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Impacting surgical training: Role of surgical anatomy dissection courses

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ABSTRACT

INTRODUCTION: Human anatomy is one of the fundamental pillars of basic medical sciences, which forms the cornerstone of the ever-evolving medical practice. It is, therefore, important to strengthen anatomy education at all stages of medical training. Since 2020, the Department of Human Anatomy, in collaboration with the Department of Surgery, organized surgical anatomy dissection courses to improve surgical practice safety and competence. This educational study aimed to share lessons learned from organizing anatomy dissection courses and measure the impact on knowledge and skills acquisition by surgical trainees.

METHODS: Courses were designed with clear learning objectives and programs. A pre-test was administered to trainees before the dissection course, and a post-test was organized at the end of the course. Descriptive statistics were used to compare pre- and post-test scores. A p-value less than 0.05 was considered statistically significant. The Likert scale was used to measure trainees' satisfaction at the end of every course.

RESULTS: From August 2020 to December 2021, 11 cadaveric dissection courses were organized, and 173 trainees from 6 Surgical Residency programs: Plastic surgery, General surgery, Orthopedic surgery, Urology, Neurosurgery, ENT, and Obstetrics and Gynecology. Nineteen trainers from the Surgery Department and Anatomy Department were involved.

There was a significant improvement in marks in the post-test test as compared to the pre-test score. The average increase in the mark was 26.4% with a 95% CI [23-0 – 29.7], p-value < 0.001.

There was a negative correlation (r=-0.8948, p-value < 0.001) between the marks at pre-test and the improvement score, suggesting that the lowest performers on the pre-test had the biggest post-test improvement.

Trainees' satisfaction was at a high level. 87.6% of trainees reported a desire to pursue training to become anatomy educators in the future.

CONCLUSION: Surgical anatomy dissection courses positively impacted surgical knowledge and skills acquisition, integrating anatomy into surgical training. Cadaver-based surgical procedures simulation should be encouraged and integrated into surgical curricula.

Keywords: Anatomy, Dissection, Surgical Anatomy, Surgical Training, Cadaver Course

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INTRODUCTION

Human anatomy is among the fundamental pillars of medical sciences, which forms the basis of the ever-evolving medical practice. Anatomy is essential for medical practice but more so for surgery. For the surgical patient's safety and the surgeon's confidence, it is imperative that the operated region's anatomy is mastered at the highest level [1].

Human anatomy is formally taught during the first and second years of the medical curriculum. At the University of Rwanda, the medical curriculum includes three anatomy modules that cover all parts of the human body and are taught in Year one and Year two [2]. At the postgraduate training level of all surgical disciplines curricula, a recall anatomy module relevant to the specialty is taught in Year 1, but has had a shortcoming of being only theoretical and not providing the students the exposure to actual anatomy structures.

Although there is recall of anatomy in clinical modules and clinical rotations, the transition between fundamental sciences learning and clinical sciences learning shows weakness in integration of basic and clinical sciences [1].

Globally, there is a concern about the anatomical knowledge exhibited by clinical class students or even medical graduates [1–3]. Clinical trainers are of the view that anatomy knowledge is not adequate for safe medical practices and, more so, for interventional procedures. This inadequate anatomical knowledge is constantly reported by clinical trainees, medical professionals, and students themselves [4,5]. This presents a risk for a patient who may experience unnecessary iatrogenic complications and the surgical trainees who may experience unpleasantly medico-legal litigation and professional frustration.

As a result of this concern for the gap in anatomy knowledge from medical graduates, the teaching of anatomy is under scrutiny worldwide and in the East Africa Community (EAC). Anatomy is one of the pillars for accreditation of medical and dental programs and mutual recognition of degrees that facilitate the free movement of medical and dental graduates within the EAC country members.

It is therefore advised to focus on strengthening anatomy education. The surgical residency curriculum offers anatomy as a basic course before trainees take the in-theater and in-hospital surgical training. This training strategy may not mitigate the anatomy–surgery integration observed in undergraduate medical training [1–5]. Researchers have demonstrated that even with the early integration of anatomy and clinical cases, anatomical knowledge retention and application when needed in clinical classes remain insufficient. Studies have also shown that clinical instructors may lack educational strategies to overcome identified clinical anatomical knowledge gaps [1].

Growing evidence has shown that anatomy clinical structured courses for senior medical students, surgical trainees and practicing surgeons have positively impacted the safety of procedures and the confidence of medical practitioners [1–3,5–9].

In this trend, since August 2020, the department of human anatomy has been collaborating with the department of surgery by organizing surgical anatomy dissection courses with the aim of impacting surgical safety and competencies. The aim of our study is to report the results from 10 consecutive surgical anatomy courses by senior surgical residents from September 2020 to December 2021.

METHODS

This study investigates the knowledge and skills acquired during cadaveric dissection courses.

Courses were designed with clear topics, learning objectives, and programs. Each course aims at integrating anatomy into surgical practices, and where feasible common procedures related to the region were simulated (Figure 1).

A pre-test was administered to the trainees before the dissection course, and the same test was taken as a post-test at the end of the course.

A course evaluation done at the end of the course measured the satisfaction of trainees and the relevance of the course through nine structured questions. Data were collected using the 5' Likert scale (1: strongly disagree, 2: disagree, 3: neither disagree nor agree, 4: agree, 5: strongly agree).

The competencies acquired by the trainees at the end of the course were assessed. Trainers identified ten specific concrete competencies and assessed, asking students if the competence was either fully attained, partially attained or not.

To further assess the quality of the course, trainees were requested to provide free comments on the positive aspects of the course and the areas where

Figure 1: Trainees focused on the dissection

improvements were needed.
The data were presented in percentage, mean, median and average. The statistical analysis has been done using the T-test.

RESULTS

Between August 2020 and December 2021, 11 cadaveric dissection courses were organized (Figure 1). The first course was a trial course and thus was excluded from this study. The 11 dissection courses were attended by 173 participants – trainees from the following postgraduate surgical training programs (plastic surgery, general surgery, orthopedic surgery, urology, neurosurgery, ENT, obstetrics, and gynecology).

Nineteen trainers from the surgery and anatomy departments were involved.
Ninety-nine trainees submitted both the pre- and post-tests and thus were included in our quantitative analysis.

The results of this study showed that the overall improvement average was 29.4% (Figure 2) and statistically valuable, $p<0.001$. Analysis of the test performances showed that the lowest performers in the pre-test had the highest improvement rate. There was a negative correlation ($r=-0.8948$, p-value < 0.001) between the marks at the pre-test and the improvement score (Figure 2 and Table 1). This suggests that those who scored less during the pre-test were those who improved their score the most during the post-test.
There is a significant improvement in marks in the post-test test compared to the pre-test score. The average increase in the mark was 26.4% with a 95% CI [23-0 – 29.7], p-value < 0.001.

The trainees' satisfaction survey showed that the trainees were highly satisfied. Further, 87.6% of trainees reported a desire to pursue training to become anatomy educators in the future (Table 2). The acquired competencies after the dissection

Table 1: Comparison between pre-education and post-education marks

Variable	N	Median	Mean	Std. Err.	[95% CI]
Post-test	99	80.0	79.9	0.88415	[78.2- 81.7]
Pre-test	99	54.4	53.5	1.972078	[49.6- 57.4]
Difference	99	22.5	26.4	1.683503	[23.0- 29.7]

Table 2: Trainees Satisfaction Survey using the Likert scale

Dissection course	I	II	III	IV	V	VI	VII	VIII	IX	X	Average
Pre-course communication was timely, organized, and bettered my understanding of my role and expectations during the course	4.88 (97.5%)	4.88 (97.5%)	4.83 (96.7%)	4.73 (94.5%)	5 (100%)	4.54 (90.8%)	5 (100%)	5 (100%)	4.86 (97.1%)	5 (100%)	4.87 (97.4%)
The topics were appropriate for the audience	4.75 (95%)	4.94 (98.8%)	4.58 (91.7%)	4.82 (96.4%)	5 (100%)	4.46 (89.2%)	4.71 (94.3%)	5 (100%)	4.86 (97.1%)	5(100%)	4.81 (96,2%)
Resources provided for the training were easy to use and adequate	4.88 (97.5%)	4.69 (93.8%)	4.83 (96.7%)	4.73 (94.5%)	5 (100%)	4.23 (84.6 %)	4.86 (97.1%)	5 (100%)	4.86 = (97.1%)	5 (100%)	4.81 (96.2%)
I felt that I was accepted by the team and I felt respected by the other team members	4.94 (98.8%)	4.94 (98.8%)	4.83 (96.7%)	4.82 (96.4%)	5 (100%)	4.31 (86.2%)	4.86 (97.1%)	5 (100%)	4.86 (97.1%)	5 (100%)	4.86 (97.1%)
This program is a great training mechanism for surgical training	4.94 (98.8%)	4.94 (98.8%)	5 (100%)	5 (100%)	5 (100%)	4.31 (86.2%)	4.86 (97.1%)	5 (100%)	4.86 (97.1%)	5 (100%)	4.89 (97.8%)
I would like to attend future courses of this kind	4.94 (98.8%)	4.94 (98.8%)	5 (100%)	5 (100%)	5 (100%)	4.31 (86.2%)	4.71 (94.3%)	5 (100%)	4.86 = (97.1%)	5 (100%)	4.88 (97.5%)
I would recommend this training program to other surgery residents	4.94 (98.8%)	4.94 (98.8%)	5 (100%)	4.91 (98.2%)	5 (100%)	4.31 (86.2%)	5 (100%)	5 (100%)	4.86 (97.1%)	5 (100%)	4.90 (97.9%)
I would like to continue training to become a Clinical anatomy educator	4.44 (88.8%)	4.44 (88.8%)	4.45 (89.1%)	3.91 (78.2%)	4.8 (96%)	3.62 (72.3%)	4.57 (91.4%)	5 (100%)	4.57 (91.4%)	4 (80%)	4.38 = (87.6%)
I would like to join the Society of Clinical Anatomy of Rwanda (S-CAR)	NA	NA	NA	NA	NA	NA	4.71 (94.3%)	5 (100%)	4.86 (97.1%)	4 (80%)	4.64 (92.9%)

courses were very good, as shown in Appendix 1. One of the most challenging gains to acquire was on the heart, which is understandable as there is not a functioning cardiac surgery unit in the county.

DISCUSSION

Sound anatomical knowledge is an essential requirement for medical practice. Anatomical knowledge allows medical trainees and professionals to examine the patients, communicate with the team and patients, elaborate the diagnosis, and perform interventional and surgical procedures
Since Sinclair's Lancet editorial notes in 1975 about medical students' lower level of anatomical knowledge, numerous authors have reported similar concerns [1]. The debate on this anatomical knowledge gap suggests different causes ranging from the curriculum, mode of delivery, and integration of fundamental sciences and clinical sciences learning [1–6]. The nature of forgettable basic sciences knowledge has also been reported [1]. Those concerns should lead to educational strategies that stimulate anatomical lifelong learning attitudes for those who need it the most, and surgeons are undebatable in being included.
Our study evaluated an educational intervention that intended to bridge the anatomical knowledge of surgical trainees. Our results demonstrated an excellent improvement in performance after the dissection course. Interestingly, the trainees with the most limited pre-test knowledge showed greater improvement. This may be due to the fact that they had more room for growth compared to those students who had a higher level of baseline knowledge. Our results also showed that the pre-interventional performances are improving with the next courses. This indicates that trainees are picking interest and have a changing attitude toward continuity in learning anatomy. Authors have suggested this form of vertical integration of anatomy in medical education from the undergraduate, postgraduate, and continuous professional development programs [1,7–9].
This educational intervention was a trainee-centered learning activity, and most of the tasks were done by the trainees, while the role of trainers was mainly supportive. The satisfaction survey of trainees showed that they were highly satisfied with the course. This is in accordance with various publications underscoring the importance of dissection courses in surgical training [2,3,7–9].
The program of cadaver surgical training (CST), which integrates anatomy and surgery at all levels of medical education, is surfacing in Rwanda through the regular organization of dissection courses [8,9].

CONCLUSION

The surgical anatomy dissection courses have proven to impact the surgical trainees' surgical

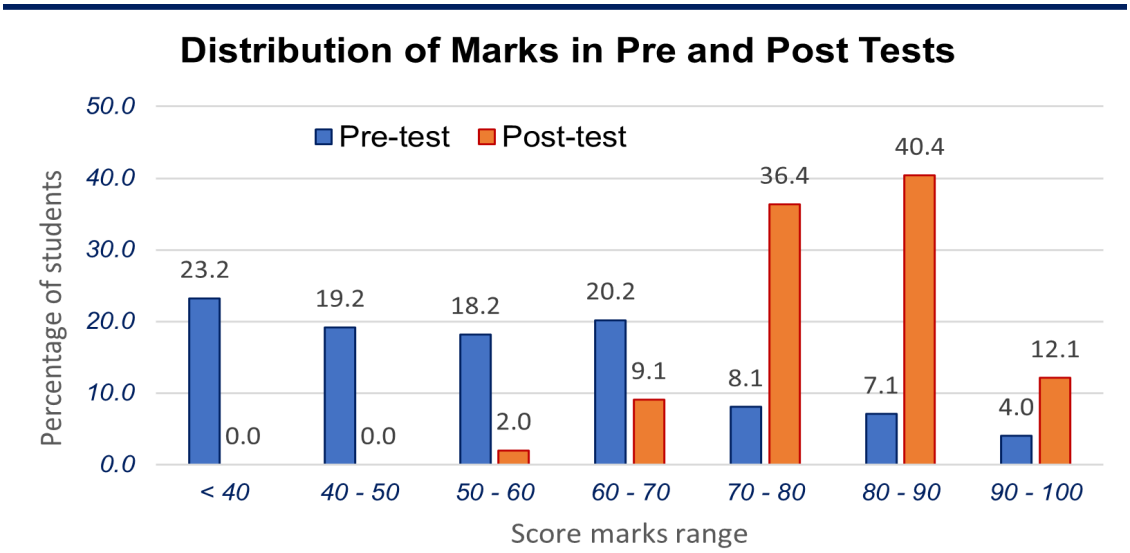

Figure 2: Distrubution of marks combining the data of different dissection courses.

competencies, thus influencing the surgical procedure's effectiveness and safety. Those courses are an integrative modality of anatomy into surgical practices. It should be understood that integration is not a moment but rather a long-term process that needs a virtuous cycle of learning – practicing – assessing, and re-learning. This virtuous cycle of professional development should be an individual as well as an institutional responsibility to unlock SurAnat (surgical anatomy) as an intimate value of surgeons. Further studies on the impact of such dissection courses on the engagement of trainees in complex surgical procedures are needed.

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Appendix 1: Competencies after dissection courses

Lower Limbs			
Competencies after the course	**Yes (fully)**	**Yes (Partially)**	**No**
Muscles of the pectoral region (pectoralis major and minor, subclavius, serratus anterior) and delto-pectoral groove and its contents	100%		
Brachial plexus (cords and terminal branches	85.7%	14.3%	
Axillary and brachial arteries and its main branches	71.4%	28.6%	
Superficial veins of the forearm and cubital fossa	85.7%	14.3%	
Cubital fossa contents and its relationship	84.6%	15.4%	
Superficial nerves of the forearm	42.9%	57.1%	
Carpal tunnel and its contents	85.7%	14.3%	
Palmar arches and its branches	85.7%	14.3%	
Radial nerve and deep radial nerve and its relationship	71.4%	28.6%	
Extensor retinaculum sub-compartments and contents	78.6%	21.4%	
The thorax			
Layers of postero-lateral thoracotomy	100%		

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Layers during sternotomy	90.9%	9.1%	
Long thoracic nerve	54.5%	45.5%	
Azygos vein and azygos arch	72.7%	27.3%	
Esophagus and its relationship	100%		
Sympathetic ganglia, sympathetic trunks and greater splanchnic nerves	63.6%	36.4%	
Hila of lungs and disposition of structures	90.9%	9.1%	
Aorta, its parts, branches and its relationship	100%		
Superior mediastinum, contents and relationship	81.8%	18.2%	
Pericardial cavity and sinuses	63.6%	27.3%	9.1%
Heart, chambers, coronary arteries, cardiac vein and coronary sinus	45.5%	54.5%	
The infra colic compartment, retroperitoneal space and pelvic cavity			
Superior mesenteric artery, branches and relationship	90%	10%	
Inferior mesenteric artery, branches and relationship	100%		
Gonadal vessels, relationship and differences at right and left	80%	20%	
Mobilization of right colon and duodenum (Kocher maneuver)	100%		

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Mobilization of left colon (Mattox Maneuver)	100%		
Kidneys, hilum contents and relationship	90%	10%	
Adrenal veins difference at right and left	60%	40%	
Ureter, its course and relationship	100%		
Sympathetic chain	40%	60%	
Internal iliac artery and its branches	80%	20%	
Marginal artery of Drummond (Marginal arcade)	90%	10%	
Sacral plexus	30%	70%	
Psoas muscle, lumbar plexus nerves emerging patterns	70%	30%	
The lower limbs			
Gluteal muscles + pelvi-trochanteric muscles and relationship	92.3%	7.7%	
Gluteal vessels and nerves and emerging foramina	69.2%	30.8%	
Sciatic nerves, its emerging pattern and its relationship	92.3%	7.7%	
Pudendal vessels and nerve, nerve of obturator internus, nerve of quadratus femoris	53.8%	38.5%	7.7%
Popliteal fossa: boundaries, contents and its disposition	92.3%	7.7%	

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Layers of posterior compartment of leg + pathway of tendons	76.9%	23.1%
Tibial nerve & posterior tibial artery, its branches and pathway	84.6	15.4%
Femoral triangle, boundaries and contents + branches of femoral nerve & greater saphenous vein pathway	92.3%	7.7%
Deep femoral arteries branches The neck	92.3%	7.7%
Layers of thyroidectomy cadaveric simulation	85.7	14.3%
Right and left external branches of the SLN	85.7%	14.3%
Right and left RLN	71.4%	28.6%
Parathyroid glands	14.3%	85.7%
Branches of external carotid artery (superior thyroid, lingual and facial arteries)	71.4%	28.6%
Neck triangles, boundaries and contents	57.1%	42.9%
Hypoglossal nerve	71.4%	28.6%
Accessory nerve and its course	42.9%	57.1%
Phrenic nerve and it course	57.1%	42.9%
Brachial plexus	57.1%	42.9%

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The abdominal wall, inguinal region and supra-colic compartment		
Layers of the anterolateral abdominal wall and associated structures		
Rectus sheath and its contents	12.5%	
Inguinal canal (superficial ring structures, its walls, contents +inferior epigastric vessels)	25%	
Umbilical folds, peritoneal ligaments, mesenteries	25%	
Hepato-duodenal ligament, its contents and disposition	12.5%	
Calot triangle and content	12.5%	
Celiac trunk and its branches	12.5%	
Stomach blood supply		
Stomach lymphatic drainage	37.5%	25%
Pancreas-duodenum complex, its blood supply and relationship	37.5%	