JOURNAL OF ABDOMINAL WALL SURGERY
EUROPEAN HERNIA SOCIETY

TYPE Original Research
PUBLISHED 04 November 2026
DOI 10.3389/jaws.2026.17125

Check for updates

OPEN ACCESS

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RECEIVED 11 June 2026
REVISED 06 August 2026
ACCEPTED 19 October 2026
PUBLISHED 04 November 2026

CITATION
Taremwa M, Basimbe F, Mubezi I, Kakooza F, Oppong C and Akoh J (2026) Surgical skill retention among surgery trainees following standard surgery skills acquisition workshops model early preliminary findings, a mixed method study.
J. Abdom. Wall Surg. 5:17125.
doi: 10.3389/jaws.2026.17125

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Surgical skill retention among surgery trainees following standard surgery skills acquisition workshops model early preliminary findings, a mixed method study

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Background: In resource-limited settings, postgraduate surgical training often faces constraints such as limited supervision, inconsistent operative exposure despite the high patient loads that presents a paradox. To address these gaps, surgical training Workshops have emerged as a supplemental strategy to enhance hands-on procedural competence. However, the extent to which surgical skills are retained following such intensive interventions remains unclear. We aimed to investigates the medium-term retention of surgical competence in standard hernia repair among surgical residents in Uganda who participated in a structured surgical skills transfer program.

Methods: we employed a longitudinal mixed-methods design. A purposive sample of 8 surgical residents, membership and fellowship of surgery candidates who were recruited to surgical skills transfer program and where followed up at three assessment points: pre-Training (D0), immediate post-training (D1), 1.5 months post-training (FU). Quantitative data collection will utilize College Of Surgeons of East Central and Southern Africa (COSECSA) -validated tools, including self-assessments, trainer assessments, structured OSCEs, and surgical logbooks. Qualitative data was gathered through in-depth interviews and focus group discussions with a sub-sample of doctors and faculty mentors. Quantitative data was analyzed using descriptive statistics, paired and multivariate analyses, while thematic analysis was applied to qualitative narratives. Data triangulation was used to support a comprehensive understanding of skill retention trajectories and influencing factors.

Results: The study reported improvements in self-assessed and trainer-assessed surgical competence immediately post-training, with measurable retention in the short-term. Qualitative insights highlighted enablers such as mentorship and procedural frequency, as well as barriers like institutional workload and limited access to operative cases.

Conclusion: This study generated important evidence on the effectiveness of surgical training Workshops in fostering sustainable surgical skills among surgery residents, this presents promising preliminary findings of a small residents cohort.

Recommendation: short-term surgical intensive skills workshops should be integrated into formal residency programs in Uganda and similar low-resource settings, enhancing both skill acquisition and long-term competence.

KEYWORDS

hernia specialists, hernia surgery, lichtenstein procedure, medical education, surgery training workshops

Introduction

The development and retention of surgical skills are critical for building a competent and self-sustaining surgical workforce, particularly in low- and middle-income countries (LMICs) such as Uganda, where access to safe surgical care remains limited. Inguinal hernias are among the most common surgically treatable conditions worldwide, and in Uganda, it is estimated that over 100,000 individuals require hernia surgery each year. However, a significant proportion of these patients remain untreated due to a critical shortage of skilled surgical providers and limited operative training opportunities for surgical doctors, particularly at district and regional referral hospitals. Enhancing competency in standard hernia repair, particularly the Lichtenstein technique, has therefore become a national priority for surgical education and workforce development.

Globally, surgical training has transitioned from time-based apprenticeship models to competency-based medical education, emphasizing measurable skill acquisition through simulation, deliberate practice, and structured feedback [1, 2]. In contrast, surgical residency programs in Uganda remain predominantly service-oriented, with limited access to simulation laboratories or structured skills training. In overcrowded tertiary teaching hospitals, doctors often compete for scarce operative opportunities and may spend extended periods in observational roles due to unfavourable supervisor-to-trainee ratios [3, 4].

Emerging evidence underscores that without regular, deliberate practice, surgical skills, particularly those used in minimally invasive surgery (MIS) deteriorate over time [5]. The degree of skill decay is directly related to the length of time skills go unused and is mitigated when a higher baseline level of proficiency is achieved prior to the interruption [6]. In this context, simulation-based surgical training is gaining prominence not only as a powerful tool for initial skill acquisition, but also as a proven method to reduce surgical error rates, enhance patient safety, and support long-term skill retention through standardized assessment and refresher practice.

To address the limitations of hospital-based surgical training, particularly the scarcity of hands-on operative experience and simulation access, short-term surgical training Workshops have emerged as a practical and innovative supplement to traditional residency models. These intensive, skill-focused interventions offer immersive, high-volume surgical exposure in district or mission hospital settings, where doctors can concentrate on mastering key procedures under close supervision. Since 2016, more than 10 surgical skilling workshops have been conducted in Uganda through a collaboration between College of East Central and Southern Africa and Operation Hernia an International Medical Charity with a specific focus on standard inguinal hernia repair using the Lichtenstein technique. Through these Workshops, over 60 surgical residents from Makerere University, Mbarara University of Science and Technology, Uganda martyrs university, membership and fellowship; candidates from the college of surgeons of east central and southern Africa (COSECSA) and other postgraduate training programs have each had the opportunity to perform 10 to 15 supervised hernia repairs, with strict competence assessment and scoring, significantly exceeding what many would encounter in typical tertiary hospital rotations. These experiences are particularly valuable given the known risk of skill decay without regular practice [5, 6] and the growing recognition of simulation and repetition as essential strategies for reinforcing surgical competence and ensuring long-term retention [2, 7].

The cumulative effect of these efforts has been a notable increase in surgical doctors' confidence and technical competence in performing hernia repairs. Consistent with findings from both high- and low-income settings, boot Workshop-style interventions have been shown to yield significant improvements in procedural performance and self-efficacy [8–10]. However, despite these initial gains, concerns persist regarding the durability of skills acquired during such short-term training. As doctors return to routine clinical rotations, often marked by limited case availability, high patient volume, low supervision, and insufficient mentorship, there is a high risk of skill decay, particularly in the absence of deliberate practice or reinforcement [5–7, 11].

This study aimed to address that critical gap by evaluating the retention of technical skills in standard hernia repair among Ugandan surgical residents weeks after participation in a surgical Hernia Operative skills transfer workshop. Using the OSATS tool adapted for inguinal hernia procedures, it compares doctors' operative performance immediately after the Workshop with their performance after up to 6 weeks after training. In addition, the study investigates contextual factors including post-Workshop surgical exposure, access to senior supervision, and frequency of self-initiated practice that may influence the maintenance or deterioration of acquired skills.

In Uganda, medical schools have responded to workforce shortages by significantly expanding enrolment. However, this expansion has outpaced the capacity of teaching hospitals and specialist mentors to provide adequate, hands-on clinical training. As a result, residency programs often operate in overcrowded clinical environments, with minimal supervision where doctors struggle to gain sufficient exposure to essential surgical procedures, such as standard inguinal hernia repair.

In response to these challenges, surgical training workshops have emerged as a strategic intervention to supplement traditional residency training.

A critical gap, therefore, exists in understanding whether surgical workshops lead to durable skill retention among surgery residents, and what contextual or individual factors (such as operative case volume, access to supervision, or frequency of

practice) contribute to sustaining or eroding those skills over time. Addressing this knowledge gap is essential to informing the design of sustainable, competency-based surgical education models in Uganda and similar LMIC contexts. Such insights are vital for aligning short-term training interventions with long-term workforce development goals and the growing surgical needs of the population.

Materials and methods

We employed a quasi-experimental repeated-measures longitudinal mixed-methods design to evaluate the acquisition and retention of surgical knowledge and technical competence in standard hernia repair among surgical trainees following participation in a structured Hernia repair training workshop.

The design was organized around three clearly defined assessment time points drawn from the available dataset. The first time point, D1, represented the baseline assessment conducted before the start of the hernia surgery skills workshop. This point was used to establish participants' initial level of procedural knowledge and technical competence before exposure to the training intervention. The second time point, D2, represented the immediate post-training assessment conducted at the end of the training period. This assessment captured the short-term effect of the workshop on learning and performance and was used to determine the extent of immediate knowledge gain and technical skill improvement after supervised instruction and repeated operative exposure. The third time point, 1.5 months post-training, represented the early follow-up assessment conducted 6 weeks after completion of the training.

This study was conducted within the context of standard hernia repair surgical training workshops involving postgraduate surgical residents of Uganda martyrs university, membership and fellowship candidates of the college of surgeons of east central and southern Africa and affiliated training sites. These workshops, organized under the auspices of university-affiliated professional bodies and non-governmental organizations, provided an intensive, supervised, and high-volume learning environment focused on the Lichtenstein tension-free mesh hernia repair technique. The workshop setting was specifically designed to maximize operative exposure within a condensed period by providing real patient cases, close mentorship from specialist surgeons, repeated opportunities for hands-on practice, and immediate structured feedbackthe workshop model concentrated learning in a way that promoted deliberate practice, rapid skill acquisition, and reinforcement of procedural competence. Follow-up assessments were then conducted after participants returned to their usual clinical placements, allowing evaluation of how effectively the skills acquired during the workshop were transferred and sustained in real clinical environments where case exposure, supervision, and institutional support differed.

The primary outcomes of this study were retention of technical skill and retention of procedural knowledge in standard hernia repair. Technical skill retention was measured using repeated structured assessments of operative performance based on the Objective Structured Assessment of Technical Skills framework and a hernia repair–specific task checklist. The global rating scale helped assess overall technical competence across domains such as respect for tissue, time and motion, instrument handling, knowledge of procedure, flow of operation, use of assistant, and overall performance [12]. The task-specific checklist also assessed whether the critical steps of the Lichtenstein repair, including patient preparation, incision, inguinal canal exposure, identification and reduction of the hernia sac, mesh placement, fixation, and layered wound closure, were performed correctly and confidently. Knowledge retention was measured using structured pre-course and post-course knowledge assessment tools adapted from COSECSA instruments, as well as follow-up self-assessments where applicable. Qualitative analysis of focus group discussions were based on the criteria described by Basnet et al. [13].

Secondary outcomes included self-reported confidence, clinical exposure to hernia cases during follow-up, access to senior supervision, and perceptions of workshop usefulness. These variables were directly aligned with the study objectives, which sought to assess technical skill retention, procedural knowledge retention, and the contextual factors that influenced both.

TABLE 1 Participants demographics.

Variable	Number (N)
Gender	
Male	07
Female	01
Age	
20–29	02
30–39	04
Above 40	02
Years of practice	
0–4	01
5–9	04
Above 10	03
Level of training	
Surgical residents	06
College membership candidate	01
College fellowship candidate	01

Results

The demographics of the eight residents is shown in Table 1. The overall knowledge and skills scores before and after the training course are depicted in Table 2 and Figure 1.

Table 3, and Figures 2, 3 show the repeated measures in overall technical performance with statistically significant variation between the time points ($p = 0.0001$). The percentage change in total technical performance scores between different time points are shown in Table 4 and Figure 4. The greatest change was between D1 and D2. Performance on several technical domains followed the same pattern (Table 5). Overall technical performance continued to improve after the training.

TABLE 2 Overall pre- skills Training course and post-skills training.

Variable	Number	Pre-course mean (SD)	Post-course mean (SD)	Mean change	P -value
Knowledge score	8	6.88 (0.99)	8.62 (0.92)	1.75	0.013
Self-rated skill score	8	6.25 (1.04)	8.88 (0.99)	2.62	<0.001



FIGURE 1
Mean knowledge and self-rated skill scores before and after training.

Repeated checklist scores of key procedural steps showed steady improvement in mean scores over time points D1, D2 and 1.5-month except layered wound closure (Table 6). With respect to changes in topic-level procedural knowledge, tissue repair and epidemiology of paediatric hernias were not associated with any statistically significant change (Table 7). However, all the other topics were associated with a highly statistically significant improvement after training with mesh repair reflecting the greatest improvements (Table 7 and Figure 5).

Qualitative analysis of focus group discussions based on criteria described by Basnet et al [13]

Conceptual clarity after structured teaching

"Before attending the workshop, I had a general idea of hernia repair, but my understanding was fragmented. I could mention some steps from memory, yet I was not confident about the logic behind the sequence or the reasons certain actions were necessary. During the workshop, the teaching sessions connected the anatomy, the pathology, and the operative steps in a way that made sense to me. After that, I no longer viewed the operation as isolated tasks, but as one coherent procedure with a clear beginning, middle, and end . . . FGD-P01: "

Improved understanding of anatomy and operative landmarks: "One of the biggest changes for me was understanding the anatomy properly. Before the workshop, I often confused the structures in the inguinal region, especially when thinking about how to identify the sac and protect surrounding tissues. The trainers repeatedly emphasized the landmarks and then showed us the same structures during live surgery. That practical reinforcement made the anatomy much clearer, and I think that is why I became more confident both in answering questions and in following the operation. . .. FGD-P03"

Better understanding of mesh placement and fixation: "Previously, mesh repair was an area where I lacked clarity. I knew mesh was important, but I was not confident about why it was shaped, positioned, and fixed in a particular way. The workshop explained not only how to place the mesh, but also the purpose behind each step. That helped me understand the operation beyond imitation. By the end of the training, I felt that I was no longer simply memorizing instructions, but actually understanding the principles of repair. . .. FGD-P0"

Theory reinforced by immediate application: "What made the knowledge stay was the fact that the theory was immediately followed by practice. In many settings, we attend lectures and then do not get a chance to apply what we learned for a long time. In this camp, we discussed the procedure, then saw it, then performed it. That sequence made the knowledge much easier to remember and apply. . . FGD-P07"

Improved surgical judgment: "The workshop improved my judgment as much as my factual knowledge. I became better at thinking through the procedure, anticipating the next step, and understanding what could go wrong. That kind of knowledge is different from simply recalling facts, because it affects how you behave during surgery. . .. FGD-P09"

Improvement in technical skill

Rapid growth in confidence and hands-on control

FGD-P02: "At the beginning of the workshop, my movements were slow and hesitant. I was constantly second-guessing how to

TABLE 3 Repeated-measures trend in overall technical performance.

Variable	#	D1 mean (SD)	D2 mean (SD)	1.5 - month mean (SD)	Overall p-value
Global rating scale total (/35)	7	20.86 (2.79)	29.29 (2.75)	28.71 (2.93)	<0.0001
Checklist total (/24)	7	18.00 (3.56)	22.43 (0.79)	22.57 (0.53)	<0.0001

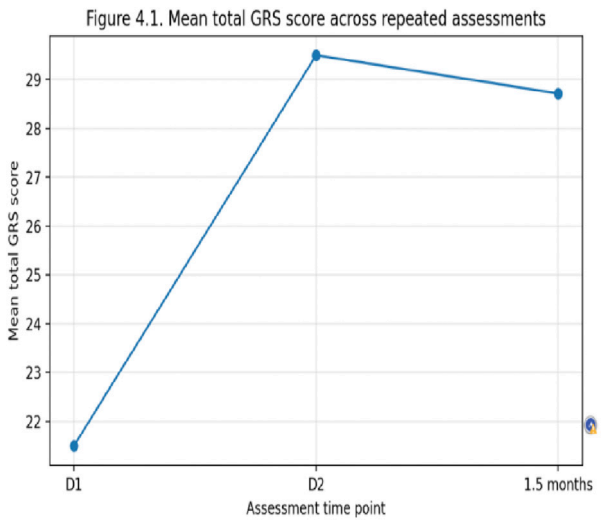


FIGURE 2
Mean total checklist score across repeated assessments. Skills Decay at 6 weeks Following skills Training Workshop. Show that while a small reduction occurred in the global technical score after participants returned to routine practice, the procedural checklist remained essentially stable. This suggests that early retention was stronger for the core steps of the operation than for broader elements of operative fluency.

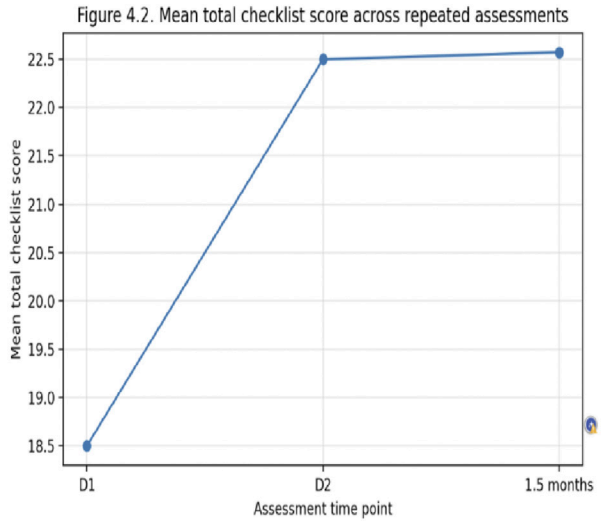


FIGURE 3
Mean total GRS score across repeated assessments. Skills Decay at 6 weeks Following skills Training Workshop. Show that while a small reduction occurred in the global technical score after participants returned to routine practice, the procedural checklist remained essentially stable. This suggests that early retention was stronger for the core steps of the operation than for broader elements of operative fluency.

hold instruments, where to place my hands, and whether I was exposing the field properly. As I repeated the procedure under supervision, that hesitation reduced significantly. By the end of the camp, I felt more in control of the instruments, more aware of the tissue planes, and more deliberate in the way I executed each step."

Skill acquisition through repetition

FGD-P04: "The repeated exposure during the surgical skills training workshop made a very big difference. In routine hospital practice, you may watch a case or perform a small part of it, but in the workshop, we had the opportunity to go through the operation several times in close succession. That repetition accelerated my learning. Each case built on the previous one, so the improvement was not only in knowledge but also in hand coordination, sequencing, and confidence."

Better tissue handling and respect for tissue

FGD-P06: "One area where I clearly improved was tissue handling. At first, I was either too cautious or too rough because I was unsure of the correct amount of tension and the correct instrument use. The trainers kept correcting me on how to handle tissue gently but effectively. Over the course of the camp, I became more conscious of economy of movement and atraumatic dissection, and I think that is one of the reasons my performance improved."

Improved procedural flow after guided practice

FGD-P08: "Before the workshop, I did not have a smooth mental map of the operation. I would pause, think, and sometimes depend too much on prompts. During the workshop, repeated supervised performance gave me a clear sense of flow. I became better at transitioning from one step to the next without losing orientation. By the end, the operation felt more organized and less fragmented."

Growth in operative independence

FGD-P10: "The most important improvement for me was moving from passive participation to active performance. In my previous experience I often assisted or observed, but in the workshop, I was expected to do the operation under supervision. That changed how I learned. It forced me to think and act like the primary operator, and I believe that is why my technical performance improved so much."

Short- to medium term skills retention at follow-up (i.e., 1.5 months)

Retained mental structure of the operation

FGD-P01: "When I returned to my usual clinical setting, I found that the overall structure of the operation had remained with me. I still remembered the major stages of the repair and the important landmarks to identify. Although I was not performing cases as intensively as during the workshop, I felt that the workshop had established a strong mental framework that persisted beyond the training period."

Sustained confidence above baseline

FGD-P03: "At follow-up, I was definitely more confident than I had been before the workshop. Even though some of the fluency

TABLE 4 **Percentage change in total technical performance scores across repeated assessments.**

Outcome	D1 mean	D2 mean	1.5-month mean	% change D1 to D2	% change D2 to 1.5 months	% change D1 to 1.5 months
Total GRS score	21.50	29.50	28.71	37.21	−2.66	33.55
Total checklist score	18.50	22.50	22.57	21.62	0.32	22.01

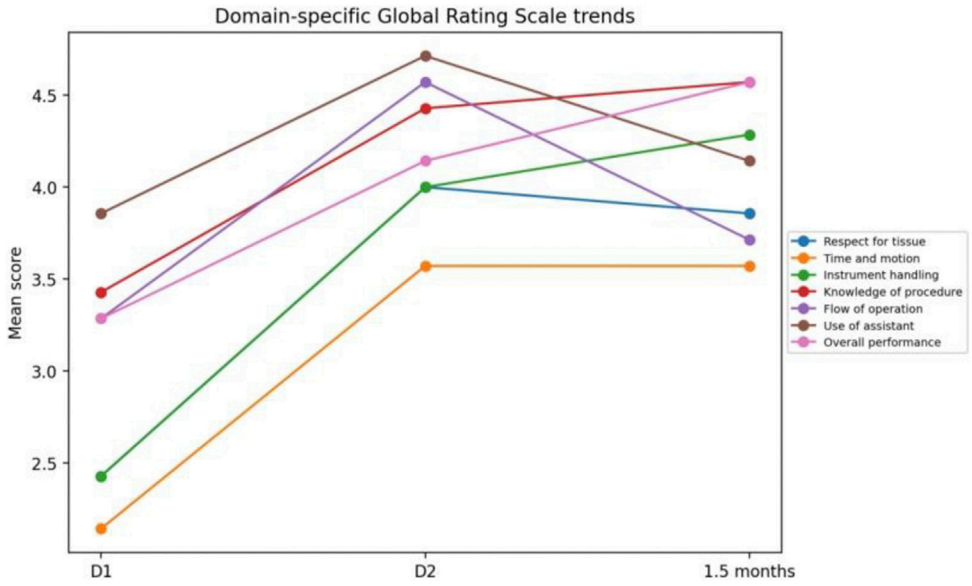


FIGURE 4
Performance of surgery trainees rated using the domain specific Global Rating Scale. As shown in Table 4, the mean total GRS score increased from 21.50 at baseline (D1) to 29.50 immediately after the workshop (D2), representing a 37.21% improvement. At the 1.5-month follow-up, the mean total GRS score was 28.71, indicating only a 2.66% decline from the immediate post-workshop level, while still remaining 33.55% above baseline. As illustrated in Figure 4. All domains improved between baseline and immediate post-workshop assessment, confirming a broad positive effect of the training workshop across the different components of surgical performance. Foundational competencies such as knowledge of procedure, instrument handling, and respect for tissue showed the strongest persistence over time, while more dynamic domains such as flow of operation, time and motion, and use of assistant showed mild decline after the intensive training period ended. These differences suggest that some components of surgical competence are more readily consolidated after short-term training, whereas others require more continuous exposure and reinforcement to be maintained. Overall, the findings indicate substantial short to medium term retention of hernia repair competence. The percentage changes confirm that although some post-workshop decline was observed in selected domains, follow-up scores remained well above baseline in all domains, showing that the workshop produced meaningful and retained gains in overall surgical performance.

TABLE 5 **Performance of trainee doctors as regards several technical domains mainly during their performance of procedures.**

GRS domain	n	D1 mean	D2 mean	1.5-month mean	% change D1 to D2	% change D2 to 1.5 months	% change D1 to 1.5 months	P-value
Respect for tissue	7	2.43	4.00	3.86	52.38	−3.57	46.94	<0.001
Time and motion	7	2.14	3.57	3.57	61.11	−1.48	58.73	<0.001
Instrument handling	7	2.43	4.00	4.29	60.00	7.14	71.43	<0.001
Knowledge of procedure	7	3.43	4.43	4.57	28.57	1.59	30.61	<0.001
Flow of operation	7	3.29	4.57	3.71	37.04	−19.69	10.05	0.010
Use of assistant	7	3.86	4.71	4.14	22.58	−12.78	6.91	0.010
Overall performance	7	3.29	4.14	4.57	22.22	10.82	35.45	<0.001

TABLE 6 Repeated checklist scores for key procedural steps.

Checklist step	N	D1 mean	D2 mean	1.5-month mean	P-value
Patient positioning and skin preparation	7	2.43	3.00	3.00	0.02
Accurate skin incision	7	2.57	3.00	3.00	0.05
Identification of hernia sac	7	1.86	2.43	2.57	0.03
Hernia sac reduction and ligation	7	2.57	2.86	2.29	0.05
Mesh selection and correct placement	7	2.14	3.00	3.00	0.01
Mesh fixation using sutures	7	2.14	2.86	3.00	0.01
Layered wound closure	7	2.71	3.00	3.00	0.14

TABLE 7 Topic-level changes in procedural knowledge.

Knowledge domain	N	Pre mean	Post mean	Mean gain	P-value
Mesh repair	8	5.88	9.50	3.62	0.00
Epidemiology of hernias in Uganda	8	5.00	7.75	2.75	0.01
Performing surgery	8	6.38	9.12	2.75	0.00
Local anesthetic technique	8	6.88	9.25	2.38	0.00
Femoral hernia repair	8	5.75	8.12	2.38	0.00
Complications of mesh	8	6.75	8.88	2.12	0.01
Ventral hernia repair	8	6.38	8.25	1.88	0.03
Tailored approach	8	6.88	8.50	1.62	0.02
Nerve identification	8	7.88	9.38	1.50	0.04
Anatomy of inguinal and femoral canals	8	7.62	9.00	1.38	0.02
Pediatric hernias epidemiology	8	6.25	7.00	0.75	0.50
Shouldice repair	7	6.71	7.14	0.43	0.20
Non-mesh repair	8	6.25	6.38	0.12	0.92

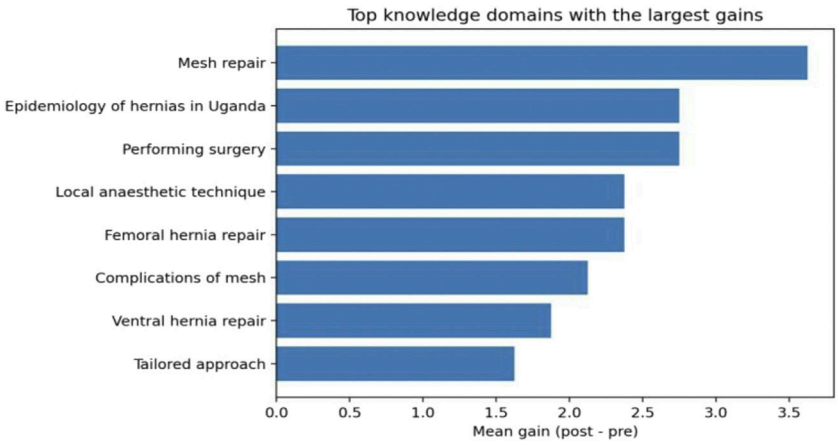


FIGURE 5
Knowledge domains with the largest post-training gains. Figure 5 above highlights the topic areas with the greatest increase after training. The dominance of mesh repair, local anesthetic technique and operative performance topics suggests that the workshop improved knowledge in the same areas where practical teaching was most concentrated.

from the camp reduced slightly, I did not return to my former level of uncertainty. I still approached hernia repair with more confidence, more clarity, and a stronger sense that I could complete the procedure safely."

Skill transfer into real practice

FGD-P05: "The real test came after returning to routine work. I found that I could still apply what I had learned, especially in identifying the anatomy, handling the sac, and placing the mesh. The camp had not only improved my performance in the training environment, but had also given me skills that I could take back into actual service delivery."

Retention of key procedural steps

FGD-P07: "Even several weeks after the workshop, the key steps remained clear in my mind. I could still recall the sequence of exposure, identification of the sac, reduction, mesh placement, and closure without much difficulty. That tells me the learning was not temporary but had become embedded to some extent."

Better preparedness for independent cases

FGD-P09: "At follow-up, I felt more prepared to manage a hernia case than before the workshop. I may not have been as fast as I was during the camp, but I was still more organized, more knowledgeable, and more capable than I had been at baseline."

Mild decline in flow, time, and assistant-related domains

Reduction in skill slightly after leaving the workshop

Reduced speed due to fewer practice opportunities

FGD-P02: "Although I retained the main steps of the operation, I noticed that my speed decreased after leaving the workshop. During the workshop we were operating regularly, which gave me rhythm and continuity. Back in routine practice, the number of similar cases was lower, so I did not maintain the same level of fluency. The knowledge remained, but the smoothness was somewhat reduced."

Loss of operative rhythm outside the workshop setting

FGD-P04: "The skills workshop environment created momentum. We were immersed in the same procedure repeatedly, and that built a strong rhythm. Once I returned to normal duties, that rhythm was interrupted by ward work, emergencies, and fewer hernia cases. As a result, although I still knew the procedure, I sometimes felt less smooth and less automatic than I had been immediately after training."

Difference in theatre team coordination

FGD-P06: "One challenge outside the skills training workshop was that the theatre team was not always equally familiar with the procedure. During the workshop, the assistants and trainers understood the steps and anticipated what was needed. Back at my hospital, that was not always the case. Even if I knew what to do, the flow could still be affected when the assistant did not respond in the same coordinated way."

Cognitive retention more than psychomotor fluency

FGD-P08: "I would say that I retained the knowledge and general competence more than the fine fluency. I still understood the operation and could perform it, but the movement from one step to the next was not as natural as it had been during the skills training workshop. That part seems to require more continuous repetition."

Reduced reinforcement after return to routine setting

FGD-P10: "Immediately after the workshop, I was at my best because the teaching, supervision, and repetition were all fresh. At follow-up I was still improved, but some of the refinement had faded because there was less reinforcement in routine clinical work."

Strong retention in instrument handling and procedural knowledge

Sustained improvement in instrument use

FGD-P03: "Instrument handling was one of the gains that stayed with me most strongly. The workshop trained me to be more deliberate, more economical, and more aware of what each movement should achieve. Even after leaving the skills training workshop, that awareness remained, and I found myself using instruments with more purpose than before."

Durable procedural understanding

FGD-P05: "Once I understood the logic of the repair, it became easier to retain. Knowing why each step is done gave the whole procedure meaning, and that made it easier to remember and reproduce later. For me, procedural knowledge has remained one of the strongest outcomes of the training."

Lasting anatomical orientation

FGD-P07: "The skills training workshop improved my anatomical orientation in a way that has persisted. I now approach the operation with a clearer map of what I expect to see and what I need to identify. That has continued to guide my practice beyond the workshop."

Greater internal organization during surgery

FGD-P09: "My performance improved not only because of repetition, but because the operation became mentally organized. That internal organization has remained useful, especially in helping me stay calm and systematic during surgery."

Mentorship and supervision as drivers of improvement

Immediate corrective feedback accelerated learning

FGD-P01: "The immediate feedback from the trainers was one of the most valuable aspects of the workshop. Errors were corrected at the moment they happened, which prevented bad habits from becoming established. That kind of correction made the learning much more efficient than what I usually experience in routine settings."

Close supervision increased confidence and safety

FGD-P04: "Having a senior surgeon nearby gave me the confidence to attempt steps I would normally hesitate to do. The supervision created a safe environment for learning because I knew I would be corrected if I was going in the wrong direction."

Mentorship strengthened retention

FGD-P06: "The trainers did more than just supervise the operation; they explained the reasoning behind each step and reinforced the same principles repeatedly. That mentorship made the skills more memorable and easier to retain."

Trainer presence improved decision-making

FGD-P08: "The presence of experienced mentors improved not only my technical performance but also my intraoperative decision-making. Their guidance helped me understand what to prioritize and what to watch out for."

Steep early learning curve during surgical skills workshop

FGD-P02: "My learning curve was very steep in the first few cases. At first, I was mostly trying to understand orientation, then I started becoming more comfortable with the sequence, and by later cases I felt significantly more capable. The improvement was noticeable even to myself over a short period."

Repetition turned uncertainty into familiarity

FGD-P05: "At the beginning the procedure felt complicated, but repetition reduced the complexity. What first seemed like many separate tasks gradually came together into one familiar operation."

Transition from observation to performance

FGD-P07: "Before the workshop I had more observational than operative experience. The surgical skills training workshop shifted me from knowing about the operation to actually doing it. That transition was important because it changed how I understood the skill."

Skill growth through cumulative exposure

FGD-P09: "Each case added something to the previous one. The learning was cumulative. I did not just repeat the same errors; I improved from case to case because the environment supported active reflection and correction."

Barriers to longer-term retention.

Discussion

Knowledge acquisition and retention

The study found a significant improvement in participants' knowledge scores between pre- and post-course assessments, indicating effective knowledge acquisition during the training workshop. This aligns with existing evidence that structured surgical training programs enhance cognitive understanding through a combination of didactic teaching and hands-on exposure [14, 15].

Qualitative findings further strengthen this observation. Participants described a transition from fragmented to structured understanding of hernia anatomy and procedural steps. One participant noted that *"the structured teaching sessions, combined with intraoperative demonstrations, helped me clearly understand the anatomy and how it guides the repair technique"*, highlighting the role of integrated learning approaches.

These findings are consistent with adult learning theory, which emphasizes experiential learning and contextual application as key to knowledge retention [16] Similar studies in sub-Saharan Africa have demonstrated that combining theoretical instruction with repeated clinical exposure enhances both immediate learning and longer-term retention [17].

However, while immediate knowledge gains were evident, literature suggests that retention may decline without continuous reinforcement [1]. This concern was echoed qualitatively, where participants emphasized the need for ongoing practice and mentorship to sustain knowledge gains. Thus, while the training camp effectively addressed short-term knowledge gaps, long-term retention may depend on continued exposure and structured follow-up.

Technical skill development

The study demonstrated marked improvement in technical surgical skills, including tissue handling, suturing, and mesh placement. These findings are consistent with previous studies showing that simulation-based and high-volume operative exposure significantly improve psychomotor skills [8, 18].

Participants' qualitative accounts provide deeper insight into this progression. For example, one trainee reported that *"my movements were initially hesitant, but with repeated practice, my technique became more precise and coordinated."* This reflects the concept of deliberate practice, where repeated performance with feedback leads to skill mastery [1].

The observed improvements also align with evidence from surgical outreach and camp-based training models, which demonstrate that concentrated case exposure accelerates skill

acquisition compared to traditional apprenticeship models [3]. In low-resource settings, such models are particularly valuable in addressing surgical workforce gaps and enhancing competency within a short time frame.

Importantly, the progression from basic to more refined technical skills observed in this study suggests that the training camp provided an effective learning curve. However, as highlighted in the qualitative findings, sustainability of these skills may be limited by reduced case volume and resource constraints in participants' home institutions.

Operative confidence and independence

A key finding of this study was the significant increase in participants' confidence and ability to perform hernia repairs independently. This is consistent with prior research indicating that hands-on surgical training enhances self-efficacy and readiness for independent practice [19, 20].

Qualitative data strongly support this finding. Participants described a transition from dependence on supervision to increasing autonomy. One participant stated that *"by the end of the workshop, I was able to perform most of the procedure independently, only seeking confirmation for critical steps."* This progression reflects the development of competency-based proficiency, where learners move from novice to competent practitioners.

The supportive learning environment was also identified as a critical factor in building confidence. Opportunities to perform procedures under supervision, receive feedback, and learn from errors contributed to a safe and effective learning experience. This aligns with literature emphasizing the importance of mentorship and feedback in surgical education [21].

In resource-limited settings, increased confidence and independence among trainees are particularly important, as they enable task-sharing and decentralization of surgical services [20]. The findings of this study therefore have important implications for strengthening surgical capacity in similar contexts.

Contextual and system-level factors affecting skill retention

Despite the positive outcomes observed, participants identified several contextual challenges that may affect long-term retention and application of skills. These included limited case volumes, shortages of surgical supplies, competing clinical demands, and lack of ongoing mentorship.

These findings are consistent with broader literature on health systems in low- and middle-income countries (LMICs), where structural constraints often limit the translation of training into practice [3]. For instance, one participant noted that *"without regular practice, there is a risk that the skills we gained may decline over time."*

The issue of resource availability, particularly surgical supplies such as mesh, further highlights systemic barriers to sustained practice. This aligns with findings from previous studies demonstrating that lack of essential resources is a major impediment to surgical service delivery in LMICs [20].

Importance of structured mentorship and follow-up

The findings underscore that mentorship is not simply an added advantage but a core requirement for sustaining procedural competence after workshop-based training. Immediate gains in confidence may not automatically translate into safe independent practice unless trainees continue to receive guidance, correction, and encouragement during the early post-training period. Mentorship helps consolidate correct habits, prevents drift in technique, and supports clinical judgment in situations that differ from the controlled environment of the workshop.

This suggests that every surgical training camp should include a formal follow-up mentorship package. Such a package could involve scheduled on-site supervision visits, remote case discussions, video review of procedures, peer-learning groups, and consultant feedback at defined intervals after training. Mentorship should be planned as part of the intervention budget and implementation framework rather than left to informal goodwill.

At policy level, training institutions and health service managers should consider developing structured post-camp mentorship pathways. These might include designation of regional surgical mentors, digital follow-up platforms, and periodic reassessment using standardized tools such as OSATS or procedure-specific checklists. In this way, the training camp becomes the beginning of a competency pathway rather than the endpoint of a short educational episode.

Conclusion

The findings of this study show that a structured hernia repair surgical training workshop is an effective educational intervention for improving surgical knowledge, technical competence, and operative confidence among trainees. Across the study period, participants demonstrated clear gains in theoretical understanding of hernia anatomy and repair principles, improved technical performance in key operative steps, and increased confidence in undertaking hernia repair with greater independence within this early period.

Based on these early preliminary findings, it is recommended that surgical training institutions integrate structured, competency-based workshop models into postgraduate training as a complement to conventional apprenticeship-based teaching. Such workshops should not be viewed as stand-alone events, but as part of a broader educational pathway that includes follow-up mentorship, supervised practice opportunities, and periodic refresher assessments.

Data availability statement

All data and files in regards to this publication is available and can be obtained on request from the corresponding Author.

Ethics statement

The study involved human participants and was reviewed and approved by the Research and Ethics Committee of St Francis Hospital

Nsambya Kampala. The patients/participants [legal guardian/next of kin] provided written informed consent to participate in this study.

Author contributions

MT Conceptualized and Conducted the Research. FB Conceptualized and supervised the research, wrote the Manuscript. FK Supervised the research. IM Supervised the research. CO Trained the residents in the study. JA Trained the residents in the study.

Funding

The author(s) declared that financial support was not received for this work and/or its publication.

Acknowledgments

CO and JA, Tim Brown for their passion to train and pass on skill to improve surgical competences in sub-Saharan Africa, Hope and Healing centre kiwanyi for Hosting the hernia skills workshops, Prof Ignatius kakande (RIP) for the passion and vision in supporting this collaboration.

Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declared that generative AI was not used in the creation of this manuscript.

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