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ORIGINAL ARTICLE

Improving surgical education in East Africa with a standardized hernia training program

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Abstract

Introduction Inguinal hernias are among the most common surgical diseases in Africa. The current International HerniaSurge Guidelines recommend mesh-based surgical techniques in Low Resource Settings (LRS). This recommendation is currently unachievable in large parts of Africa due to the unaffordability of mesh and lack of appropriate training of the few available surgeons. There is, therefore, a need for formal training in mesh surgery. There is an experience in Hernia Repair for the Underserved in Central and South America, however, inadequate evidence of structured training in Africa.

Material and methods Since 2016, the aid Organizations, Surgeons for Africa and Operation Hernia have developed and employed a structured hernia surgical training program for postgraduate surgical trainees and medical doctors in Rwanda. This course consists of lectures on relevant aspects of hernia surgery and hands-on training in operating theatres. The lectures emphasize anatomy and surgical technique. All parts of the training were evaluated. Formal pre-course evaluation was conducted to assess the personal surgical experience of the trainees.

Results Over a 3-year period, a structured hernia training programme was employed to train a total of 36 surgical trainees in both mesh and also non mesh hernia surgery. The key principle in this course is the continuous competence assessment and feedback. Evidence is provided to demonstrate improvement in surgical skills as well as knowledge of surgical anatomy which is essential to acquiring surgical competency. With self-assessment, expressed on a Likert scale, the participants could improve the theoretical knowledge about hernias from median 4.4 (on a scale of 1–10) before training to 8.4 after the training. The specific knowledge about anatomy could be improved in the same assessment from 4.8 before training to 8.1. after the training. After training course 12 of the 36 participants (33.33%) were able to carry out both suture- and mesh-based operations of simple inguinal hernias completely and independently. 20 of the 36 participants (55.55%) required only minimal supervision and only four participants (11.11%) required surgical supervision even after the completion of the course.

Conclusion We have demonstrated that, medical personnel in Africa can be trained in mesh and non-mesh hernia surgery using a structured training programme.

Keywords Groin hernia · Africa · Low income countries · Training · Pure tissue repair · Lichtenstein repair

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Introduction

Hernias are among the most common surgical diseases worldwide. The lifelong risk of developing an inguinal hernia as a man is about 27% [1, 2]. The risk for women is significantly lower, at around 3% [3, 4]. Hernias are also a common surgical disease in Africa. It ranks second in the statistics of surgical interventions after caesarean sections [3, 5, 6]. However, an exact incidence of inguinal hernias in the population cannot be determined due to the lack of health data. Estimates may differ from actual data. In Tanzania, for example, the annual incidence is estimated at 165 per 100,000 population [7]. The prevalence of hernia disease in Africa seems to be much higher than in Higher Income Countries (HICs) [8].

There are considerable differences worldwide in the surgical treatment of inguinal hernias. While in HICs such as Europe and North America almost all patients with hernias are treated electively, in many countries, especially in Africa, only a fraction (less than 10%) of patients can be treated due to a lack of resources and personnel. According to a study from Lancet commission, almost 75% of the world's population have access to only 25% of safe and affordable surgical and anaesthetic facilities [9]. There are many reasons for this. First and foremost, there is a lack of surgical facilities. Second, there is a lack of qualified surgeons.

Current data shows that most African countries, have only a fraction of the number of surgeons in HICs [10]. For example, only about 60 consultant surgeons are available for Rwanda's 12 Mio. population (information from Rwanda's Ministry of Health own request).

The current International guidelines generally recommend mesh-based techniques for male and female adults with inguinal hernia [11]. For the first time, the guidelines also address the specific issue of Inguinal Hernia Surgery in Low Resource Settings (LRS). The use of low-cost meshes (LCM) was suggested for low-resource countries, however, careful audit and follow-up studies are required [11]. Ideally, identical treatment standards for treatment of inguinal hernias should be applied worldwide.

A recent Cochrane meta-analysis supported the use of mesh in the repair of Inguinal hernias because of the lower recurrence rate and less visceral or neurovascular injuries when compared to non-mesh repair. The report also highlighted an important barrier to the take up of mesh repair in Low Income Countries (LICs). "Non-mesh repair is less likely to cause seroma formation and has been favoured in LICs due to low cost and reduced availability of mesh materials" [12].

Before the implantation of a mesh can be considered in LRS, whether commercially produced or as an LCM, certain prerequisites must be met. This applies in particular to the training of local surgeons in such countries, who should be proficient in a surgical technique for the implantation of a synthetic mesh. There are only a few publications on structured training concepts in Africa [13]. Training in hernia surgery happens in LICs in teaching and district hospitals and also during humanitarian mission to rural hospitals. This training, however, is largely not structured and not competency based. Outside Africa, Hernia Help, a medical charity has published its field report describing a standardised training in the Lichtenstein technique in South America [14, 15].

Aim

In this paper, we have outlined the current state of surgical training in Rwanda and present a standardised concept of postgraduate training in the field of hernia surgery. The systemic, economic, personnel and patient-specific characteristics in Africa will be discussed.

Material and methods

In Rwanda, three aid organizations, Surgeons for Africa, Operation Hernia and Rwanda Legacy of Hope have collaborated to use a standardized basic hernia training model successfully in 2016, 2017 and 2019. The training model was developed by Operation Hernia and first used in Uganda in 2016 [16]. The Training course was designed for young postgraduate surgeons and also for general practitioners with surgical interest and daily practice, but not for clinical officers, medical assistants or nurses.

This Basic course in Hernia management consists of 2 days of lectures and 5 days of hands on practical training [17, 18].

Each lecture lasts 30 min. The lectures are interactive and include videos on surgical technique. Special attention is paid to the teaching of relevant anatomy, using models. A sound knowledge of surgical anatomy is essential to achieving surgical competency.

The lectures are followed by hands-on training in operating theatres. All the trainers are consultant surgeons. Each trainer has a maximum of three trainees. The Shouldice technique is the preferred non-mesh (tissue) repair taught. Lichtenstein technique is the mesh-based technique taught.

The topics of the lectures delivered are listed in Table 1.

The first and essential part of the theatre session is the live demonstration of the two hernia operation techniques. This is followed by mentoring of trainees to perform the procedures with continuous evaluation.

The focus of the 5-day practical part of the course was on the following aspects:

Table 1 Evaluation of all presentations of the theoretical part of the Hernia basic course by participants

	Excellent and very good	Good	Average	Poor
Epidemiology	16 (44.4%)	16 (44.4%)	2 (5.6%)	2 (5.6%)
Anatomy	30 (83.3%)	6 (16.7%)	0	0
Evidence mesh	30 (83.3%)	6 (16.7%)	0	0
Evidence pure tissue	30 (83.3%)	4 (11.1%)	2 (5.6%)	0
Local anaesthesia	20 (55.6%)	10 (27.8%)	6 (16.7%)	0
Video Lichtenstein	30 (83.3%)	4 (11.1%)	2 (5.6%)	0
Video Shouldice	22 (61.1%)	12 (33.3%)	2 (5.6%)	0
Femoral hernias	15 (41.7%)	8 (22.2%)	8 (22.2%)	5 (13.9%)
Ventral hernias	22 (61.1%)	8 (22.2%)	3 (8.3%)	3 (8.3%)
Pediatric hernias	16 (44.4%)	13 (36.1%)	3 (8.3%)	4 (11.1%)
Complications	30 (83.3%)	4 (11.1%)	2 (5.6%)	0

- Local anaesthetic techniques
- Treatment of paediatric hernias with hernia sac excision
- Shouldice repair
- Lichtenstein repair

The training protocol is outlined in Table 2.

Evaluation

- An essential part of the hernia course is assessment of both the trainee surgical residents and the trainers. The trainees undertook pre-course and post-course assessments of their knowledge and surgical skills. These were administered through pro forma questionnaires. The protocol of assessments is listed below: Pre-course survey of surgical experience of trainees
- Trainee self-assessment of surgical knowledge before and after the lectures (scoring on a scale of 1–10) (Fig. 1).
- Trainee feedback on lectures (scoring on a scale: poor-average-good-very good–excellent).
- Trainee feedback on theatre sessions (scoring on a scale: poor-average-good-very good–excellent).
- Assessment of surgical competence of trainees by trainers on completion of course. (scoring on a scale: not assessed, development required, satisfactory).
- Overall competence of trainees after the completion of the hernia basic course (scoring on a scale: unable to perform, able to perform aspects, able to perform with supervision, able to perform with minimal supervision, able to perform independently).

Effective communication before and during the course was essential. A WhatsApp page was set up to facilitate communication between all trainers and all trainees. Presentations were shared on Dropbox.

Results

In 2016, 2017 and 2019, a total of 36 surgical trainees took part in the structured training programme.

The pre-course survey of the trainees informed us that most of the trainees had had some experience of hernia surgery although 56% of them had no personal experience in hernia surgery. All residents had assisted in inguinal hernia surgery, but only a few of the residents had performed a groin hernia repair independently. Most of the residents, however, had performed large numbers of Caesarean sections independently and, therefore, had the basic surgical skills required for this training (Table 3).

All trainees gave feedback on lectures during the 2-day-basic-course (Table 1).

On a scale of 1–10, the trainees scored their level of surgical knowledge, overall, as a median of 4.4 (3–7). This improved to 8.4 (6–10) after the lectures (Fig. 2). Specifically, knowledge of anatomy of the inguinal region improved from a median of 4.8 (3–7) to 8.1 (6–9) (Fig. 3).

The feedback from the theatre sessions was an assessment of the effectiveness of the trainers, as perceived by

Table 2 Standardized teaching levels (Oppong [19])

Steps	Details
1	Trainer demonstrates procedure whilst a trainee assists
2	Trainee assists Trainer a number of times. The number of times a trainee assisted depended on prior knowledge, skill, aptitude and trainer's assessment
3	Trainer assists trainee to perform parts of or all of procedure depending on skill and learning
4	Semi-Independent. Trainee performs procedure assisted by fellow trainee but supervised by trainer who may be scrubbed or unscrubbed but ready to scrub to instruct and assist
5	Independent Operating. Trainee performs procedure independently. Trainer supervises from a distance
6	Trainee "trains" other trainees
7	Local Supervisor /Audit. Trainee is assigned a local supervisor who will offer him opportunities to maintain the new skill acquired and to audit his logbook

Fig. 1 Pre- and Post-Course Self-Assessment-Questionnaire of the Trainees (Knowledge Scale 1–10 (10 = Excellent))

Topic	***Pre-Course Assessment***	***Post-Course Assessment***
1 Overall knowledge of Hernia Surgery		
2 Overall Skill in Hernia Surgery		
3 Epidemiology of Hernia in Rwanda		
4 Anatomy of the Inguinal and Femoral Canals		
5 Pediatric Hernias		
6 When performing a hernia repair, do you know why it is important to identify nerves?		
7 Evidence for Mesh Repair		
8 Evidence for Tissue (Non Mesh) Repair		
9 What is your understanding of „Tailored Approach" in Hernia Surgery?		
10 How to perform Mesh Repair		
11 Local Anesthetic Technique		
12 How to perform Shouldice Repair or Tissue Repair		
13 How to repair Femora Hernias		
14 Ventral and Incisional Hernias		
15 Complications of Mesh Repair		
16 Repair of Incisional Hernia		
17 If you required a hernia repair, would you choose a Mesh or a Tissue Repair?		

Table 3 Pre-Course Survey of average Surgical Experience of Trainees 2016–2019

Year	Number of trainees	Years of practise	Average Casaerian sections as surgeon	Average Hernia repair as assistant	Average Hernia repair as surgeon
2016	15	5	210	25	3
2017	14	1	165	51	7
2019	7	2	128	35	1

the trainees. It was heartening to note that these three core parameters of the hands-on training: Steps of Hernia Procedure; Demonstration of Anatomy; Hands-on Mesh Repair were rates as "excellent" by 80%; 75%; and 58% of the trainees, respectively. (Table 4). 58% (21 of 36) of the participants rated the „Hands-on Mesh Repair " as excellent. Due to the fact that only two of the trainers taught non mesh techniques, this method was often only demonstrated to the participants. Despite this fact, the pure tissue repair hands-on training was rated excellent or very good by 20 out of 36 trainees (55.55%) (Table 4).

As stated earlier, each trainer was assigned maximum of three trainees.

All trainees were trained in mesh repair. Some were competent in tissue repair as well (Table 5).

On completion of the hands-on sessions, all 36 participants of the Hernia Basic Course from 2016, 2017 and 2019 completed a self-assessment of their surgical skills and competence in performing a hernia repair (Table 6) 34 of the 36 participants (94.44%) rated their knowledge of the anatomy of the inguinal region as satisfactory. They also rated as satisfactory the following stages of surgery: Exposure of the inguinal canal with the identification of structures, including nerves (33 of the 36 participants, 91.67%), and the insertion of mesh (32 of the 36 participants, 88.88%). They saw the greatest need for their development, in the technique

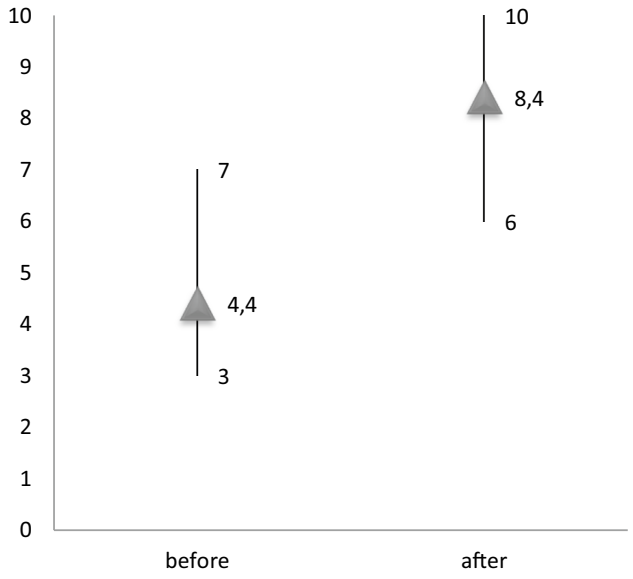

Fig. 2 Self-assessment of the theoretical knowledge before and after the theoretical course by the participants

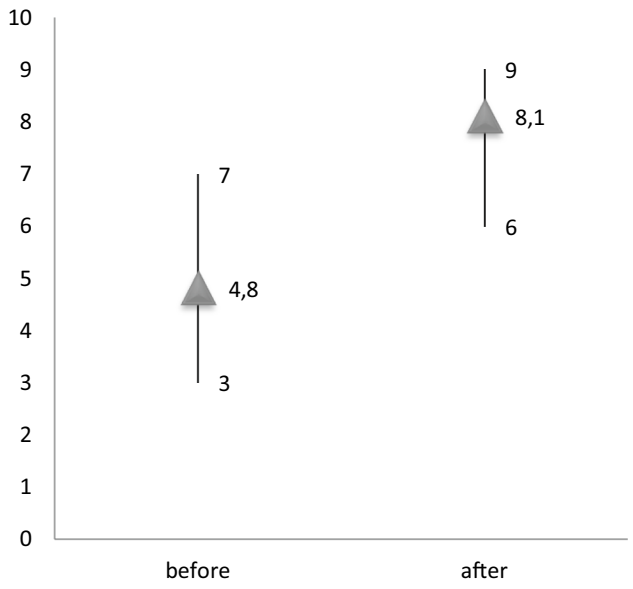

Fig. 3 Self-assessment of the anatomical knowledge before and after the theoretical course by the participants

of infiltration of local anaesthetic (26 of the 36 residents 72.22%).

The trainers' assessment of the level of competence of the course trainees revealed an enormous improvement in surgical skill. After completion of the practical part of the course, 12 of the 36 trainees (33.33%) were able to carry out both suture and mesh-based inguinal hernia operations independently. 20 of the 36 trainees (55.55%) required minimal supervision. four participants (11.11%) required surgical supervision even after completion of the course (Table 7).

Discussion

Lack of resources in African countries

In the majority of African countries, there is a shortage of physicians. Ghana has only 2.3% of the number of doctors per population in Germany (Table 8) [20]. Most surgeons in African Non-teaching hospitals are generalists. They perform mostly emergency operations in gynaecology, urology, general surgery and orthopaedic trauma. There are surgical training programs in some African countries, but one does not often find structured training programs in Hernia surgery. Most inguinal hernia surgeries in Africa are performed by general practitioners in smaller district hospitals without mesh. Rates of repair and the use of mesh are higher than previous estimates in Ghana and Sub-Saharan Africa but not as high as in high-income countries [21]. In addition to these differences in the availability of surgeons, there are also significant differences in availability of surgical instruments, sutures and equipment between African and European hospitals [22]. It can also be assumed that only very few hospitals in Africa have a functioning modern endoscopic surgical unit.

A comprehensive endoscopic surgery program in the majority of Africa countries is currently unsustainable. Capital costs, maintenance costs and lack of skill to maintain and repair equipment and frequent power outages make it difficult. Nevertheless, there are small individual studies that unreservedly recommend the use of laparoscopic techniques in selected African countries, especially North and South Africa, on the basis of their comparable good outcomes [24–26]. For the countries of the sub-Saharan region there is only one publication by Blondel et al. from Cameroon,

Table 4 Evaluation of the Trainers by Trainees

	Excellent	Very good	Good	Average	Poor
Demonstration of anatomy	27 (75.0%)	8 (22.2%)	1 (2.8%)	0	0
Various steps of hernia repair	29 (80.6%)	7 (19.4%)	0	0	0
Hands-on mesh repair	21 (58.3%)	15 (41.7%)	0	0	0
Hands-on non-mesh repair	10 (27.8%)	10 (27.8%)	12 (33.3%)	4 (11.1%)	0

Table 5 Number and average number of performed procedures during the practical training course by trainees

Year	Number of Trainees	Number of Shouldice repairs performed by trainees	Average of performed Shouldice repairs per trainee	Number of Lichtenstein repairs performed by trainees	Average of performed Lichtenstein repairs per trainee	Number of Marcy and Other hernia repairs performed by trainees	Average of performed Marcy and other hernia repairs per trainee
2016	15	19	1.27	42	2.8	5	0.33
2017	14	12	0.86	41	2.93	10	0.71
2019	7	12	1.71	28	4	17	2.42

Table 6 Trainees self-assessment of Competence at performing stages of Hernia Repair

	Satisfactory	Development required
Knowledge of anatomy	34 (94.4%)	2 (5.6%)
Recognition of structures	33 (91.7%)	3 (8.3%)
Ability to administer local anaesthesia	10 (27.8%)	26 (72.2%)
Tissue handling	25 (69.4%)	11 (30.6%)
Use of instruments	18 (50.0%)	18 (50.0%)
Exposure of inguinal canal	33 (91.7%)	3 (8.3%)
Dissection of Sac	26 (72.2%)	10 (27.8%)
Insertion of mesh	32 (88.9%)	4 (11.1%)

Table 7 Overall Competence of the Trainees after the Hernia Basic Course

Level	Competence	Trainees
1	Unable to perform procedure	0
2	Able to perform aspects of the procedure	0
3	Able to perform procedure with supervision	4
4	Able to perform with minimal supervision/ occasional Help	20
5	Able to perform independently	12

who successfully performed a transabdominal pre-peritoneal (TAPP) repair in a total of 9 patients [26].

Special characteristics of patients in Africa

There might be etiological differences between African and European hernias. In the Central African countries, it must be assumed that thousands of inguinal hernias remain untreated due to a lack of resources [27]. The proportion of emergency operations due to incarcerated hernias is thus significantly higher in Africa than in Europe [28–31] and leads to increased mortality [32–34]. This is also confirmed by the number of hernia repairs requiring intestinal resections, which is significantly higher in Africa than in HICs [6]. In addition, the proportion of indirect inguinal hernias in Africa appears to be significantly higher than in Europe [35]. One possible explanation would be that a large proportion of these cases involve untreated childhood hernias. In

Table 8 WHO Health Report Global Health Observatory (GHO) data Full report 2018 extraction of selected countries https://www.who.int/gho/publications/world_health_statistics/en/ (access: 20.10.2019) [23]

	Total population (000 s) 2016	Density of physicians / 1000 population	Density of nursing and midwifery personell / 1000 population
Germany	81,915	4.2	13.8
U.K	65,789	2.8	8.4
Ghana	28,207	0.1	0.9
Nigeria	185,990	0.4	1.5
Malawi	18,092	0.0	0.3
Rwanda	11,918	0.1	0.8
Liberia	4614	0.0	0.5

many cases, inguinal hernia patients develop increasingly extensive scrotal hernias over time due to the lack of access to surgical treatment. These are often associated with hydroceles, which are possibly the result of failed obliteration of the patent processus vaginalis [36].

In addition, anatomical differences probably also exist. Mitura et al. suggests that the inguinal canal in the African is significantly shorter than in the European [37]. This may also explain why suturing procedures for African hernias are likely to be good and successful. For the same reason, it might be advisable to adapt the size of mesh used to repair an African Hernia to the differences in anatomy [37]. In recent years, there have also been initial reports that anulorraphy (ligation of the hernia sac and narrowing sutures) also shows good long-term results, especially in younger patients [38, 39]. In addition, some authors recommend the use of the Shouldice technique for the majority of hernias in Africa, as it can often be performed under local anaesthesia and has excellent results [40]. There are also indications in Europe that the Shouldice technique leads to equivalent results for selected patients [41]. Due to the limited resources in Africa, the feasibility of hernia operations under local anaesthesia is of particular importance. Many African countries also lack trained anesthesiologists. Anaesthetic technicians (ATs) are often the only people responsible for the patient's anaesthesia, and are most similar to ATAs (anaesthesiologic technical assistants). The ATs are generally well experienced in practicing spinal anaesthesia. Routine intubation anaesthesia or Total Intravenous Anaesthesia (TIVA) is not readily available, especially in rural areas, due to limitations in trained and experienced personnel. It is in fact not necessary for most inguinal hernia repairs.

Current surgical technique guidelines

In the current International Guidelines, mesh-based techniques are generally recommended for male and female adults with inguinal hernia [11]. The inguinal hernia should be treated using either the minimally invasive technique (TAPP or TEP) or the open Lichtenstein technique [11]. Other open techniques, in particular the mesh-free procedures, play only a minor role according to the current guideline recommendations. For women, laparo/endoscopic access with the associated use of meshes is also principally recommended.

In contrast, in many African countries, suture-based techniques are still the most common techniques (Bassini technique almost 80%) [21, 42]. Both the high costs and the insufficient availability of meshes can be seen as the reasons for the low uptake of mesh techniques [43]. For example, a patient in Burkina Faso has to pay around $40 for a suture-based hernia operation alone. This corresponds to his average income of 2 months [44]. The cost of a groin hernia operation in Uganda, for example, is estimated at $ 58–66 [45]. The price of commercial mesh is as high in Africa as in HICs and is between $40 and $150, which is up to three times the cost of suture-based surgery.

The current international HerniaSurge guidelines, therefore, propose the use of Low-Cost Meshes (LCMs,) in the absence of brand meshes in LRS [11]. This is based on individual randomized studies and meta-analysis based on these studies [44, 46, 47]. However, the use of these LCMs should also require knowledge of the chemical composition and physical properties [11]. The cost saving per intervention in the use of LCMs compared to brand meshes is estimated at approximately $120. Published data show comparable results [47, 48]. Operation Hernia organisation reports excellent results and experience with use of prepackaged sterilized Low-Cost Meshes from an Indian company [19].

Nevertheless, there are special features to consider for the LCMs. In principle, sterilization of low cost meshes is only possible at low temperatures ("less strict") at 121 °C [49]. Even when sterilized at low temperatures, polyethylene meshes in particular shrink by up to 40% [50]. The sterilisation usually carried out at 134 °C sometimes leads to complete melting or clumping of these meshes [50]. The pore size or the effective porosity after sterilisation, therefore, varies considerably. In our opinion, there are currently only two ways out of this quandary: The current trend in the production of cheaper meshes by the mesh companies is the way forward. Local production of sterilised mesh commercially, is to be recommended [51].

Surgical education and training in Africa discussion of own results

Surgical training is important in any setting. In Africa and other LICs, however, the lack of resources hinders appropriate surgical training. Previous studies have pointed out the deficits in training [15]. A specific educational concept seems to be essential for sustainable capacity building to address the global burden of surgical disease. Most of the trainees have already acquired basic surgical skills and have experience with caesarean sections but not with hernias. The training concept in hernia surgery in some LICs now embodies standardised learning of the Lichtenstein technique. Through the initiative of the organisation Operation Hernia, this has been implemented and established on a large scale in Ghana and also in other African countries such as Uganda and Tanzania [16, 19]. It has been well established in Central and South America through the initiative of Hernia Repair for the Underserved [14, 15]. They also reported about the use of wearable technology for training [52]. Significant improvements have also been achieved through 2–5-day hands-on training sessions. A recent study compared the outcomes after inguinal hernia repair performed by medical

doctors and surgeons after a specific training in Ghana [53]. Following the idea of task sharing medical doctors in a low-resource setting can be trained to perform elective inguinal hernia repair with good results and high patient satisfaction [53].

In most cases, however, a theoretical basic course was not explicitly offered but integrated into the practical course. In this study, we established the essential foundation of surgical knowledge by providing lectures on relevant aspects of hernia surgery, as recommended in the new Cochrane Database study [12] and included what we consider essential training in anatomy and in pure-tissue repair.

Our results demonstrate a substantial improvement in the surgical knowledge of our trainees after the series of tailored lectures. The use of models in the anatomy session, we believe, is crucial to the understanding of the anatomy of the groin. The continuous evaluation of all parts of the training helps to improve quality and to compare different courses. One third of the trainees could do non-mesh and mesh-based hernia operations completely and independently after this basis course. Almost two thirds need minimal supervision only. All trainees are able to communicate and share their practice experience after the course with their trainers and also with the other participants of the course using WhatsApp at any time. The trainees who still require supervision after the hernia course, should receive careful proctoring from their local surgical trainers. With further ongoing training each year there is a chance to improve the knowledge and skills even further. So far, however, it has been assumed that suture process has poorer results [11].

We are of the opinion that this assertion is due to inadequate teaching and demonstration of the anatomy of the groin and adequate training in the technique. Feedback received from the trainees suggested that the learning curve of tissue repair (Shouldice) is not much longer than that of mesh repair. Feedback from most of the trainees shows that technically, the most demanding and complicated part of the training is not the insertion of mesh or the process of the tissue repair, it is, in fact, the preparation of the hernia sac with the identification and protection of all-important anatomical structures (vas deferens, vessels and nerves). In either case, a clear standardisation of the surgical technique is a prerequisite for success. The use of the internet enables further possibilities for future training beyond national borders and continents.

Conclusion

Access to safe and affordable surgery in Africa is not comparable to access in HICs.

A fully functioning infrastructure is the main challenge. In rural regions of Africa, especially, there are too few hospitals, too few doctors, especially surgeons, anaesthetists and nursing staff. The equipment in some existing hospitals is not only poorly maintained, the electricity supply is subject to considerable fluctuations. Our results have shown that structured training of the surgical trainees working on site leads to an increase in competence in the treatment of inguinal hernias.

In contrast to the endoscopic mesh-based operations favoured in international guidelines, non-mesh-based techniques for the therapy of inguinal hernia in Africa continue to be justified.

Compliance with ethical standards

Conflict of interest RL, CO, AF, ML, DS, AT and RW declare that they have no conflict of interest.

Ethical approval All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Human and animal rights This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent This study does not include any patients, and therefore, informed consent was not applicable.

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