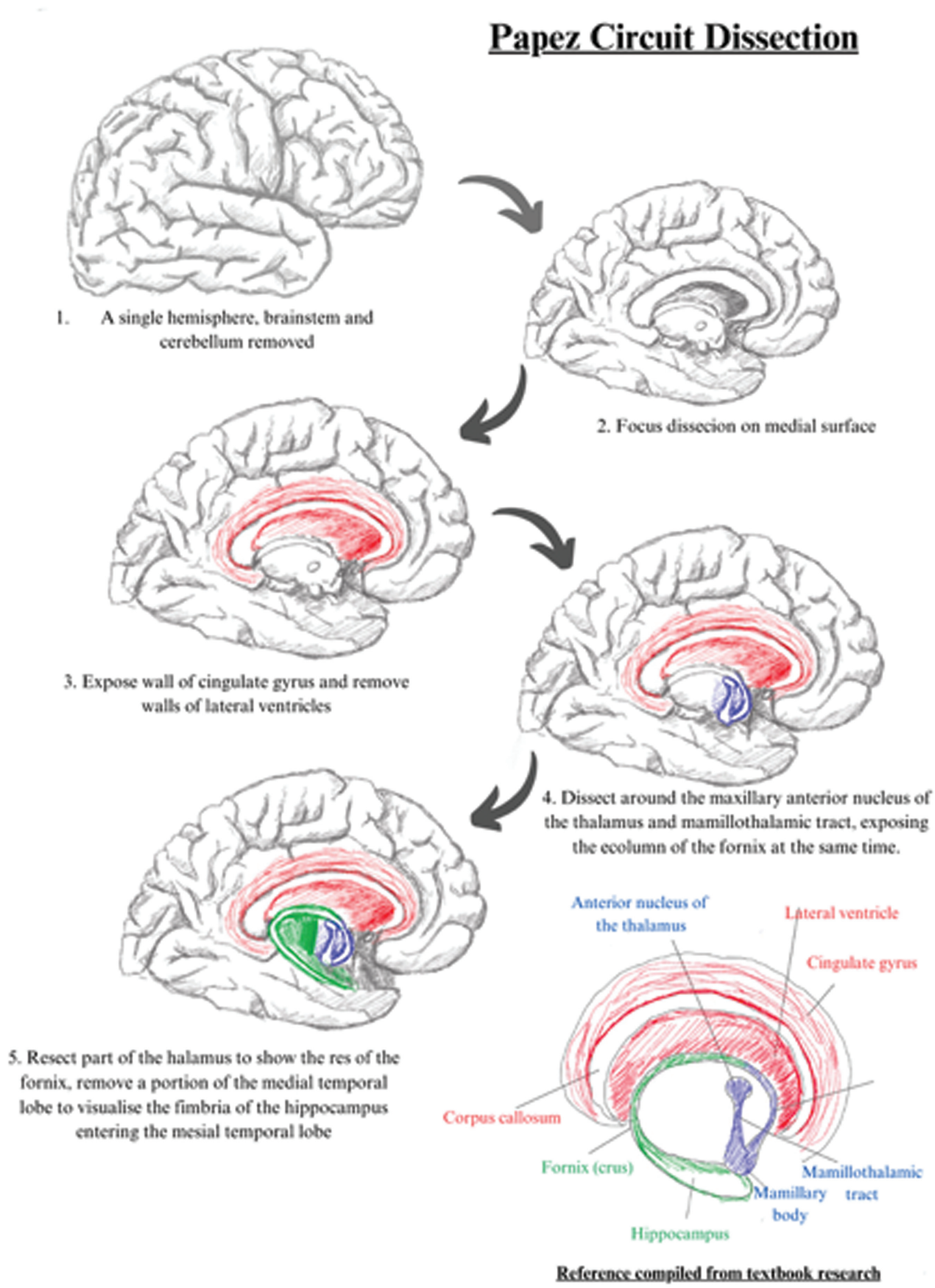

Fig. 3 An example of predissection planning from the National Undergraduate Neuroanatomy Competition 2023 dissections. This figure shows the process of dissecting the Papez Circuit *in situ* and alongside a color-coded reference drawing based on extensive subject reading prepared by Primary Chair, Ameerah Gardee.

(►**Fig. 3**). In comparison to more traditional means of white matter dissection, such as Klingler's method, which fixes white matter tracts and has been shown to greatly aid medical student comprehension of the relationship between neuroanatomical structures, this narrative offers the viewpoint that the methodologies outlined here are comparable in terms of anatomical accuracy and efficacy.[21] All specimens were inspected and reviewed by a team of internal examiners and validated by NUNC's external examiner, Prof. Ceri Davies, who is based at a different institution from the NUNC. Through this process, the anatomical accuracy and efficacy of the dissections performed by the students is held to the highest standard possible under the circumstances. As the NUNC grows at the University of Glasgow, these authors hope to be able to produce Klinger's specimens alongside the ones described in this narrative to better compare the two

Fig. 4 The Papez circuit as dissected by Ameerah Gardee for the National Undergraduate Neuroanatomy Competition 2023. Dissected in a median sagittal view, all the components can be carefully visualized as demonstrated here (A = anterior nucleus of the thalamus; B = mammillothalamic tract; C = mamillary body; D = column of the fornix; E = crus of the fornix; F = hippocampus). The posterior end of the thalamus has been removed in order to view E clearly.

techniques and further validate the potential for dissecting white matter without utilizing Klinger's method. At present, the amount of research required to perform the dissections discussed here limited the number of them that could be produced at any one time; as student experience grows with the NUNC's increasing collection, these authors suggest that this issue will naturally resolve.

Combining practical "physical" knowledge of the three-dimensional proportions of the white matter tracts of interest gained from radiological study with research across several neuroscience textbooks and neurosurgical atlases, these authors formed stepwise plans for each dissection described in this narrative, which allowed us to circumvent the difficulty of having to dissect in stages over time, as the steps could be spread across several sessions and progress measured (►**Fig. 3**). By illustrating the steps, these authors found they were more prepared to appreciate the anatomy in situ as opposed to purely observational learning, a trend that has been noted in the literature on this topic.[26]

This discussion and its technical domains reflect the dissection work conducted by the lead author (A.G.).

Papez Circuit

The Papez Circuit (►**Fig. 4**) was first identified in 1937 by Hames Wenceslaus Papez and encompasses the hippocampus, hypothalamus, anterior thalamus, cingulate gyrus, and their connections.[27] It was first identified as the anatomical basis of emotion, but is now understood to be more significant for memory and, in instances of dysfunction, epileptogenisis.[27–29] Knowledge of this region is important clinically for neoplastic, vascular, and other pathological lesions that affect circuit structures directly, or indirectly, by exerting physical pressure on them.[30]

This was the first dissection completed specifically for the NUNC 2023 (►**Fig. 4**); the majority of the preparation was based on textbook descriptions rather than images and DTI studies that showed the structure in relation to the surrounding tissue. Figures from Catani et al were used as a basis for planning the approach; radiological images such as these were key in helping identify tissue that could be dissected rapidly in order to expose structures of interest.[31] In-depth discussion of the steps followed can be read in ►**Supplementary Material** (available in the online version).

When performing the dissection, it was a surprise to find that with a superior approach through the lateral ventricle, the pulvinar groove could be felt and used as a landmark to identify the superior portion of the anterior nucleus of the thalamus. This provided a clear target to aim for and expose first, leaving the visible mamillary body intact (►**Fig. 4**) to approach later, and thereby better visualize the connection between it and the anterior thalamic nucleus.

The fragility of the deeper structures rapidly became evident and improvising with alternative tools proved extremely beneficial—namely a 3-mm crochet hook (►**Fig. 5**) and a straight pin. The former was useful to resect without breaking the tissue in order to identify the directionality of the fibers and overall size of the tracts. The latter was useful to separate blood vessels from adjacent tissue and to separate individual fibers to create a greater appreciation of the target structures.

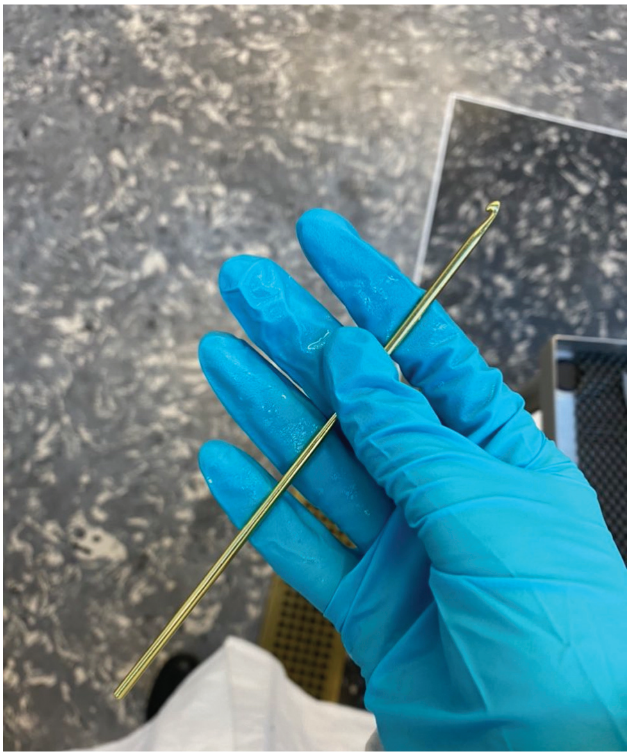

Fig. 5 The 3-mm crochet hook used for the National Undergraduate Neuroanatomy Competition 2023 dissections.

The hardest part of the process was trying to identify structures before they were fully exposed, as there was substantial concern about potentially dissecting tissue that should be preserved. Historical accounts of dissection, while immeasurably helpful in supporting planning, did not account for the difficulty encountered when trying to identify the circuit components in isolation—as almost all textbooks show them as a group, without their surroundings, but unrelated structures that are present in a cadaveric specimen. For more detail on the orientation process of this dissection, please see ►**Supplementary Material** (available in the online version).

In future, if one were to replicate this process, it would be useful to be mindful that the postcomissural fornix is deeper than it can appear in textbooks (►**Fig. 4**), which would enable one to complete later parts of the process faster (see ►**Supplementary Material**, available in the online version) as it was at times difficult to determine how much medial temporal lobe should be resected to expose it and it took several sessions as opposed to a single one due to excess caution. The impact of the experience of performing this first dissection had a profound effect on the clinical learning of the medical students organizing the NUNC 2023 as, although initially time-consuming, provided the initial immersive, hands-on learning experience that streamlined the dissection process for the subsequent two specimens discussed here.

Corticospinal Tract

The corticospinal tract (CST; ►**Fig. 6**) is one of the main efferent tracts in the corticospinal system, descending from the superior cortical centers to the brainstem, passing through the corona radiata, internal capsule, and cerebral peduncles before decussating in the lower third of the medulla, before traversing the spinal cord.[32,33] Like the Papez circuit, DTI was exceptionally useful in predissection planning, as white matter fibers can be hard to separate into distinct groups, particularly toward the tract's origins.[31–33]

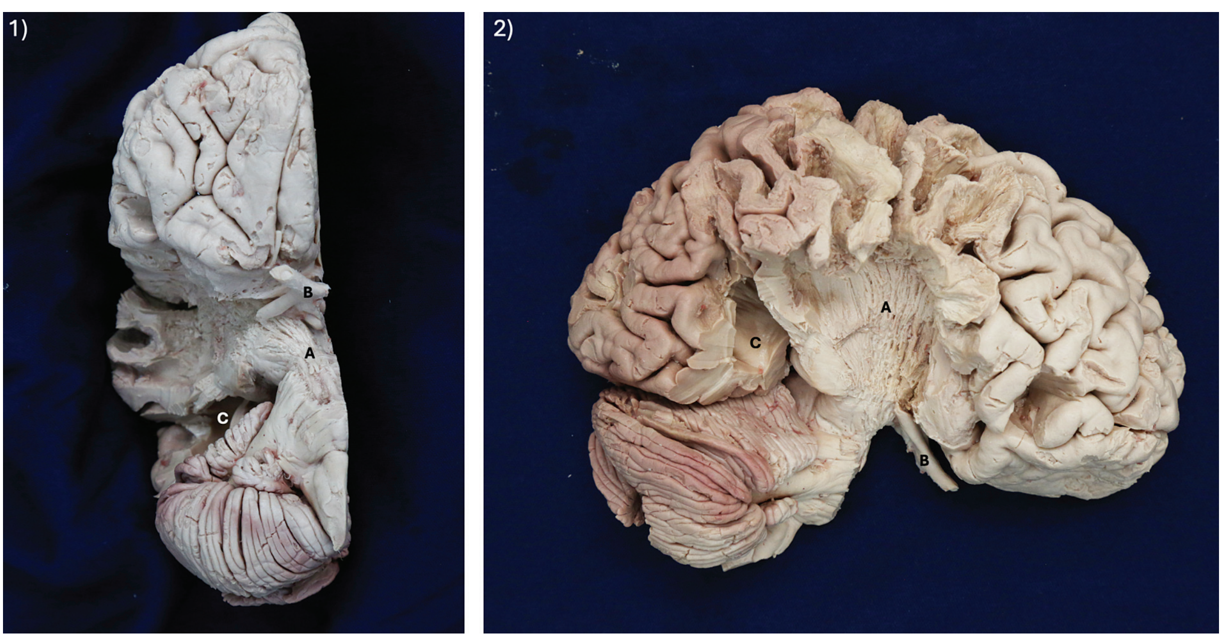

Fig. 6 The CST fibers as dissected by Ameerah Gardee for the National Undergraduate Neuroanatomy Competition 2023. (**1**) The specimen positioned to show its inferior surface. (**2**) The specimen in a lateral position. Across both images, A = descending CST fibers; also demarcated are the optic chiasm (B) and the inferior horn of the lateral ventricle (C), which are useful landmarks to note during the process of dissection. The majority of the temporal lobe and a portion of the posterior frontal lobe have been resected for optimal visualization of the structure of interest.

In this instances, figures from Bozkurt et al[34] and Guevara[32] served as templates for planning the dissection.

Dissecting the CST at a cranial level presented a singular set of challenges as often teaching related to it is centered on its path and position in the spinal cord. Detailed directions used for this dissection are found in ►**Supplementary Material** (available in the online version). Furthermore, brainstem anatomy had been previously presented to these authors as transverse sections, so one of the first tasks undertaken to prepare for this dissection was translation of these to relate to the three-dimensional structure of the brainstem.

Older textbooks proved to be of most value in doing this as their more traditional style of illustration was more relatable to cadaveric specimens.[32,35] Upon reflection, the initial dissection through the medullary olive and superior cerebral peduncle (►**Fig. 6.1**) could have benefited from a magnifying glass or microscope, as the lack of either meant this process took several sessions in order to complete due to a slower pace resulting from the size of the target structure.

Again, improvised dissection tools proved useful here as several tracts pass very close to the CST, so having the crochet hook (►**Fig. 5**) and straight pin was key in making initial distinctions. In addition, a size 8 knitting needle proved helpful in appreciating the texture differences between tracts and nuclei without breaking the tissue. The opportunity to test novel tools for dissection was a unique opportunity for creative problem-solving and micro-innovation, giving students a chance to build confidence in their own ideas and abilities.

Another unexpected conundrum was deciding which portion of the corona radiata to define in order to complete the path of the CST, given that it contributes to multiple pathways and, for a CST, is most clear in a coronal section, as opposed to a three-dimensional dissection. In determining how to proceed, DTI images were again a key reference, together with discussion among senior staff members at the anatomy department. The final specimen is shown in ►**Fig. 6**.

Throughout all dissections performed for the NUNC, one of the most beneficial parts of the process for personal development of the dissector was the opportunity to work more closely with teaching staff on a long-term project and gain insight into how they visualize anatomy and the process of dissection. Their advice proved insightful and invaluable in supporting the development of student knowledge and practical skills alike. Going forward, this knowledge will hopefully enable better clinical application of textbook knowledge and facilitate a smoother transition from academic to clinical learning.

Uncinate and Inferior Longitudinal Fasciculi

The uncinate fasciculus (►**Fig. 7**) was first described by Johann Christian Reil in 1809 and is a bidirectional tract connecting the orbitofrontal cortex and anterior temporal lobe.[36,37] It has been implicated in episodic memory and socioemotional processing, although its exact role is unclear.[37] The inferior longitudinal fasciculus (ILF) is another associative white matter tract that connects occipital and temporo-occipital regions to anterior temporal structures.[38] It is a bidirectional tract and is thought to be involved in processing visual cues and thus visually directed decisions and actions; this is important clinically as studies have shown that disruption of the ILF can lead to impairments of visual cognition, which in some instances may be the basis of visual hallucinations.[38] Like all white matter dissection, use of DTI was highly beneficial in identifying the correct fibers on dissection and anticipating the depth required to dissect in order to reach them.[39]

This specimen was prepared later in the academic year, closest of these examples to the NUNC 2023, and benefited significantly from experience in performing the previous two dissections described above. For details of the process, see ►**Supplementary Material** (available in the online version). The final dissection is shown in ►**Fig. 7**.

With the benefit of experience from the approaches previously discussed, it was clear that looking at DTI images as opposed to textbook illustrations was a key step in the planning process as they proved more reflective of what was encountered while dissecting. The angle of the tract was more acute than expected when exposed in this particular specimen, but with detailed prior study and advice from senior anatomists, it was possible to remain confident it had been correctly identified; it was then possible to proceed to define it in a similar manner to the previous two specimens described here.

It proved easiest to identify the anterior portion of the ILF due to its proximity to the uncinate fasciculus (►**Fig. 7**).[39] Once identified, following it posteriorly was the most straightforward approach until the arcuate fasciculus was reached. This was a locus of interest, so it was predominantly preserved, while simultaneously penetrating and exposing a window into the inferior horn of the lateral ventricle (►**Fig. 7**). This last decision was not initially included in the dissection plan prepared for this specimen, but over time, it became clear that it was both possible and enhanced the specimen as a whole, both aesthetically and in terms of its potential use in questions for the NUNC spotter examination.

Of the three dissections described, this was the easiest to perform. It is likely on reflection that this is partially because prior dissection experience yielded an enhanced understanding of the gross anatomy of these tracts and their functions, and in this instance did not have to identify and isolate nuclei or brainstem structures. These authors also likely benefited from a growth in confidence having gained experience starting on arguably harder dissections and received more focused guidance in the process.

Conclusion

White matter dissection is often a daunting task for students as often they are commonly inadequately prepared, although many interested in neuroanatomy readily

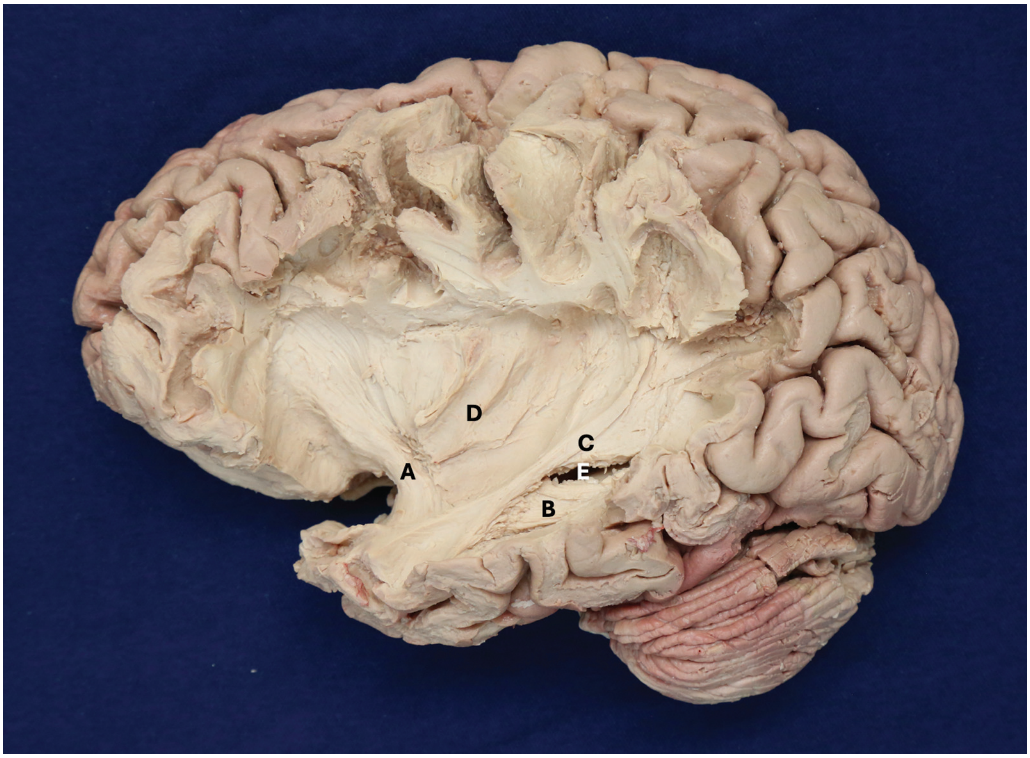

Fig. 7 A dissection of the uncinate fasciculus and inferior longitudinal fasciculus for the National Undergraduate Neuroanatomy Competition 2023 by Ameerah Gardee. This dissection was performed with the specimen in a lateral orientation; A = uncinate fasciculus; B = inferior longitudinal fasciculus. Other structures shown that serve as useful landmarks are C = deep fibers of the arcuate fasciculus and D = deep white matter of the insular gyri and E = the inferior horn of the lateral ventricle sitting below B. The majority of the temporal lobe, fronto-orbital lobe, and posteroinferior temporal lobe have been resected in order to view the structures of interest.

acknowledge the importance of dissection to their current and future education/career aspirations. This narrative aims to serve as a starting point for more accessible white matter dissection protocols, by providing a step-by-step guide to white matter dissection on cadaveric specimens, rather than relying on Klinger's method. This deviation from the accepted "gold standard" of white matter dissection is an attempt to mitigate the time and resource constraints faced by most students and institutions in the present day, while still facilitating meaningful learning. Going forward, the NUNC hopes to grow its presence at medical schools across the United Kingdom by recruiting local medical student NUNC representatives and, where possible, encourage students to undertake dissection as part of their preparation for the competition with the support of their respective departments of anatomy. It is these authors' hope that this manuscript serves as evidence of what is possible for student-directed learning and can serve as a template for this process, both in the United Kingdom and further afield, for those who wish to undertake similar initiatives. To assess the long-term impact of the NUNC and similar opportunities, utilization of follow-up surveys of past NUNC participants and committee members alike could provide valuable longitudinal observations on the impact of early dissection and specimen exposure on medical students' career choices and trajectories.

Note
All dissections and data collection were performed with the approval of the University of Glasgow School of Medical, Veterinary and Life Sciences Ethics Review Board.

Authors' Contributions
A.G. contributed to conceptualization, writing the original draft, dissection, data analysis, figure production, editing, and reviewing. E.G. contributed to conceptualization and editing. S.L. contributed to editing and reviewing. M.A. contributed to conceptualization, editing, and reviewing. H.I. contributed to editing and reviewing. A.C. contributed to editing and reviewing. L.N.A-S. contributed to editing and reviewing. S.B. contributed to editing and reviewing.

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Conflict of Interest
None declared.

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