



Original Research

Perspectives of Surgical Branch Residents on Anatomy Education and Its Importance

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Abstract

Objectives: To evaluate the pre-graduation anatomy training of residents from multiple surgical specialties and to assess their views and needs concerning anatomy during their surgical residency training.

Methods: Following the acquisition of the requisite institutional approvals, a questionnaire prepared using the Google Survey platform was circulated online among physicians at various stages of surgical residency training. This multicenter study included participants from multiple hospitals across different cities in Türkiye. Questions about participants' demographic characteristics and experiences with anatomy training during both their undergraduate and specialist training were asked. All responses were analyzed statistically.

Results: A total of 143 surgical residents participated in the study. Of the participants, 31.5% were female and 68.5% were male, and the mean age was 28±2.8 years. Of the residents, 67.1% had taken anatomy courses in the first two semesters of medical school, and 67.7% stated that they found their medical education inadequate for surgical residency. During their undergraduate education, 97.2% of the participants received face-to-face anatomy practice training, 47.6% received training with cadavers and plastic models. In addition, those who were trained with cadavers were more supportive of anatomy integration ($p=0.031$). It was also noteworthy that senior residents (defined as those with ≥ 2 years of residency training) considered anatomy integration into surgical residency training more necessary ($p=0.006$).

Conclusion: This study highlights the critical role of anatomy knowledge in surgical training and emphasizes its importance in the effective integration of education during surgical residency training.

Keywords: Anatomy, integration; surgical education, surgical residency

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Anatomy, as a branch of science, examines the normal structure of the human body, the functioning of these structures, and their interconnections. It is a core component of the basic sciences curriculum in medical schools. A

strong foundation in anatomy is essential for establishing accurate clinical diagnosis and determining appropriate surgical approaches, playing a critical role in specialization training across clinical and surgical disciplines.^[1] Tradition-

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al anatomy education includes cadaver dissection and the use of plastic models, providing students with a three-dimensional (3D) understanding of anatomical structures.^[2]

Postgraduate medical education involves specific training programs tailored to the expectations and requirements of each medical specialty. Specialization training in surgical branches is a complex process that integrates multidisciplinary knowledge and skills. Among the cornerstones of this process, anatomy knowledge remains an indispensable element of surgical practice.^[3,4] The anatomy education provided during undergraduate training is of critical importance for surgical residents and medical specialists; it enables the accurate identification of anatomical structures, correct diagnosis, effective surgical planning, and the prevention of intraoperative complications.^[5] In particular, detailed knowledge of vascular and nerve anatomy increases precision during surgical procedures, while a lack of anatomical knowledge may increase the risk of complications.^[1] Previous studies have shown that students who receive comprehensive training in cadaver dissection during medical school and those who receive clinically focused anatomy training develop safer and more successful surgical skills during their specialist training.^[6] Surgical specialty programs aim to provide residents with the necessary level of anatomical knowledge for surgical applications and ensure its effective use in patient care both inside and outside the operating room. Furthermore, it has been emphasized that topographic anatomy training should be integrated with radiological imaging and supplemented with cadaver dissection during specialization training.^[3,4]

Few studies have evaluated the adequacy of pre-graduation anatomy training during specialization training and its effectiveness in clinical practice.^[7-9] In this context, the present study aimed to assess the adequacy of anatomy education received before graduation, gather residents' feedback on their undergraduate anatomy training, and evaluate the extent to which anatomical knowledge is needed during surgical specialization training. Additionally, the study aimed to contribute to the literature by highlighting the necessity of integrating anatomy education into surgical residency training.

In this context, the present study focuses specifically on surgical residency training and aims to evaluate whether undergraduate anatomy education adequately meets the practical and clinical demands encountered during residency.

Methods

In accordance with the principles of the 1964 Helsinki Declaration, ethical approval for this study was obtained from

the Istanbul Yeni Yuzyil University Scientific and Health Sciences Research Ethics Committee (IRB No: 2023/10-1105). The research was conducted between January 2024 and January 2025 using a Google Survey Form developed by the University of Istanbul Yeni Yuzyil, in collaboration with Kanuni Sultan Süleyman Training and Research Hospital and Kırıkkale University Faculty of Medicine Hospital, with the participation of residents working in various hospitals across Türkiye. The survey form was administered to residents undergoing specialist training in surgical branches and recruited using the snowball sampling method. The survey was initially distributed to surgical residents working in university hospitals and training and research hospitals, who were then asked to share the questionnaire with colleagues in other institutions. Snowball sampling was selected to facilitate access to residents from different surgical specialties and institutions within a limited time frame. The participants were informed that the survey was completely anonymous and voluntary. In addition, on the first page of the survey, residents' statements confirming that they participated in the study voluntarily were obtained. Residents who were not receiving specialist training in surgical branches but were temporarily assigned to surgical units for rotation at the time of the study were excluded.

The questionnaire was developed based on a review of the relevant literature and refined through expert opinion from anatomists and clinicians involved in surgical education. Prior to distribution, survey items were reviewed for clarity and content relevance. The questionnaire consisted of two sections. The first part included short-answer and multiple-choice questions addressing the participants' age, gender, institution, branch, and year of residency training. Participants were also asked about the periods during which they received anatomy education during their undergraduate training, the materials used for practical training, whether cadaver training involved prosection or dissection, whether their training coincided with the pandemic period, and whether instruction was delivered face-to-face or online. Multiple-choice questions (with an option for additional comments) assessed the participants' opinions on the optimal timing of anatomy education and the most effective materials for practical training. Using a 5-point Likert scale, the participants evaluated the contribution of their undergraduate anatomy education to their surgical residency training, its adequacy, the frequency with which they needed anatomy resources during specialization, and their perceived necessity of integrating anatomy into surgical residency training. The second part of the form focused on the participants' views regarding the status and necessity of anatomy rotations during their specialization training.

Statistical Analysis

The Kolmogorov–Smirnov test was used to assess the normality of the data. Continuous variables were presented as the mean±standard deviation (SD) or median (minimum–maximum), while categorical variables were presented as numbers (n) and percentages (%). Comparisons of categorical variables between groups were performed using Pearson's chi-squared test. Statistical analyses were conducted using IBM SPSS Statistics for Windows 21.0 (IBM Corp., Armonk, NY, USA), and $p < 0.05$ was considered statistically significant.

Results

Participant Characteristics

A total of 143 residents specializing in surgical branches from 19 hospitals across different cities in Türkiye participated in the study. The distribution of participants by institution type and surgical branch is given in Table 1. The ages of the residents ranged from 24 to 47 years, with a mean age of 28 ± 2.8 years, and 68.5% of the participants were male. Of the participants, 25.2% were first-year residents,

37.1% were second-year residents, 11.2% were third-year residents, 11.9% were fourth-year residents, and 14.7% were fifth-year residents.

Undergraduate Anatomy Education and Training Methods

According to the curriculum of medical faculties in Türkiye, 67.1% of residents reported taking anatomy courses only during the first two semesters (1st and 2nd semesters), 13.3% during the 1st to 3rd semesters, 1.4% during the 1st to 4th semesters, and 1.4% during the 1st to 5th semesters, while 11.2% reported taking anatomy courses intermittently or during various semesters (e.g., only the 2nd semester, 2nd and 3rd semesters, 2nd to 4th semesters, or only the 4th semester). When asked, "In which terms of your undergraduate education do you think anatomy courses should be given?", 24% selected terms other than Term 1, 37.1% selected Terms 1 and 2, 15.4% selected Terms 1, 2, and 3, and 33.5% preferred the clinical term.

Among the residents undergoing specialization training, 97.2% received theoretical and practical anatomy courses face-to-face during their undergraduate education. Only four participants received anatomy training during the COVID-19 pandemic period. In this context, 1.4% took anatomy courses exclusively online, and 1.4% received both face-to-face and online instruction during their undergraduate studies.

In total, 47.6% of the residents reported receiving anatomy practice training through traditional methods (cadaver dissection and plastic models) during their undergraduate education. Additionally, 14% used web-based methods alongside traditional practices, 25.8% received practice training only with plastic models, 2.8% used web-based methods combined with plastic models, 9.1% received training exclusively with cadavers, and 0.7% received training using web-based methods combined with cadavers. Among participants who received cadaver-based training, 57.3% received prosection-based training, 4.2% received dissection-based training, and 9.1% received training through both methods. Meanwhile, 29.4% reported that they did not receive any cadaver-based anatomy training during their undergraduate education.

Perceptions of Anatomy Integration During Surgical Residency

Responses to the question "How do you think anatomy training should be in medical education?" are presented in Table 2. Participants who had received cadaver-based anatomy training were significantly more likely to support the integration of anatomy into surgical residency training ($p = 0.031$), as shown in Table 2.

Table 1. Distribution of residents specializing in surgical branches by the institution type and surgical field.

	Number (n)	Percentage (%)
Affiliated institution		
Faculty of medicine	67	46.9
Training and research hospital	55	38.5
City hospital	21	14.6
Department		
General surgery	48	33.6
Obstetrics and gynecology	24	16.8
Ear, nose and throat diseases	21	14.7
Urology	18	12.6
Plastic, reconstructive and aesthetic surgery	9	6.3
Eye diseases	7	4.9
Anesthesiology and reanimation	5	3.5
Neurosurgery	3	2.1
Orthopedics and traumatology	4	2.8
Pediatric surgery	1	0.7
Gastroenterology surgery	1	0.7
Cardiovascular surgery	1	0.7
Thoracic surgery	1	0.7
Total	143	100

Table 2. Distribution of the responses from surgical residents regarding how anatomy training should be conducted in medical education

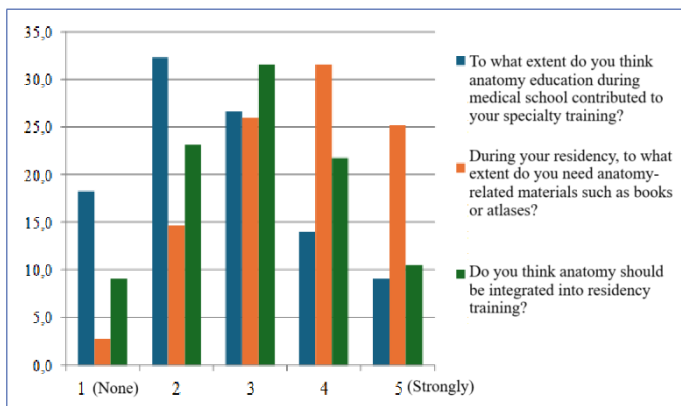
Responses	Total (n=387)	*%	**%
More emphasis must be placed on 3D data-based anatomy applications	103	26.6	72.0
The emphasis must be on cadavers	76	19.6	53.1
The emphasis must be on radiological anatomy	73	18.8	51.0
The emphasis must be on cross-sectional anatomy	63	16.2	44.0
Current traditional education methods are sufficient (cadaver dissection and plastic models)	51	13.1	35.6
Theoretical lectures are sufficient	21	5.4	14.6

*Calculated based on the total number of answers given, **Calculated based on the number of participants.

When asked, "In your opinion, to what extent was the anatomy training you received during your medical education sufficient for surgical residency?", 67.7% of the participants found it insufficient, 21.7% were undecided, and only 14.6% considered it sufficient. The residents' responses to statements about anatomy education in medical training were rated on a 5-point Likert scale (Fig. 1).

A total of 11 (7.6%) residents reported completing an anatomy rotation during their specialization training. Of these, three completed their rotation training in the first year, two in both the first and second years, five in the second year, and one in the fifth year.

A statistically significant difference was found between residents who received cadaver-based training during medical school and those who did not ($p=0.031$). Specifically, 57.3% of residents who received cadaver-based anatomy training supported anatomy integration during surgical

**Figure 1.** Percentage distribution of the responses from surgical residents to statements about anatomy training in medical education.

residency training, compared with 38.1% of those who did not receive cadaver-based training. Participants with cadaver experience were more likely to support the integration of anatomy into their surgical residency training.

A statistically significant difference was observed between junior residents (those with less than two years of training) and senior residents (those with two or more years) regarding the perceived necessity of integrating anatomy into specialization training ($p=0.006$). Senior residents were significantly more likely to consider anatomy integration essential.

No statistically significant difference was found between residents training at a university hospital and those at training and research hospitals or city hospitals in terms of their views on the necessity of integrating anatomy integration into surgical residency training ($p=0.780$, Table 3). For the analysis presented in Table 3, training and research hospitals and city hospitals were grouped together due to the small number of participants in some categories, in order to ensure adequate cell counts and improve the statistical robustness of the analysis.

A statistically significant relationship was found between the residents' perceptions of the adequacy of their undergraduate anatomy training and their need for anatomy resources during surgical residency training ($p<0.001$). Surgical residents who rated their medical school anatomy education as insufficient or less than adequate reported a greater need for anatomy resources during their surgical residency training.

Discussion

The study revealed that 67.7% of participants perceived their undergraduate anatomy education as "inadequate" in terms of meeting the early requirements of surgical assistant training. This finding, rather than contradicting the fundamental aim of undergraduate education to impart the core anatomical competencies necessary for medical practice, indicates a 'transfer/application' gap in the transition to the rapidly increasing postgraduate demands for discipline-specific (procedural, operative, and imaging-related) knowledge and skills. Indeed, the fact that participants primarily experienced anatomy in their early years with limited surgical-oriented practical opportunities may make it difficult to meet the expected depth of regional-procedural anatomy, surgical approach planning, and radiological correlation requirements during assistant training. Therefore, our finding suggests not redefining the undergraduate curriculum with a "surgical training" mission, but rather strengthening the timing and content integration of the curriculum in the undergraduate-spe-

Table 3. Opinions of the surgical residents on the necessity of anatomy integration in surgical residency training by the type of training institution

Training institution		Do you think there should be anatomy integration in your surgical residency training?						p
		1 (Unnecessary)	2	3	4	5 (Necessary)	Total	
Education and research hospital/ City hospital	n	6	5	9	18	38	76	0.780
	%	7.9	6.6	11.8	23.7	50.0	100.0	
Medical faculty hospital	n	7	5	11	11	33	67	
	%	10.4	7.5	16.4	16.4	49.3	100.0	
Total	n	13	10	20	29	71	143	
	%	9.1	7.0	14.0	20.3	49.7	100.0	

Training and research hospitals and city hospitals were combined for statistical analysis due to low cell counts in individual categories.

cialization continuum. Feasible steps include spiral/vertical integration, anatomy enriched with clinical scenarios, cadaver- and simulation-based workshops, radiological-operative anatomy sessions, and bridge (bootcamp) programs at the start of residency. This approach is consistent with the literature indicating the need for longitudinal support of anatomy throughout medical education.^[4,10]

The rate of perceived inadequacy of anatomy knowledge among surgical residents in the present study was consistent with findings reported in the literature. Toogood et al.^[11] evaluated the anatomy knowledge and perceptions of residents beginning orthopedic specialization and found that participants rated the adequacy of their anatomy training at an average of 6.5 out of 10, with a correct answer rate of 44.2% on objective tests. These results indicate that anatomy education in its current form is limited for clinical practice. Similarly, Azer and Eizenberg reported that anatomical knowledge gaps among medical students and recent graduates could lead to difficulties in clinical practice.^[12] Kowalczyk and colleagues also emphasized that surgeons' inadequate anatomical knowledge may contribute to surgical complications and noted that new techniques such as minimally invasive or robotic surgery require the ability to visualize complex structures in three dimensions.^[13] These findings highlight the importance of not only theoretical knowledge but also practical applications in a clinical context in anatomy education. In our current study, 33.5% of participants stated that anatomy courses should be extended into the clinical years. The expectation here is that anatomy should be supported in conjunction with relevant disciplines throughout clinical placements, rather than being taught intensively only during the basic science years. The main reasons why this is currently only happening to a limited extent include curriculum intensity, time constraints in clinical lectures, limited cadaver and laboratory facilities,

and insufficient teaching staff. The proposed methods for this integration include brief reviews of relevant regional anatomy during clinical branch lectures, continuation of cadaver or dissection workshops during clinical years, addition of anatomy sessions correlated with imaging (CT/MRI) and endoscopy videos, and reinforcement of anatomy through clinical case scenarios. Thus, anatomical knowledge can be directly linked to the clinical decision-making process, moving beyond being an abstract basic science. The literature also reports that supporting anatomy education with a longitudinal and spiral approach enables students to retain the information more permanently.^[12,13]

Drake et al.^[14] emphasized the importance of clinical integration in anatomy education and recommended methods such as case-based learning, problem-solving scenarios, and clinical simulations. Similarly, Khalil et al.^[15] stated that the integration of basic and clinical sciences ensures continuity in education, while Pusparajah et al.^[16] noted that this approach increases student motivation and makes knowledge more permanent. In many medical schools in the United Kingdom, radiology and imaging methods are integrated into clinical anatomy education and contribute to the development of students' surgical planning, navigation, and clinical decision-making skills.^[17,18] When evaluated alongside the results of our study, extending anatomy courses into the clinical years in Türkiye and similarly strengthening interdisciplinary integration with radiology may enable students to relate their theoretical knowledge to real patient cases and better prepare them for surgical practice.

In the present study, residents who received cadaver-based training during undergraduate anatomy practice courses were significantly more likely to support the integration of anatomy into surgical residency training compared to those who did not (p=0.031). Notably, 29.4% of the partic-

ipants reported not receiving any cadaver-based anatomy training during medical school. Cadaver dissection provides students with the opportunity to develop 3D anatomical understanding, recognize anatomical variations, and enhance surgical skills.^[19] Collins similarly reported that cadaver dissection forms the foundation for surgical skills development, improving hand–eye coordination, tactile sensitivity, and problem-solving abilities.^[20] Ong et al.^[21] further emphasized that cadaver dissection fosters critical professional attributes such as empathy and professionalism. Although emerging technologies such as virtual dissection, 3D modeling, and augmented reality offer promising educational tools, they cannot fully replicate the experience of cadaver dissection. Cadaver-based training allows students to work with real tissues and observe anatomical structures in their natural context.^[22,23]

In this study, senior residents were significantly more likely than junior residents to consider the integration of anatomy into surgical residency training as necessary ($p=0.006$). This finding suggests that as surgical experience increases and surgical residency training progresses, the clinical importance of anatomical knowledge becomes better appreciated. With the growing complexity of surgical practice, detailed knowledge of anatomical structures becomes more vital, underscoring the need for the continuous updating of anatomy education. These results support the implementation of mentoring programs and collaborative study groups where senior residents can share their anatomical knowledge and clinical experiences with junior residents to enhance their anatomy training. Additionally, incorporating regular anatomy reviews and clinical–anatomical correlation sessions into surgical residency training programs may help residents address knowledge gaps and maintain up-to-date anatomical competence. The key finding of this study is that a substantial proportion of surgical residents perceive undergraduate anatomy education as insufficient for the practical demands of residency, highlighting the need for longitudinal and clinically integrated anatomy training.

Another important finding of this study is that residents who found undergraduate anatomy education inadequate showed a significant increase in their need for anatomy resources during their specialist training ($p<0.001$). This situation is also related to the changing attitudes of students during their education. Anatomy learning, which often remains exam-focused and theoretical during medical school years, becomes directly linked to clinical practice and patient safety with the transition to surgical residency; this directs residents toward atlases, textbooks, and online resources. This trend indicates that deficiencies are being

addressed through self-directed learning, while also being interpreted as a natural and expected part of surgical training. However, the limitations of undergraduate anatomy education—such as disconnected, intensive but short lecture blocks; limited dissection and practical opportunities; and a lack of integration with imaging and surgical scenarios—are highlighted as the main reasons for this gap. To overcome these shortcomings, it is recommended that the anatomy curriculum be extended longitudinally into the clinical years, interdisciplinary integration be strengthened, regular anatomy review sessions be held, and case-based scenarios and practical training related to structures in the operating theatre environment be added to the programs. This will ensure that anatomical knowledge adapts to the changing needs of students throughout their careers and directly contributes to surgical competence. These findings are particularly relevant for medical and surgical education in Türkiye, where anatomy education is largely concentrated in the early years of medical school and may not adequately address the evolving needs of surgical residency training.

Limitations

The study had some limitations. First, the data were collected using a survey, which may have introduced subjectivity and recall bias. Second, the number of residents participating in the study was limited, and due to the data collection method, a balanced distribution across different surgical branches could not be achieved, potentially limiting the generalizability of the findings. As a limitation of the snowball sampling method, it was not possible to determine the response rate or identify selection bias, as it was unknown how many individuals were informed about the survey but chose not to participate.

Additionally, the study relied solely on quantitative data. Future studies should incorporate qualitative methods to provide a more in-depth understanding of anatomy education, including residents' challenges, their learning preferences, and suggestions. Furthermore, differences in the anatomy-related needs and expectations of residents across various surgical specialties could be explored.

Conclusion

This study underscores the critical role of anatomy education in surgical residency training and highlights the perceived inadequacy of undergraduate anatomy preparation for clinical practice. Strengthening longitudinal and clinically integrated anatomy training may enhance surgical competence and patient safety. Future studies should explore specialty-specific anatomy needs and evaluate targeted educational interventions.

Disclosures

Ethics Committee Approval: The study was approved by Istanbul Yeni Yuzuil University Science and Health Sciences Research Ethics Committee (No: 2023/10-1105, Date: 03.10.2023).

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