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Dundee Annual Neurosurgery Skills Event (DANSE)—Improving the Availability and Affordability of Neurosurgical Skills Workshops for Medical Students

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Abstract

Background Neurosurgery can be a daunting career choice for medical students, with preparation for trainee application often being inaccessible and expensive. This article describes a student-led neurosurgical skills event supported by local neurosurgery faculty members. Such event was designed to offer a means to bridge this gap by providing an opportunity to practice neurosurgical techniques in simulation, and learn about what a career in neurosurgery involves.

Methods Pre- and postskills laboratory surveys were used to ascertain the baseline confidence and knowledge of common neurosurgical techniques, as well as to what both the application to neurosurgery and the typical workload of a neurosurgeon involves. The conference offered six neurosurgical workshops as well as three lectures to provide practical and theoretical learning opportunities. The session included introduction to the candidates and faculty, identification of learning objectives, and career discussion. Postcourse feedback also was also used to assess learning outcomes.

Keywords
- medical education
- simulation teaching
- accessibility
- neurosurgical skills
- medical student

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Results Eighteen students attended the event. Postskills event, students were significantly more likely to understand the principles behind all of the relevant neurosurgical skills included on the day. Additionally, students were more likely to understand what a career in neurosurgery involves, and how to approach applying for a training number. Respondents enjoyed the workshops, valued hands-on experience and interactions with consultants, found it affordable, and would recommend to their peers.

Conclusions For medical students interested in a career in neurosurgery, opportunities to learn relevant techniques and skills are often expensive and difficult to come across. Here, we highlight affordable methods of simulation to result in significant student satisfaction. Additionally, providing ample opportunity to practice different neurosurgical techniques under almost 1:1 level tutoring enables significant increases in students' confidence and understanding of different neurosurgical concepts. We greatly encourage other medical student groups to develop their own hands-on simulation events to attract medical students to a surgical field often considered daunting and inaccessible, and address gaps in the medical school curriculum.

Introduction

Medical students who are initially attracted to a career in neurosurgery may be deterred upon realization as to the many "barriers" to eventually becoming a neurosurgeon. Neurosurgical training is one of the most sought-after specialty worldwide.[1] In the United Kingdom alone, there were 255 applications for 16 neurosurgical trainee posts in 2022 (competition ratio of 15.94).[2] As a result of this high competition ratio, there is a significant backlog of applicants, with many hopeful applicants adjusting their career plans to facilitate a second attempt at application. This may include taking gap years, and/or clinical or teaching fellow years in the interim, as well as taking extra time to ensure that their portfolio is up to a higher standard.

It is worth noting that unsuccessful applicants will more than often significant potential to be an excellent candidate, but will have been disadvantaged secondary to a lack of support or mentorship during their medical school and/or foundation training years.

There is yet another "hurdle to jump" for trainees once they have completed their eight-year run-through training program, with the Society of British Neurological Surgeons reporting an increasing number of trainees to have completed their residency, but have no substantive attending/consultant post available to them. They predict this number to rise to a peak of around 100 trainees in 2029.[3] This means that individuals spend several years of their lives stuck in "bottlenecks" awaiting rightful passage to the next stage of their career. Most UK trainees affected by this predicament usually opt to complete further training years in research and/or subspecialty fellowships (e.g., vascular, complex spine, skull base) or act as a locum consultant while awaiting an available consultant post.

Any student interested in neurosurgery should be aware that a competitive application for a training number should ideally include supporting evidence of formal clinical neurosurgical experience (e.g., elective placements, time in theater).[4] Unfortunately, such opportunities are challenging for the average medical student to come across, mainly due to medical schools having minimal representation of niche specialities such as this within the undergraduate curriculum.[5] This is because UK medical schools have now adopted a more generalist (as opposed to specialty-focused) approach to medical education and training in response to a national shortage in the number of general practitioners.[6] This reiterates the need for local specialty interest groups and medical student societies to develop and provide additional learning opportunities for interested medical students. This will provide such students with the exposure required to make an informed choice regarding the specialty in question, and to develop a competitive portfolio in time for specialty training application.

Applying for neurosurgery in the United Kingdom involves attaining a strong portfolio of achievements. The strength of the portfolio is measured across multiple domains, including publications, oral or poster presentations, teaching and leadership opportunities, audit and quality improvement, and the completion of higher research degrees or postgraduate exams.[4] In light of these extensive requirements, aspiring neurosurgeons should ideally start building up their portfolio from an early stage. However, this is often not the case due to limited exposure to the specialty and limited contact with experienced neurosurgeons who can guide interested students.[6,7] The amount of time available for interested foundation doctors to spend on developing their portfolio will also negatively be affected by the lack of support and rota gaps that arise within an understaffed National Health Service (NHS).[1]

Hands-on neurosurgical workshops are a means to combat this lack of teaching and exposure, as well as provide networking opportunities with other interested students. They also are a means for experienced neurosurgical faculty members to give advice about trainee application preparation and to provide insight into the personal and professional

life of a neurosurgeon.[8–10] These events are either led by medical student societies or providers external to a particular medical school. Unfortunately, many students cannot easily access or afford these teaching opportunities due to a lack of availability, and the use of high-cost materials that overall contribute to unaffordable ticket prices. For example, a recent national neurosurgical skills workshop was limited to only one UK location, and priced its tickets at £75 per person.[11] For most undergraduates, this may be a significant sum of money, particularly when having to travel far and wide to even access the event.

This article aims to describe an affordable, one-day, student-led neurosurgical skills event supported by a local neurosurgical department in NHS Tayside. The purpose of the event was to widen participation and bridge the gap between students who can and cannot afford typically expensive surgical skills events and ultimately increase the likelihood of success in future specialty applications. The event was designed to have a high teacher-to-student ratio, ensuring students have optimal exposure to different neurosurgical techniques. The event is not unique, and has been adopted and created by different societies, universities, and sponsors across the United Kingdom. By publishing this data, we hope to share our experiences and encourage others to start their own neurosurgery interest groups and replicate our style of neurosurgical teaching.

Methods

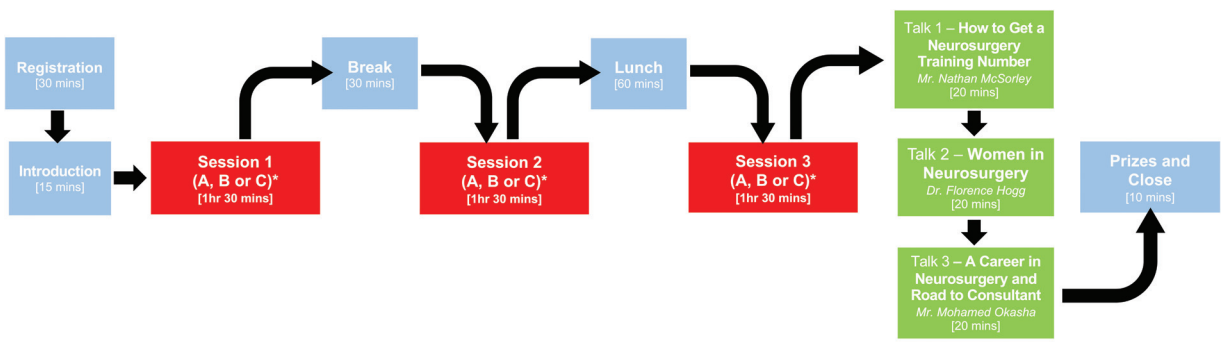
We delivered a full day neurosurgery skills workshop facilitated by consultant and trainee neurosurgeons. This nonprofit event costs £35 per person to cover material costs, as well as catering for students and faculty. To maximize the delegates' learning opportunities, the workshop was delivered to 18 students and consisted of six different surgical skills stations, followed by a series of three lectures.

In the month prior to the event, students were given access to online modules, with the purpose of enhancing their knowledge prior to undertaking each of the six stations on the day. These were provided through Sway—an online app from Microsoft Office that allows you to produce presentations that include media and text simultaneously in a "story-telling" format. This enables students to make their way through interactive presentations and content in their own time, and without the need for a presenter.

The skills day was entirely organized by foundation doctors and medical students, and supported by a consultant neurosurgeon. In addition to the organizing team, neurosurgery trainees were also recruited to help with the facilitate the six surgical skills stations. Most faculty members were associated with the Dundee neurosurgical department (Ninewells Hospital and Medical School), and the Institute of Neurological Sciences, Queen Elizabeth University Hospital Glasgow. The six workshops comprised of:

- *Clinically relevant neuroanatomy and neuronavigation*
- *Spinal fixation—pedicle screw insertion*
- *Burr holes and craniotome use*
- *External ventricular drain (EVD) insertion and intracranial pressure (ICP) monitoring*
- *Cranial skin flaps*
- *Basic suturing skills (delivered by Dundee surgical society)*

The components of the six stations as well as the program for the day are illustrated in ►**Fig. 1**. Students rotated around each of the six stations in groups of three, ensuring they had almost 1:1 support from experienced faculty members. This meant that they had ample opportunity to ask questions (allowing them to further expand on any principles learnt within the preceding Sway modules), as well as acquire additional tips and suggestions relevant to each specific surgical topic. Each station lasted approximately 45 minutes. This allowed enough time for the instructor at each station to



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Session A	Session B	Session C
A.1 Burr holes and Craniotome use [45 mins]	**B.1** Spinal fixation + pedicle screws [45 mins]	**C.1** Basic suturing skills [45 mins]
A.2 EVD insertion + ICP monitoring [45 mins]	**B.2** Clinical neuroanatomy + Neuronavigation [45 mins]	**C.2** Cranial skin flaps [45 mins]

Fig. 1 Event workflow and duration of contents. Three students attended each station at one time, with six stations being always in simultaneous operation. Each session was split into two, for example, A.1 and A.2.

deliver an informal introductory lecture to demonstrate the exercise/equipment, followed by time for each delegate to practice the neurosurgical technique under direct supervision.

The final component of the skills day was comprised of a series of three lectures delivered by neurosurgery registrars ($n = 2$) and consultants ($n = 1$). The three talks delivered during the day addressed the barriers to getting a neurosurgical training number ("How to Get a Neurosurgery Training Number"), the typical workload and career path of a neurosurgeon (A Career in Neurosurgery and Road to Consultant"), and the challenges of being a woman in neurosurgery ("Women in Neurosurgery"). The speakers were asked to ensure their talks were pitched to a level suitable for medical students.

To determine the event's relevance, quality, and effectiveness, we developed a two-part questionnaire for delegates to complete. These questionnaires also focused on establishing the delegates' existing neurosurgical knowledge and skills, as well as what they wished to achieve on the day. This was statistically compared with findings afterwards. This was done using preskills laboratory and postskills laboratory questionnaires that were developed using Google Forms, an open-source platform for creating questionnaires (Google, Mountain View, California, United States). Students were asked to scan a QR code for the preskills laboratory questionnaire on arrival. They were then asked to scan the postskills laboratory QR code immediately following the event. Both surveys contained identical five-scale ratings and free text questions, allowing for direct comparisons of answers for each delegate before and after the event. Data was retrospectively analyzed using Microsoft Excel Version 16.77. Independent *t*-tests were used to compare pre- and postquestionnaire mean scores. *p*-Value less than 0.05 was considered statistically significant.

Results

Demographics

Eighteen delegates attended the event. The cohort of delegates was 66.7% female, with students ranging between years the second and fifth years of medical school. Most delegates were from the University of Dundee ($n = 14$, 77.8%), with three students from the University of Aberdeen and one from the University of Edinburgh. About 61.1% of students ($n = 11$) stated that they had attended a surgical skills event before. Further demographic details for delegates are included in ►**Table 1**.

Table 1 Delegate demographics

	n	%
Gender		
Male	6	33.3
Female	12	66.7
University		
University of Dundee	14	77.8
University of Aberdeen	3	16.7
University of Edinburgh	1	5.6
Year		
2	3	16.7
3	4	22.2
4	6	33.3
5	3	16.7
Intercalating	1	5.6
Prior surgical skills event attendee		
Yes	11	61.1
No	7	38.9

Table 2 Preskills laboratory questionnaire results

	n	%
Interested in a career in neurosurgery?		
Definitely	5	27.8
Very likely	3	16.7
Likely	5	27.8
Maybe	4	22.2
Unlikely	1	5.6
What are you hoping to learn from the course?		
Suturing and procedural skills	7	38.9
Neurosurgery career advice	6	33.3
Both of the above	4	22.2
Learn about specific management of neurosurgical presentations	1	5.6
Use of pre-reading SWAY modules		
Yes	12	66.7
No	6	33.3

Prelaboratory Questionnaire

A total of 18 participants completed both the pre- and postlaboratory questionnaires, with a 100% response rate. The results of the prelaboratory questionnaire (see ►**Table 2**) revealed that 72.3% of students ($n = 13$) were "definitely," "very likely," or "likely" to be interested in a future career in neurosurgery. Most students hoped to learn more about suturing or procedural skills, or acquire more information about what embarking upon a career in neurosurgery involves.

Six SWAY modules were sent to all students prior to the event. The purpose of these was to give students some background information to enhance the level of learning and teaching on the day of the event. When asked if they found the modules an appropriate length of time, two delegates answered "strongly agree" (16.7%). Seven answered "agree" (58.3%), and three answered "neutral" (25.0%). When asked if they found the modules an appropriate level of information,

six answered "strongly agree" (50.0%), four answered "agree" (33.3%), and one answered "neutral" (8.3%).

Comments regarding the SWAY modules included "Excellent revision material. Can definitely be used for this purpose too."

Postlaboratory Questionnaire

Students were asked to give feedback on the event with a postlaboratory questionnaire. All stations were rated between three and five (out of five) by delegates (see ►**Table 3**). The highest rating station was the burr hole and craniotome use station, with a mean rating of 4.72 out of five. The lowest rating station was the cranial flap station. About 38.9% of delegates ($n = 7$) stated that the burr hole and craniotome use station was their favorite station.

After the course, 61.1% of students still said they were "definitely," "very likely," or "likely" to be interested in a career in neurosurgery. The mean rating of what a neurosurgical career and what training application involves both significantly increased by 2.00 ($p < 0.0001$) ($p < 0.0001$) and 2.50 ($p < 0.0001$), respectively.

Table 3 Delegate ratings for each skills station

Station	Mean rating	Min rating	Max rating
Cranial flaps	4.39	3	5
Neuroanatomy and neuronavigation	4.50	3	5
EVD insertion and ICP monitoring	4.61	3	5
Basic suturing skills	4.67	3	5
Burr holes and craniotome use	4.72	4	5
Spinal fixation	4.72	4	5

Abbreviations: EVD, external ventricular drain; ICP, intracranial pressure.

Hundred percent of students enjoyed the course overall, with 83.3% of students stating it to be "excellent," while 100% of students stated they would recommend the event to their peers. Most students found the event to be an appropriate time, but two found it to be too long. Hundred percent of delegates found the event to be aimed at an appropriate level for medical students. However, there was a 11.2% decline in students stating to be interested in a future career in neurosurgery (72.0 vs. 61.1%).

Delegate Confidence and Knowledge

Students were asked about their confidence in different areas that were covered during the course. Pre- and postskills laboratory confidence ratings were compared. There was a statistically significant improvement in confidence levels in all areas outlined in ►**Table 4**. The most significant difference in confident rating for the skills stations alone was seen for the concepts of burr holes (2.00, $p < 0.0001$) and ICP monitoring (2.00, $p < 0.0001$). The greatest mean difference across all concepts was seen for confidence as to what a neurosurgical application involves (2.50, $p < 0.0001$).

Discussion

Neurosurgery is one of the most sought-after specialties worldwide, and one of the most competitive in the United Kingdom.[1] At most, neurosurgical teaching within the undergraduate curriculum focuses on basic neuroanatomy and common neurosurgery presentations relevant to the burden of neurosurgical disease that is often managed by generalists.[6] This means that there is minimal opportunity to augment or develop an interest in neurosurgery at medical school. For students that have an established interest, the lack of early exposure to neurosurgery and lack of quality mentorship programs mean that students often do not understand the specialty in terms of clinical and practical implications that would be required should they wish to

Table 4 Comparison of pre- and postskills laboratory confidence ratings

	Preskills laboratory rating			Postskills laboratory rating			Mean difference	Significance (p-value, two-tail)
	Mean	Min	Max	Mean	Min	Max		
Burr holes	2.17	1	3	4.17	3	5	2.00 (92.3%)	4.94×10^{-7}
Craniotomy	2.28	1	4	4.00	2	5	1.72 (75.6%)	6.97×10^{-7}
ICP monitoring	2.06	1	3	4.06	3	5	2.00 (97.3%)	1.34×10^{-8}
EVD insertion	2.00	1	4	3.89	3	5	1.89 (94.4%)	4.83×10^{-7}
Spinal fixation	2.28	1	3	4.11	3	5	1.83 (80.49%)	6.34×10^{-8}
Cranial skin flaps	2.06	1	3	3.89	2	5	1.83 (89.2%)	3.33×10^{-6}
Basic suturing skills	2.78	1	4	4.00	2	5	1.22 (44.0%)	2.69×10^{-3}
Neuronavigation and neuroanatomy	1.94	1	3	3.78	2	5	1.83 (94.3%)	4.37×10^{-7}
Neurosurgical career	2.28	1	3	4.28	3	5	2.00 (87.8%)	1.06×10^{-7}
Neurosurgery application	1.78	1	3	4.28	3	5	2.50 (140.6%)	5.03×10^{-8}

Abbreviations: EVD, external ventricular drain; ICP, intracranial pressure.

apply for a trainee number, as well as have a genuine insight as to what it means to be a neurosurgeon.[12]

Additional placements such as student-selected components[5] and electives and relevant intercalated degree programs can often be challenging to organize, with teaching quality and experiences potentially being inconsistent across and within different neurosurgical centers, depending on tutors and facilities. It is even more difficult for students at medical schools with no neurosurgical department at their associated hospital.

These factors are often also the reason why many students aspiring to undertake a career in neurosurgery ultimately lose interest and no longer think it worthwhile to apply.[6] There is, therefore, a great need for medical students and early career doctors to have access to a guide or "roadmap" of the entire process from start to finish to enable them to make informed career decisions and prepare in advance to successfully meet the demanding criteria involved in application.[1]

Medical student-led skills events and conferences, therefore, represent a key means by which guidance about neurosurgery and how to complete the relevant achievements for trainee application is made more accessible to students. Considering this, our event aimed to offer high-quality teaching of multiple neurosurgical skills under expert tuition, while being accessible and low cost. The results of this study illustrated delegate understanding of neurosurgery as a career and the application process significantly increased following the conference (average confidence rating 2.28–4.28 out of 5 and 1.78–4.28 out of 5, respectively). This was mainly due to our program facilitating talks on "How to Get a Neurosurgery Training Number," "Women in Neurosurgery," and "A Career in Neurosurgery and Road to Consultant."

The first talk introduced the students to the matrix used to recruit neurosurgery applications for interview, with the speaker making recommendations for students, as well as reflecting on the reasoning behind his own previous successes and failures. The final talk outlined the various roles of a neurosurgeon on a day-to-day basis and an insight into the individual speaker's career journey and the impact of the process on personal life outside neurosurgery. The speaker also reflected on the personal and professional attributes required (subjectively) to be successful in a career in neurosurgery.

The second talk highlighted potential barriers women may face within the field of neurosurgery. There is still a high risk of experiencing biased selection, as well as gender discrimination from male counterparts, with up to 66.7% of females still experiencing discrimination in the surgical workplace.[13] There are reports of a lingering "old boys' club" mentality within neurosurgery, with some women feeling "undervalued, ignored and patronized because they are women."[14] Additionally, there is an ongoing (and outdated) perception that women interested in neurosurgery should feel guilty for "sacrificing" a life that has space for self-interests (i.e., starting a family),[13] with difficulty balancing motherhood and a neurosurgical career being a leading reason for attrition. Increasing the visibility of female role models who successfully combine a neurosurgical career and a family life may help shift this balance in the future.[14] Considering this, our second speaker shared how she managed being a new mother and a being neurosurgical trainee without letting them impact one another. Interestingly, 66.7% of our participating students interested in neurosurgery were female. However, despite progression in gender equality within the United Kingdom in recent years, the proportion of female staff in UK neurosurgery has remained flat over the past decade,[14] with only 42 of 458 (9.2%) consultant neurosurgeons in 2020 being female.[3] This discrepancy in percentage between "initial interest" to "job success" reiterates the need to prevent promising female students from being deterred from the subspecialty due to certain perceptions or misconceptions about women in neurosurgery. One potential way to combat this is through better mentorship from women in leading positions in neurosurgery.[14] Thus, a talk directly delivered by a female trainee was a particularly valuable resource. We hoped the event would also highlight (to both female and male colleagues) the importance of continuing to recognize and address gender inequalities within any future career path.

Simulation tools are becoming more and more widely used in education and training in a variety of high-risk professions and disciplines, including medicine.[15] For our event, we felt it important to opt for a simulation-based style of teaching, as simulating of a range of complex subspecialist procedures in a safe and nonpressurized environment may provide participating students with a broad insight and appreciation of the field.

Unfortunately, conferences and skills events are often expensive, with a recent national skills workshop utilizing high-cost materials to provide multiple neurosurgical skills stations costing £75 per person.[11] This also does not include travel and accommodation costs, which are not always covered by medical school bursaries. Taking this price into context, students in Scotland can take up to £7,000 per year as a bursary for living.[16] International students coming to the United Kingdom to study are expected to pay an average cost of £22,000 for a year of tuition fees, and around £900 to 1300 per month (£1300–1400 in London) on living expenses.[17] Therefore, on top of typical monthly expenses, £75 is a large sum of money for a student to pay for a one-day course. Postgraduate conferences and courses are even more expensive, with the average postgraduate spending £3360 on such events.[18] It, therefore, makes sense to endeavor to try more affordable techniques for neurosurgical simulation.

In 2021, the Glasgow Neuro Society (a medical student led society based at the University of Glasgow Medical School) ran their 9th annual Glasgow Neuro International Conference, which provided delegates with an excellent and broad exposure to neurosurgery through several talks and hands-on workshops. Instead of high-cost Rowena head models, they made use of novel affordable models for a clinical workshop on ICP monitoring,[19] and were able to charge £17 to £25 per ticket (depending on society membership status). The cost-effective models were created with Plaster of Paris, children's play slime, and waste bags to mimic brain parenchyma and dural puncture.[20] This allowed for accurate simulation, as well as significant satisfaction of students, trainees, and consultants.[20] We

Fig. 2 (**A–D**) Cost-effective simulation for external ventricular drain and intracranial pressure monitoring. Handmade calvarium models were with cranial suture markings that were fixed to square plywood boards using Plaster of Paris. Internal to the calvarium was a small-sized bin/trashcan bag filled with children's play slime to model the dura and brain parenchyma, respectively. A small block of neoprene was added to model the area of scalp where the suture would be made.

used these models for our EVD and ICP monitoring skills session, with significant success (average student rating 4.61 out of 5; see ►**Fig. 2A–D**).

The main approach used to reduce the cost of our event was to use "domestic" objects to mimic the skull and scalp. For our cranial skin flap station, we used the Glasgow models in combination with our own innovative technique, using the material neoprene atop the calvarium to simulate skin (see ►**Fig. 3A, B**). Neoprene is a synthetic rubber produced by the polymerization of chloroprene,[21] and is commonly known for its use in wetsuits. Using this relatively affordable material avoided the need to purchase expensive Rowena head models that include a scalp layer. We were also inspired by Drummond-Braga et al [22] and used coconuts to simulate skull models, and facilitate the practice of burr holes and craniotomy (see ►**Fig. 4**). Boiled eggs have also been shown to successfully model the skull in surgical simulation.[23–26] Considering this, we provided each delegate with the

Fig. 3 (**A, B**) Neoprene for simulation of cranial skin flap techniques. We used custom-cut sheets of this material to cover and stick to the low-cost calvariums (using its adhesive bottom surface). The neoprene was of appropriate thickness to simulate layers of the scalp, as well as for penetration by a scalpel. Surgical drapes were used for additional visual simulation value.

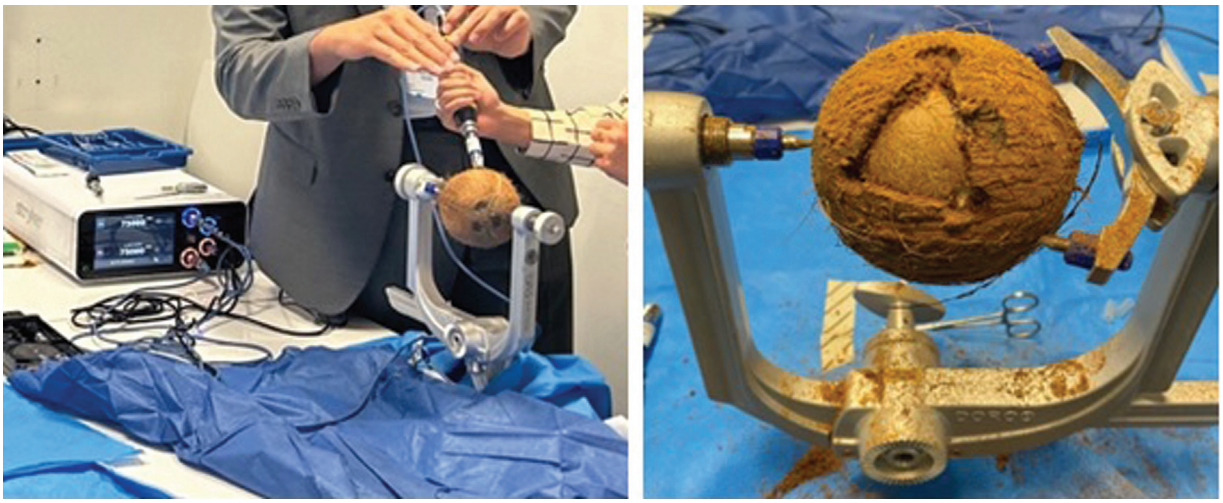

Fig. 4 Using coconut shells to simulate burr holes and craniotomy. Each delegate had the opportunity to perform craniotomy on a coconut shell. This involved using a perforator to create multiple burr holes, and then connect these together with a craniotome to complete a craniotomy. The coconuts were secured to the work surface with a Mayfield.

opportunity to challenge themselves in using a diamond drill on a boiled or raw egg (see ►**Fig. 5**).

Our skills event was based on the same principle of low-cost and optimum access for students as the 9th annual Glasgow Neuro International Conference.[19] However, our event was aimed at a smaller cohort and delivered an almost one-to-one ratio of simulation teaching under expert tuition. This provided an opportunity for the tutor to identify each student's learning needs and adapt the hands-on learning experience to the individual.[27]

Neurosurgical conferences and skills events also facilitate conversations with senior clinicians that can potentially help demystify an area of the medical school curriculum that is perceived by many students to be one of the most challenging and daunting.[28,29] Discussions with facilitators improved the students' understanding of a neurosurgeon's roles, responsibilities, and day-to-day tasks, and thus helped to perhaps dispel some of the angst students may feel toward the specialty.

All students reported to enjoy the course. However, on comparison of pre- and postevent questionnaires, there was a 11.2% decline in students stating to be interested in a future career in neurosurgery (72.0 vs. 61.1%). We hypothesize that this could be due to becoming more aware of the implications and intensity of training application. Considering this, we found students to become significantly more understanding of neurosurgery application process postskills event compared with preskills event, with the greatest mean difference (in comparison to other topics and skills addressed on the day) of 2.50 ($p < 0.0001$).

While this event was a good solution to increase learning and exposure to neurosurgery, we considered that for some

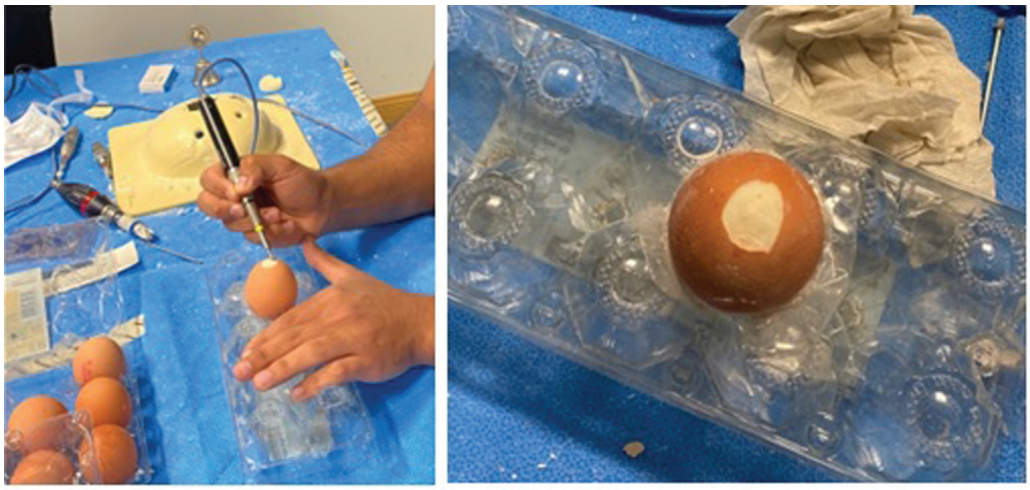

Fig. 5 Each delegate had the opportunity to use a diamond drill on the eggshells of both boiled and raw eggs. The former involved ensuring to penetrate the shell (i.e., the skull), but not disrupting the underlying membrane (i.e., the dura), and thus indenting the underlying solid egg white. The latter involved ensuring full penetrate of the shell without seepage of the liquid egg white. Eggs were secured to a support (carton) beneath while using the drill. The aim for participating students was to create the biggest circular lesion as possible without penetrating the membrane.

students it may be a once-off experience. Therefore, we created some online electronic learning modules (Sway modules) for the students as a long-term initiative to not only facilitate enhancement of the learning during the event but also a means for the students to have continued access to a substantial neurosurgery learning resource.

This study has limitations. First, the sample size was small ($n = 18$) and may have influenced the statistical significance of some responses. However, we have highlighted that we preferred a smaller cohort to achieve a higher tutor to student ratio. This was also a pilot event and the first of its kind. In the upcoming years, we aim to increase the number of delegates per skills event, and continue to reassess our feedback. Second, there was an element of selection bias, with most of our delegates being from the University of Dundee. This may be mainly due to a greater support and advertising from societies within the local medical school and represents a greater need to reach out to and raised awareness about the event at other universities to a greater extent. Third, the event was performed in a lecture / teaching facility. This facility was free for use, and hence the choice of location for an event aimed at being as affordable as possible. In future years, we would hope that we would acquire funding to enable the event to be performed in a more costly surgical skills center. This would allow us to improve simulation techniques and use larger equipment that we were unable to transfer into the facility (e.g., neuronavigation equipment). Finally, the results of this study were subjective in the most part and based on individual experiences and expectations. We have tried to quantify our results where possible; however, they still should be interpreted knowing the above.

Conclusion

For medical students interested in a career in neurosurgery, opportunities to learn relevant techniques and skills are often expensive, and difficult to come across. Here, we highlight affordable methods of simulation to result in significant student satisfaction. Additionally, providing ample opportunity to practice different neurosurgical techniques under almost one-to-one level tutoring enables significant increases in students confidence and understanding of different neurosurgical concepts. We greatly encourage other medical student groups to develop their own hands-on simulation events to attract medical students to a surgical field often considered daunting and inaccessible, and address gaps in the medical school curriculum.

Authors' Contributions

Dana Hutton and Mohamed Okasha organized the study. Mohamed Okasha and Nicholas Scott helped in burr holes and craniotome use. Michael Helley, Tony Poutney, Mohammed Ashraf, and Hassan Ismahel contributed to EVD insertion and ICP monitoring. Nathan McSorley and Beverley Page helped in cranial skin flaps. Katie Hepburn and Carmen Chai provided suturing skills. Belal Mohamed and Daniel Sescu contributed to clinically relevant neuroanatomy and neuronavigation. Mohammed Abdulrahman and Roslyn Porter helped in spinal fixation and pedicle screws. Dana Hutton, Emma Lumsden, and Poppy Wright helped in catering and event flow. Poppy Wright contributed to photography. Dana Hutton managed social media, advertising, and designing.

Conflicts of Interest

None declared.

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