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ORIGINAL RESEARCH

Surgical Management and Reconstruction Training (SMART) Course for International Orthopedic Surgeons

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Abstract

BACKGROUND The burden of complex orthopedic trauma in low- and middle-income countries (LMICs) is exacerbated by soft-tissue injuries, which can often lead to amputations. This study's purpose was to create and evaluate the Surgical Management and Reconstruction Training (SMART) course to help orthopedic surgeons from LMICs manage soft-tissue defects and reduce the rate of amputations.

METHODS In this prospective observational study, orthopedic surgeons from LMICs were recruited to attend a 2-day SMART course taught by plastic surgery faculty in San Francisco. Before the course, participants were asked to assess the burden of soft-tissue injury and amputation encountered at their respective sites of practice. A survey was then given immediately and 1-year postcourse to evaluate the quality of instructional materials and the course's effect in reducing the burden of amputation, respectively.

RESULTS Fifty-one practicing orthopedic surgeons from 25 countries attended the course. No participant reported previously attempting a flap reconstruction procedure to treat a soft-tissue defect. Before the course, participants cumulatively reported 580-970 amputations performed annually as a result of soft-tissue defects. Immediately after the course, participants rated the quality and effectiveness of training materials to be a mean of $\geq$4.4 on a Likert scale of 5 (Excellent) in all 14 instructional criteria. Of the 34 (66.7%) orthopedic surgeons who completed the 1-year postcourse survey, 34 (100%, $P < 0.01$) reported performing flaps learned at the course to treat soft-tissue defects. Flap procedures prevented 116 patients from undergoing amputation; 554 (93.3%) of the cumulative 594 flaps performed by participants 1 year after the course were reported to be successful. Ninety-seven percent of course participants taught flap reconstruction techniques to colleagues or residents, and a self-reported estimate of 28 other surgeons undertook flap reconstruction as a result of information dissemination by 1 year postcourse.

CONCLUSION The SMART Course can give orthopedic surgeons in LMICs the skills and knowledge to successfully perform flaps, reducing the self-reported incidence of amputations. Course participants were able to disseminate flap reconstructive techniques to colleagues at their home institution. While this course offers a collaborative, sustainable approach to reduce global surgical disparities in amputation, future investigation into the viability of teaching the SMART course in LMICs is warranted.

KEY WORDS Plastic surgery, orthopedic surgery, rotational flap reconstruction, global health, global surgery, amputation, cadaver course, surgical education

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INTRODUCTION

Injuries account for 9.6% of the world's deaths and 11.2% of the global burden of disease; >90% of injuries occur in low- and middle-income countries (LMICs).[1,2] The global surgical burden of injuries is further complicated by estimates that for every death, as many as 3-8 more people may be permanently disabled.[3] One of the most common and preventable forms of disability in LMICs is amputation, which often occurs after failure of soft-tissue wound management in the setting of traumatic fracture.[4-11] It has been estimated that soft tissue injuries are present in up to 82.8% of traumatic injury, significantly increasing risk of infection and complicating potential limb salvation for the LMIC patient.[9-11] When used appropriately, soft-tissue reconstruction can close wounds, promote revascularization of ischemic bone and tissue, prevent infection, limit nonunion, and ultimately prevent amputation.[12-14] From a technical skill and equipment perspective, soft-tissue coverage procedures can be performed effectively in low-resource settings.[15,16]

A substantial deficit in the number of surgeons trained to manage soft tissue defects and prevent amputation has been documented in LMICs.[4,17,18] Opportunities to improve soft-tissue wound care and reduce disability-adjusted life years by providing increased flap reconstruction training or access to plastic surgery services have been suggested in the literature.[4,5,8,14-23] Although surgical mission trips were devised to provide wound management care to trauma patients in LMICs, the mission-based model has been criticized for its lack of sustainability because volunteers can only provide surgical services for a finite period of time.[7-10] In response to criticism, recent publications have outlined guidelines for the plastic surgery community to deliver ethical and quality care in resource-poor settings.[24] Despite the known lack of soft-tissue-coverage expertise, little has been done to address this growing disparity in LMICs.

To address the need for soft-tissue reconstruction in LMIC trauma patients in a sustainable, resource-efficient process, the Surgical Management and Reconstruction Training (SMART) course was created for orthopedic surgeons from regions with limited plastic surgery access. The purpose of this study was to evaluate the effect of the SMART course with respect to soft-tissue wound management on LMIC orthopedic surgeons previously untrained in flap reconstruction. We hypothesize that the SMART course can teach participants to successfully perform flaps on trauma patients in low-resource settings, reducing the self-reported incidence of amputations. We further hypothesize course participants would feel confident enough to teach skills learned at the SMART course to colleagues at their home institutions.

METHODS

The 2-day SMART course was hosted by the Institute for Global Orthopaedics and Traumatology at the Orthopaedic Trauma Institute of San Francisco General Hospital. Participants were selected from an applicant pool of orthopedic trauma surgeons from LMICs, with preference given to academically affiliated applicants facing a high volume of soft-tissue injuries and without access to plastic surgery. Course content was created through feedback from LMIC orthopedic surgeons who had previously attended pilot flap courses and was modified through consultation with instructors from institutions experienced in conducting flap courses. After 2 years of content development, 22 flaps (11 upper extremity, 8 lower extremity, 3 trunk) were chosen for the course curriculum because of their versatility, ease of being taught, and potential to prevent amputations (Table 1). The course content was taught through multidisciplinary case-based didactics, open discussion, and case-based cadaver dissection sessions. Instructors and course directors consisted of board-certified plastic surgery and orthopedic trauma faculty from multiple US institutions.

To facilitate hands-on experience, participants were split into 2 groups, lecture and dissection, with each group alternating between lectures and cadaveric wet labs. All lectures focused on technical performance, indications, complications, and outcomes of the procedures. During wet-lab sessions, groups of 4-6 participants were assigned 1 instructor and 1 cadaver, providing participants the opportunity to perform simulated flap procedures under close instructor guidance. In addition, participants were given a syllabus, an electronic version of didactic lectures, and step-by-step videos of surgical techniques performed by course faculty to enhance retention of course content.

Before the course began, participants were sent a precourse survey designed to assess the need for soft-tissue management skills in their clinical practices, identify the proportion of operative cases that had an associated soft-tissue injury or

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Table 1. Flaps Taught at the Surgical Management and Reconstruction Training (SMART) Course

Upper Extremity Flaps	1. Cross-Finger
	2. Thenar
	3. Axial
	4. Kite
	5. Radial forearm
	6. Flexor carpi ulnaris
	7. Brachioradialis
	8. Anconeus
	9. V-Y hand
	10. Flexor carpi radialis
	11. Reverse radial forearm
Lower Extremity Flaps	1. Gastrocnemius
	2. Soleus
	3. Sural
	4. Reverse sural
	5. Gluteus
	6. Tensor fascia latae
	7. Posterior thigh
	8. Gracilis
Trunk Flaps	1. Latissimus
	2. VY sacrum
	3. Groin

complication related to soft-tissue injury, and determine amputations performed as a result of soft-tissue injuries. At the course conclusion, a postcourse survey was administered in person to assess participant satisfaction with course materials, dissections, didactics, overall course logistics, and the ability of the course to meet learning objectives. Participants evaluated the course components on a 5-point Likert scale (1 = Poor; 2 = Fair; 3 = Good; 4 = Very Good; and 5 = Excellent).

To assess the long-term impact of the SMART course on flap utilization and amputation burden, a 1-year postcourse survey was administered using Qualtrics Research Suite (Provo, UT) and sent to each course participant through e-mail. Participants were asked to provide the types of flaps being used, the flap success rate, and number of amputations averted by flap reconstruction. In addition, the evaluation assessed to whom the skills learned at the SMART course were disseminated, the number of individuals to whom skills were disseminated, and how many of those individuals were then performing the skills. Clinical data were self-reported and not compared with patient charts at participants' home institutions.

Descriptive statistical analyses were used to summarize participant assessment responses. Student t test was used for continuous data and Fisher exact test was used for categorical data. Pearson coefficient was calculated to determine the correlation among number of amputations averted, flap success rate, and number of flaps attempted.

RESULTS

Fifty-one orthopedic surgeons from 25 LMICs attended the September 2012 SMART course and were enrolled in this study. Thirty-four (66.7%) of the course participants completed the 1-year postcourse survey; of the 17 participants who did not respond, there was no significant difference in the distribution of geographic regions from the original study cohort. Of the course participants, The World Health Organization Global Burden of Disease (GBD) Region most represented was sub-Saharan Africa (34.2% of participants, including surgeons from Nigeria, Ethiopia, Tanzania, Ghana, Malawi, Kenya, Cameroon, Sierra Leone, South Africa, and Uganda), 27.8% of participants practiced in the South Asia GBD Region (Bangladesh, Nepal, Pakistan, Afghanistan, and India), and 21.5% of participants practiced in the Southeast Asia, East Asia, and Oceania GBD Region (Philippines, Myanmar, Cambodia, and Vietnam) (Table 2). The majority of participants (77.5%) claimed some academic teaching affiliation, and nearly 75% indicated that at least 20%-40% of lower-extremity operative cases were associated with or had complications related to soft-tissue injury. Most importantly, course participants estimated that 93.3% of the 970 amputations performed over the span of the previous year were due to inability to manage soft-tissue injury (Table 2).

For the postcourse survey, the median participant scores were $\geq$4.5 and mean participant scores were $\geq$4.4 for all 14 evaluation categories out of a 5-point Likert scale (Table 3). The highest-rated components of the course were the "value of information" presented in didactics (mean 4.8 [0.4]), "knowledge of surgeons" in course didactics (mean 4.8 [0.4]), and "communication of course logistics" (mean 4.8 [0.4]). The biggest areas identified for future improvement were "time allocated" for didactic lectures (mean: 4.4 [0.6]) and "how well did the course meet your learning objectives?" (mean 4.4 [0.5]), although both were above the "Very Good" threshold.

At 1-year follow-up, 100% of responding participants indicated that they had successfully performed flap reconstruction (vs 0% precourse; $P <$ 0.01); 93.3% of 594 total flaps attempted were successful, and flaps were responsible for deterring 116

Table 2. Demographics of Surgical Management and Reconstruction Training (SMART) Course Participants

Variables	Participant Characteristics (N = 51)
Teaching-hospital affiliated	77.5%
Region of practice	
Sub-Saharan Africa	34.2%
North Africa and Middle East	1.9%
Central Europe, Eastern Europe, Central Asia	0.7%
Latin America and Caribbean	13.9%
Southeast Asia, East Asia, Oceania	21.5%
South Asia	27.8%
Max number of amputations performed in 1 year	970
Max number of amputations performed in 1 year due to inability to manage soft-tissue injury	905

amputations (Table 4). On average, each course participant attempted 17.5 flaps and averted 3.4 limbs amputations over the course of a year, which is the equivalent of saving nearly 1 limb for every 5 flaps attempted.

Of flaps attempted at least 10 times, the thenar (35/35), axial (32/32), kite (11/11), and flexor carpi ulnaris (11/11) flaps had 100% self-reported success rates. In contrast, the most challenging flaps to perform were reverse sural (80% success rate) and groin (81.3% success rate) (Table 4). The flaps most frequently utilized were the gastrocnemius (107 attempts), V-Y hand (93 attempts), soleus (72 attempts), and cross-finger (69 attempts), which, combined, deterred 72 amputations, or 62.1% of total amputations averted (Fig. 1). Of note, the sural flap was the eighth most frequently attempted (31 attempts) but ranked fifth in overall amputations averted (10). A direct correlation was found between the number of flaps attempted and total amputations averted ($r = 0.90$ $P < 0.01$), but no correlation was found between flap success rate and total amputations averted ($r = -0.36$; $P = 0.11$).

With respect to dissemination of SMART course skills, 33 (97%) of 1-year follow-up respondents reported teaching flap reconstruction techniques to colleagues or residents, and they estimated that 28 additional surgeons undertook flap reconstruction as a result of information dissemination.

DISCUSSION

The SMART course in San Francisco allowed participating orthopedic surgeons practicing in LMICs to improve their ability to manage soft-tissue injury. On average, each course participant could potentially save nearly 1 limb for every 5 flaps attempted after utilizing SMART course flap reconstruction

Table 3. Participant Response to Postcourse Survey (5 = Excellent, 4 = Very Good, 3 = Good, 2 = Fair, 1 = Poor)

Question Asked	Median Response Score	Mean Response Score (Standard Deviation)
For the hands-on surgical skills portion of the course, please rate the following:		
Quality of presentations	5	4.6 (0.4)
Value of info	5	4.7 (0.4)
Applicability to practice	5	4.6 (0.6)
Based on didactics, please rate the following:		
Knowledge of surgeons	5	4.8 (0.4)
Quality of presentation	5	4.7 (0.4)
Value of information	5	4.8 (0.4)
Applicability to practice	5	4.6 (0.6)
Time allocated	4.5	4.4 (0.6)
How well did the course meet your learning objectives?	4.5	4.4 (0.5)
For Overall Course Logistics, please rate the following:		
Organization of program	5	4.7 (0.5)
Efficient time use	5	4.6 (0.5)
Communication of course logistics	5	4.8 (0.4)

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Table 4. Total Flaps Performed, Total Successful, and Total Amputations Averted 1 Year Poscourse

Flaps	Total Attempts (n = 34)	Total Successful (n = 34)	Success Rate (%)	Total Amputations Averted (n = 34)
Soleus	72	67	93.10	23
Gastrocnemius	107	99	92.50	20
Cross-finger	69	62	89.90	15
V-Y hand	93	89	95.70	14
Sural	31	29	93.50	10
Thenar	35	35	100	5
Latissimus	13	12	92.30	5
Gluteus	12	11	91.70	4
Groin	16	13	81.30	4
Axial	32	32	100	3
Radial forearm	9	9	100	3
Reverse sural	40	32	80	3
VY sacrum	27	26	96.30	3
Tensor fascia latae	5	5	100	2
Kite	11	11	100	1
Anconeus	2	2	100	1
Flexor carpi ulnaris	11	11	100	0
Brachioradialis	1	1	100	0
Flexor carpi radialis	1	1	100	0
Reverse radial forearm	4	4	100	0
Posterior thigh	2	2	100	0
Gracilis	1	1	100	0
Totals	**594**	**554**	**93.30**	**116**

n, number of participants who responded to the one-year survey.

techniques. Participants may also have achieved as high as a 93.3% self-reported success rate on all flaps attempted, which is only slightly lower than the 96% success rate reported for >1-year flap reconstruction outcomes for patients who sustained traumatic war injuries.[25] Although the SMART course was taught only over a 2-day period, the high self-reported success of flaps attempted suggests that the 22 upper extremity, lower extremity, and trunk flaps chosen for course content were reasonably applicable in resource-poor settings. In addition, the high mean scores from the postcourse evaluation survey demonstrate that participants were satisfied with the value of learning reconstructive techniques for soft-tissue wound management. Perhaps the most objective indicator that competence in soft-tissue reconstruction can be achieved through a condensed course is that participants felt confident enough to teach flap techniques to 28 additional colleagues by 1 year postcourse.

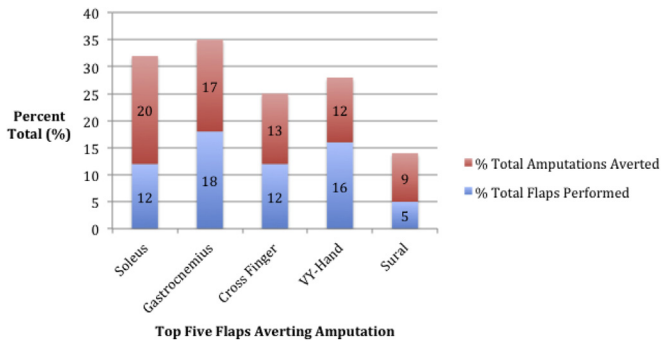

Figure 1. Top 5 flaps averting amputation: percentage of total amputations versus percentage of total flaps performed.

Because it has been suggested that LMIC health care personnel largely acquire skills through colleague-directed transfer of knowledge, increasing the skills and knowledge of SMART course participants can potentially have a multiplier with respect to information dissemination.[26]

To our knowledge, this is the first study to prospectively examine how a soft-tissue management course can affect flap procedure success and lower amputation burden for LMIC-based orthopedic surgeons. Thus, our study is different from the existing surgical literature addressing the disproportionate global soft-tissue injury burden in LMICs. For instance, much has been written in the plastic surgery literature about medical missions to resource-poor environments to provide reconstructive expertise and surgical assistance for trauma patients.[27,28] However, the mission-based service model has been criticized for being a temporary solution to a longitudinal problem.[7-10,16] In light of the criticism, it has been suggested that surgical mission and service trips be used as a bridge for the development of more long-term capacity to care for soft-tissue injuries.[24,25] Thus, given the flap success rate and dissemination of information demonstrated by LMIC-based orthopedic surgeons who participated in the SMART course, this study adds to the literature by providing a potential sustainable alternative to manage soft-tissue wounds and reduce amputation burden.

Conversely, this study is similar to other studies that have shown successful outcomes of surgical courses designed to teach surgical and medical skills to LMIC-based surgeons.[16,26,29] For instance, Merrell et al reported teaching microsurgical techniques to surgeons in Vietnam on behalf of Operation Smile, showing that reconstructive procedures can be reliably transferred to resource-poor settings.[16] Macleod et al described the ability of a 4-day fundamental critical care course to increase physician and nursing student confidence to carry out critical care procedures at 2 Kenyan hospitals.[26] Our study adds to the existing literature on the educational impact of surgical courses by demonstrating that reconstructive skills taught during a 2-day course can effectively be applied up to 1 year after course completion.

This study has several limitations. First, the postcourse survey and 1-year flap utilization evaluation were self-reported, which may create bias toward positive reporting. However, it has been suggested that because surgeons make final decisions intraoperatively, there is no higher authority for self-reported surveys on surgical outcome averted.[30-32] In addition, given that course participants' practices span from Iraq to Myanmar, it would be logistically challenging to collect official patient records from all the affiliated hospitals located in 25 different countries. Second, no confidence scale by procedure was recorded, which made quantitative evaluation of surgical skill acquired more difficult to assess. However, our qualitative surveys were able to reasonably determine the effect of soft-tissue injury at participant hospitals precourse and 1 year postcourse, as epidemiological data in LMICs are often collected through qualitative questions.[11,17,33,34] Third, the study had only a 66.7% follow-up rate, which does not meet the 80% follow-up standard set for prospective studies considered to provide Level I evidence. An analysis by region, however, showed that the 1-year respondents were still representative of the original class cohort. In addition, to our knowledge, our study has the longest follow-up assessing impact of postcourse flap reconstruction in the existing literature.

While our results suggest the SMART course achieved its objective of teaching flap reconstruction and reducing amputations stemming from soft-tissue injury, participant feedback highlighted areas for course adjustment. First, it is noteworthy that 4 flaps (soleus, gastrocnemius, cross-finger, V-Y hand) accounted for 62.1% of amputations averted and 58% of total number of flaps attempted. Thus, organizers of future flap reconstruction courses may consider focusing on teaching flaps that are most frequently utilized and have the highest amputation-reduction yield. In addition, certain flaps, such as groin and reverse sural, had success rates at least 10% below the average. Therefore, future investigation into why certain flaps are more successful than others in resource-poor settings may be warranted.

CONCLUSION

The SMART course can give orthopedic surgeons practicing in LMICs the skills and knowledge to successfully perform flaps and reduce the self-reported incidence of amputation in low-resource settings. In addition, the impact of the SMART course may be multiplied through dissemination of information at regional LMIC institutions. Although this course offers a collaborative,

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sustainable approach to reduce global surgery disparities in amputation, many other variables need to be accounted for in LMIC orthopedic hospitals before local surgical capacity can be fully developed. Furthermore, future investigation into the educational value and cost of hosting a SMART course directly at a LMIC site is warranted.

REFERENCES

1. Murray CJL, Vos T, Lozano R, et al. Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012;380:2197–223.
2. Lozano R, Naghavi M, Foreman K, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012;380:2095–128.
3. Debas HT, Gosselin R, McCord C, et al. Surgery. In: Jamison DT, Breman JG, Measham AR, et al., eds. Disease Control Priorities in Developing Countries. 2nd edition. Washington (DC): The International Bank for Reconstruction and Development / The World Bank; 2006 Chapter 67.
4. Semer NB, Sullivan SR, Meara JG. Plastic surgery and global health: how plastic surgery impacts the global burden of surgical disease. J Plast Reconstr Aesthet Surg 2010;63:1244–8.
5. Jovic G, Corlew DS, Bowman KG. Plastic and reconstructive surgery in Zambia: epidemiology of 16 years of practice. World J Surg 2012;36:241–6.
6. Banthia P, Koirala B, Rauniyar A, et al. An epidemiological study of road traffic accident cases attending emergency department of teaching hospital. JNMA J Nepal Med Assoc 2006;45:238–43.
7. Chalya PL, Dass RM, McHembe MD, et al. Citywide trauma experience in Mwanza, Tanzania: a need for urgent intervention. J Trauma Manag Outcomes 2013;7:9.
8. Goodacre TE. Plastic surgery in a rural African hospital: spectrum and implications. Ann R Coll Surg Engl 1986;68:42–4.
9. Ikem IC, Oginni LM, Bamgboye EA. Open fractures of the lower limb in Nigeria. Int Orthop 2001;25:386–8.
10. Madubueze CC, Chukwu COO, Omoke NI, et al. Road traffic injuries as seen in a Nigerian teaching hospital. Int Orthop 2011;35:743–6.
11. Otieno T, Woodfield JC, Bird P, Hill AG. Trauma in rural Kenya. Injury 2004;35:1228–33.
12. Cierny G, Byrd HS, Jones RE. Primary versus delayed soft tissue coverage for severe open tibial fractures. A comparison of results. Clin Orthop Relat Res 1983;(178):54–63.
13. Pollak A, McCarthy M, Burgess A. Short-term wound complications after application of flaps for coverage of traumatic soft-tissue defects about the tibia. The Lower Extremity Assessment Project (LEAP) Study Group. J Bone Joint Surg Am 2000;82-A:1681–91.
14. Jones RE, Cierny GC. Management of complex open tibial fractures with external skeletal fixation and early myoplasty or myocutaneous coverage. Can J Surg 1980;23:242–4.
15. Nguyen TA. Soft tissue coverage at the resource-challenged facility. Clin Orthop Relat Res 2008;466:2451–6.
16. Merrell JC, Tien NV, Son NT, et al. Introduction of microsurgery in Vietnam by a charitable organization: a 15-year experience. Plast Reconstr Surg 2007;119:1267–73. discussion 1274–5.
17. World Health Organization. Global status report on road safety: time for action. Available at: http://whqlibdoc.who.int/publications/2009/9789241563840_eng.pdf. Accessed December 30, 2014.
18. WHO Scientific Group. The burden of musculoskeletal conditions at the start of the new millennium. World Health Organ Tech Rep Ser 2003;919:i–x. 1–218.
19. Patel A, Sinha I, McRae M, et al. The role of academic plastic surgery institutions in addressing the global burden of surgical disease. Plast Reconstr Surg 2011;127:1019–20.
20. Corlew S, Fan VY. A model for building capacity in international plastic surgery: ReSurge International. Ann Plast Surg 2011;67:568.e70.
21. Corlew DS. Perspectives on plastic surgery and global health. Ann Plast Surg 2009;62:473–7.
22. Mishra B, Koirala R, Tripathi N, et al. Plastic surgery-myths and realities in developing countries: experience from eastern Nepal. Plast Surg Int 2011;2011:870902.
23. Figus A, Fioramonti P, Morselli P, Scuderi N. Interplast Italy: a 20-year plastic and reconstructive surgery humanitarian experience in developing countries. Plast Reconstr Surg 2009;124:1340–8.
24. Schneider WJ, Politis GD, Gosain AK, et al. Volunteers in plastic surgery guidelines for providing surgical care for children in the less developed world. Plast Reconstr Surg 2011;127:2477–86.
25. Casey K, Sabino J, Weiss JS, et al. Limb salvage after vascular reconstruction followed by tissue transfer during the Global War on Terror. J Vasc Surg 2015;61:734–40.
26. MacLeod JB, Okech M, Labib M, et al. Evaluation of trauma and critical care training courses on the knowledge and confidence of participants in Kenya and Zambia. World J Surg 2011;35:9–16.
27. Natsume N. Safari surgery. Plast Reconstr Surg 1998;102:1304–5.
28. Dupuis CC. Humanitarian missions in the third world: a polite dissent. Plast Reconstr Surg 2004;113:433–5.
29. Tajsic NB, Husum H. Reconstructive surgery including free flap transfers can be performed in low-resource settings: experiences from a wartime scenario. J Trauma 2008;65:1463–7.
30. Trajkovski T, Veillette C, Backstein D, et al. Resident self-assessment of operative experience in primary total knee and total hip arthroplasty: is it accurate? Can J Surg 2012;55:S153–7.
31. Gordon MJ. A review of the validity and accuracy of self-assessments in health professions training. Acad Med 1991;66:762–9.
32. Nagler M, Feller S, Beyeler C. Retrospective adjustment of self-assessed medical competencies - noteworthy in the evaluation of postgraduate practical training courses. GMS Z Med Ausbild 2012;29:Doc45.
33. Mock CN, Quansah R, Addae-Mensah L, Donkor P. The development of continuing education for trauma care in an African nation. Injury 2005;36:725–32.
34. Tchorz KM, Thomas N, Jesudassan S, et al. Teaching trauma care in India: an educational pilot study from Bangalore. J Surg Res 2007;142:373–7.