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ORIGINAL RESEARCH

Development and Pilot Evaluation of an e-Learning Module for Autologous Fat Transfer (AFT) in Total Breast Reconstruction in the Dutch Healthcare System: Insights From 9 Plastic Surgeons

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Introduction: Autologous Fat Transfer (AFT) for total breast reconstruction is a novel, minimally invasive technique recently introduced into the Dutch healthcare system. Although plastic surgeons are experienced with AFT for aesthetic and partial reconstructive procedures, its application for total breast reconstruction presents unique challenges, necessitating standardized training.

Methods: A multidisciplinary team developed an e-learning module on The Huddle platform, guided by adult learning theory, context-specific instruction, visual learning aids, and key insights from a clinical research program (BREAST trial). The module included text, videos, illustrations, and case-based learning. Nine Dutch plastic surgeons with varying experience levels pilot-tested the module. Semi-structured interviews assessed clarity, relevance, and usability.

Results: Feedback was predominantly positive. Participants appreciated the structured format, permanent accessibility, and visual materials that supported procedural understanding. Several surgeons reported intended changes to their surgical approach, such as modifications in fat harvesting. Suggested improvements included patient selection criteria, radiological aspects, and information on common complications. The absence of narrated videos was perceived as a limitation.

Discussion: The pilot demonstrated that a flexible, visually rich e-learning format can support knowledge acquisition in a novel surgical technique. Interdisciplinary collaboration and iterative feedback were key strengths. Limitations include the small sample size and the purely qualitative design, which restrict generalizability.

Conclusion: We developed and pilot-tested an e-learning module for AFT in total breast reconstruction. The module was well received and considered clinically relevant, and could hereby fill an (inter)national gap in standardised training. Future research should evaluate learning outcomes quantitatively, compare efficacy to traditional training, and assess long-term impact on surgical practice.

Keywords: autologous fat transfer, AFT, total breast reconstruction, e-learning module, plastic surgery education, Dutch healthcare system

Introduction

The term Autologous Fat Transfer (AFT) is used to describe the act of transplanting the patient's own fat tissue to another region in the body for the purpose of correcting volume or contour deformities. It is a minimally invasive surgical technique in which the adipose tissue is aspirated from a donor site (liposuction) and relocated to a (contour)defect of the body (lipofilling), either as (defect) reconstruction or aesthetic breast augmentation.[1,2] Although plastic surgeons are widely trained in the technique of liposuction for the removal of fat, re-injection (often referred to as lipofilling) is

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a procedure which has some challenges and must be adapted to the clinical goal. The most important applications of AFT in plastic and reconstructive surgery are the face, the breast and in scar tissue.

AFT has until recently only been known to correct small breast deformities. Recently, however, it has been introduced as an option for total breast reconstruction following mastectomy. The Dutch BREAST trial showed that AFT as total breast reconstruction improves quality of life compared to implant-based reconstruction, leading to its inclusion in the Dutch national health insurance. AFT can now be offered as standard breast reconstruction, but only when adhering to the same strict criteria as the BREAST trial protocol.[3,4] As the number of centres offering this treatment expands, the Dutch Association for Plastic Surgery has emphasized the need for proper training.[5]

Due to its novelty, however, AFT as total breast reconstruction is not yet standardised in residency. Absence of standardized training in Plastic Surgery is no new phenomenon, and extends beyond the Dutch context, with literature describing substantial differences across continents, between countries, and even regionally.[6,7]

Traditional training methods, such as in-house courses with presentations, videos, and supervised practice, are effective but time-consuming and therefore costly. With demanding schedules, surgeons often lack the time to travel, whether nationally or internationally, for additional training.

E-learning offers a promising solution. Well-designed e-modules can provide continuous access to high-quality educational content, allowing surgeons to learn at their own pace and revisit complex material as needed. Moreover, literature has shown that e-learning can effectively support surgical training, enhancing both knowledge and skills acquisition.[8,9]

Our hypothesis is that an AFT e-learning is a valuable addition to the regular training, and might be effective without in-house training. To assess this, an application for Promising Healthcare Practices was granted to develop a dedicated e-learning module for AFT, using a multidisciplinary team.[10] This pilot study focuses on module design and usability.

Methods

The institutional ethical review board of the Maastricht university hospital confirmed that the Law on Medical Research Involving Human Subjects (WMO) did not apply during the development and pilot testing of the e-learning, ethical approval was hereby appointed under METC 2024–0482. As such, formal written informed consent was not required, and verbal consent was considered sufficient. All plastic surgeons provided verbal consent.

Steps Taken for Development and Implementation of Innovation

Developing an effective e-learning module requires a structured, evidence-based approach, guided by models such as ADDIE[11] and multimedia learning principles.[12] After a needs analysis to define objectives and assess the target group, design principles need to be determined. These design principles are the basis for content and technical development. Content development focuses on high-quality visuals and text that support learning while minimizing cognitive overload. The technical phase ensures the module is accessible, multimedia-supported, and allows progress tracking. A pilot test, evaluation through learner feedback, leads to continuous improvement.

Target Group and Needs Analysis

The target group of the module consists of designated plastic surgeons in the Netherlands. This group includes recently board certified plastic surgeons, those at intermediate career stages and those with years of experience. Some of them may have experience with AFT for total breast reconstruction when their residency training centre was involved in the BREAST trial or was part of the appointed AFT-centres. Most have used AFT in cosmetic procedures or to correct contour deformities. However, the majority have never performed total breast reconstruction with AFT. The module should therefore not directly focus on the technique of AFT, but rather put emphasis on it in the context of total breast reconstruction. The e-learning should elaborate on the trajectory of AFT breast reconstruction in its entirety, including secondary corrections such as scar release, and patient counselling. This approach enables the creation of flexible, scalable training modules, allowing surgeons to master procedures like AFT breast reconstruction at their own pace and according to their learning needs.

Design Principles

The aim of the module is to provide comprehensive and accessible information about the procedures, ensuring that plastic surgeons gain a complete understanding of the relevant protocols. To reach this aim, we designed the e-learning module based on four design principles. The design principles were defined based on literature on adult learning,[13] instructional strategies for skill acquisition,[14] the role of visual information in e-learning,[15] and the key knowledge to be conveyed from the BREAST trials.[5,16]

Alignment with Adult Learning Theory

The module should take into account the adult learning principles, recognizing that the target audience consists of experienced, motivated plastic surgeons who are already familiar with the fundamentals of AFT.[17] Adult learners need to understand the relevance of what they are learning, build on their prior experiences, and value autonomy in their learning process. Adults prefer education that offers practical, applicable outcomes, sometimes embracing theoretical insights but often dismissing abstract knowledge if perceived as irrelevant. In the context of online learning environments, this means that the adult learner must be able to use the available technology and have the skills to search for and identify reliable information.[18] Based on these principles, the focus is placed on presenting new information specifically related to applying AFT for total breast reconstruction, rather than revisiting foundational knowledge or general AFT techniques. Based on the content of the module, the plastic surgeons should be able to assess their own proficiency in performing AFT in the context of total breast reconstruction and determine whether they need to assist under supervision or operate under the guidance of a more experienced surgeon.

Guidance Specific to Context

Literature on skill acquisition emphasizes that providing overly detailed instructions on how to perform a task can be counterproductive. Instead, it is more effective to explain what needs to be achieved,[19] except when necessary to ensure clarity.[20] This is particularly important for experts, as excessive procedural guidance can disrupt automatization and hinder performance. Focusing on the desired outcomes supports more flexible, adaptive skill execution. This principle is supported by studies on expertise development and cognitive load theory, which show that too much guidance can cause the "reinvestment" of conscious control over automated skills, leading to performance breakdowns.[14,21]

Use of Supportive Visual Materials

Supportive visual materials are necessary for effective e-learning design, particularly for complex skill acquisition. Combining visuals with verbal information reduces cognitive load and enhances understanding. Visuals help learners form accurate mental models, direct attention to key aspects of tasks[15] and improve knowledge retention when closely aligned with learning objectives.[22] Videos featuring an expert plastic surgeon performing the procedures are particularly helpful, as they not only demonstrate how to execute the techniques but also activate the observer's mirror neuron system, enhancing learning through observation.[23]

Emphasis on Essential Knowledge From BREAST Trials

The module should highlight critical insights gained from previous breast trials to prevent users from repeating mistakes made during the development of the AFT procedure in the context of total breast reconstruction. The BREAST trials demonstrated that AFT is a safe and effective procedure for total breast reconstruction when the adapted Coleman technique is used and appropriate patient selection is applied.[5,24] Therefore in the Dutch healthcare system, AFT can only be performed using these exact techniques. Critical insights include the liposuction with caution, preparing the skin of the thorax for lipofilling, management of the volume of injected fat, and aligning surgical outcomes with patient expectations.[16] Integrating this evidence ensures that learners are trained in evidence-based decision-making to optimize patient care.

Content and Technical Development

The e- module was created in an online platform called The Huddle.[25] In this online environment, a variety of media formats such as text, video and images can be added to a module, which suited the needs of our design team. The huddle

is available on mobile devices. Participants can track their process in this environment, pause the e-learning and can continue when they wish to. The content of the module is permanently accessible. The module is structured according to the sequential stages of the full AFT procedure for total breast reconstruction (see Table 1 for an overview). We highlighted the importance of patient counselling, because the success of the reconstruction is highly dependent on patients' understanding of the total reconstruction process and their compliance in wearing the external expansion device. The use of the external expansion device also required elucidation, as most plastic surgeons are not familiar with this procedure. This device is placed on the thoracic skin pre- and postoperatively to prepare the thorax for lipofilling and to act as a splint after the operation.

The perioperative chapters contain a step-by-step guidance of what needs to be achieved by surgery. This included how the patient should be positioned in the operating theatre, how the breast should be prepared for lipofilling, and which operative techniques should be used.[4,5] Following the explanations of the operative procedures, secondary corrections to optimize breast contour are explained. The final (postoperative) chapters of the module include recovery. As explained in the design principles, it was important to put extra emphasis on the most valuable lessons learned from the BREAST trials. The key lessons have been integrated into various components of the module. To further emphasize them, they are also highlighted in the sections "Frequently Asked Questions" and "Take-Home Messages".

The text was supported by several photographs, illustrations and videos. The photographs and videos were taken during either surgery or during clinical check-ups. The photographs were anonymized and patients consented to their use. A medical illustrator designed several illustrations that depicted parts of the process in similar design style. Figure 1 depicts an example of an illustration. Figure 2 provides an example of a module overview. Videos were used to show the procedures during surgery. Videos from a camera that was placed on the head (at eye-level) of an expert plastic surgeon

Table 1 Content of Module

E-Module Content	Elaboration
General introduction	General introduction on AFT, (learning) goals of the module and BREAST team contact information
Preoperative Counselling of the patient Expansion device	How to select patients, how to counsel them for AFT, what to discuss in the outpatient clinic. Usage of the External Expansion device: Why, how and when to use this.
Perioperative Planning Positioning of the patient Massaging the breast Donor site infiltration Liposuction of the donor site Preparing the breast for lipofilling Lipofilling the breast Decantation of fat and rebuilding the grafting system	In this chapter, the total operative procedure is outlined. This contains a very detailed exposition of the preparing the patient for the surgery, followed by the technique in its entirety. Why, how and when to use the techniques is explained. This chapter contains additional videos.
Perioperative tips and tricks Rigottomy (scar release) Reversed Abdominoplasty Flap Technique (RAFT, secondary correction technique)	This section depicts secondary corrective techniques, again with why, how and when to use these. This chapter contains additional videos.
Postoperative Antiseptic ointment Recovery Expansion	This chapter depicts patient care once the surgical aspect is completed.
Frequently Asked Questions	Frequently Asked Questions were noted during AFT-masterclasses by the BREAST team, and answered in this chapter.
Take home messages	A brief summary with relevant take home messages concludes the module.

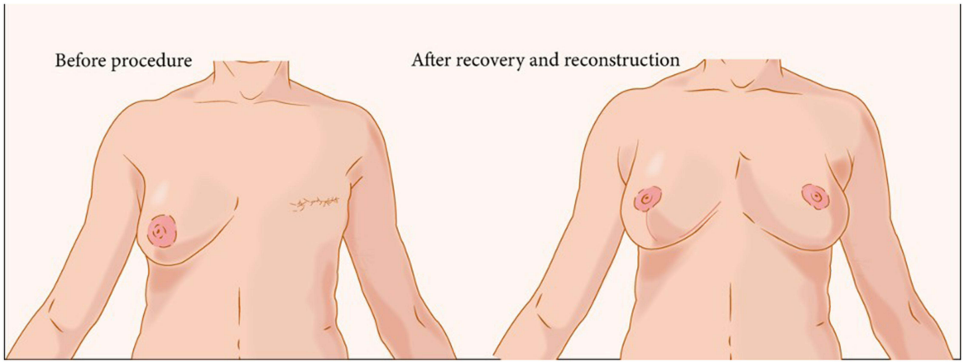

Figure 1 Left side, after amputation of left breast. Right side, after AFT-reconstruction of left breast, nipple reconstruction and reduction mammoplasty of right breast. Illustration: © Ava Krueger.

Figure 2 This figure provides an example of one of the modules, the use of the External Vacuum Expander (EVE-bra®) on the chest, as preparation before the surgery. Illustration: © Ava Krueger.

showcased a surgeon point-of-view. Videos from a camera on tripod at the foot of the operating table showcased the procedures from the point of view of an observer. Videos were recorded and exported in high-definition (HD) resolution (1920 × 1080 pixels), and were edited in the apple application iMovie. The use of video footages from various perspectives was intended to make it easier for plastic surgeons to understand the procedures and apply them independently. Video length was on average up to three minutes, with one longer video containing step-by-step approach for the RAFT technique.

Results

Evaluation of Innovation

To evaluate whether the intended aim of the module was achieved, we incorporated a pilot-testing with nine plastic surgeons. All surgeons were experienced in the application of AFT but varied in experience with the context of total breast reconstruction. Three of them had participated in the BREAST trials and were experienced (expert group), three had some experience (novice group) and three were about to start (aspiring group). The surgeons were affiliated with nine different Dutch hospitals, both academic and non-academic. For an overview of the plastic surgeons' experience level, see Table 2. After they had completed the module, they were interviewed about their experiences. Interviews were conducted in a remote setting with questions regarding strengths and weaknesses, user-friendliness, timespan, whether they would recommend the module to colleagues and whether they would alter anything in their own practice after completion of the module. Examples of the interview questions can be found in Table 3. The surgeons who participated in the BREAST trials were also asked whether they felt any information was missing or redundant.

Table 2 Baseline Characteristics of Participating Plastic Surgeons

Group	Experience as Certified Plastic Surgeon (Mean in Years, SD)	Experience with Aesthetic Lipofilling (-, +, ++)	Experience with AFT as Total Breast Reconstruction (Mean in Years, Extracurricular Activities)
Aspiring	17 ± 9.63	++	No autonomous experience yet
Novice	15 ± 4.64	+	1-2 years, have attended masterclasses
Expert	17 ± 2.49	++	10 years, expert level, received and have given masterclasses

Table 3 First Questions of Semi-Structured Interview

	Questions
1.	Could you describe your overall experience with the e-learning program?
2.	What elements of the e-learning program did you find particularly positive or valuable?
3.	Are there any aspects of the e-learning program that you would like to see improved or changed? If so, which ones and why?
4.	How much time did you spend to complete the e-learning?

On average, completion of the module took around 90 minutes, varying between 30 minutes and three hours. After nine interviews, thematic saturation was reached. All interviewed surgeons were positive about the module. They appreciated the thoroughness and the accessibility of the e-learning. They liked the well thought-out structure and permanent accessibility of the information. The videos and illustrations were seen as helpful components of the module. The surgeons with more experience experienced the module as a familiar repetition and as a refresher course. Overall, all surgeons would recommend the module to other plastic surgeons and felt well prepared to perform AFT in the context of total breast reconstruction after completing the module. Among the surgeons who were about to start with total breast reconstruction (ie the aspiring group), there was a degree of nuance between those who had previously observed a total breast reconstruction and those who had not. For the former, the module content was largely familiar and recognizable. The latter tended to rely more on their own established working methods, based on their experience with other applications of AFT. For example, they would prefer not to use small syringes as recommended to inject the fat in micro droplets (ie very small portions of fat, to improve cell-survival). They would also not use a closed liposuction system, as they were familiar with their own liposuction system. All in all, all surgeons highlighted also the value of in-person training and observations, besides following the module.

The tips that were given for possible improvement of the module differed per degree of experience among the surgeons. The surgeons with some and with extensive experience recommended to add information on common side effects. A common side effect is that a small piece of fatty tissue may not survive. This fatty tissue feels as a breast lump but is usually not cancer. It is important that patients are informed in advance, so that they do not worry. They must report to the outpatient clinic for further examination. The surgeons also pointed out the importance that radiologists can accurately identify and differentiate between fat and tumour tissue and that radiologist thus need to be informed about the new application and this common side effect. In addition, some surgeons asked in the interviews for experiences with postoperative antibiotics. This was not addressed in module, but literature showed that postoperative antibiotics has no effect.[26]

The surgeons with some experience also advised to present patient cases with varying initial conditions. In clinical practice, women can present themselves not only with amputated breasts, but often already with an implant, or even another autologous reconstruction. These different conditions require different approaches. Interviewees would prefer that these differences be discussed. The surgeons who are about to start with total breast reconstruction gave other suggestions to further improve the module. They were interested in further information about legislation and logistics, but also about inclusions and exclusions criteria among patients. AFT has been included in the basic health care service

since 2023, but only under strict criteria for patient selection, as described in the BREAST trial.[5] The surgeons would like to have this more elaborated. They would also have preferred to receive verbal just-in-time information while watching the videos. Videos were presented silent, because after filming, the sound was of bad quality. Consequently, participants now felt more as a passive observer rather than an active participant.

Responses to the question regarding changes in surgical approach after completing the module varied across surgeons. The most experienced surgeons explained that they would start to perform liposuction in the inframammary fold of the breast to increase a better shape of the breast. The module also prompted surgeons with some and with extensive experience to apply scar tissue release following fat grafting, instead of before. Furthermore, based on the pictures and photos in the module, the surgeons with some experience and starting surgeons learned to place the EVE-bra device (which patients wear two weeks before and after surgery) lower on the thorax, to no longer close injection sites, because these typically heal spontaneously and do not require suturing, and to also use inner and outer thighs as donor site (besides back and abdomen).

Discussion

In this study, we developed and pilot-tested an e-learning module to support plastic surgeons in performing AFT for total breast reconstruction. Nine Dutch plastic surgeons with varying levels of experience (with AFT) evaluated the module. Interviews showed not all participants would adhere to the techniques described in the e-learning, but rather to their own techniques, especially when they have used aesthetic lipofilling in their career. Nevertheless, several surgeons indicated that the module prompted changes in their intended surgical practice. For example, one surgeon noted she would perform the rigottomy after the re-injection of fat, while another stated she would place the external vacuum expander lower than she had done previously. Overall, participants valued the structured content, visual materials, and permanent accessibility of the platform. Suggestions for improvement of the module included the addition of information on side effects, patient selection, and radiological findings. These subjects have since been included.

The findings suggest that the e-learning module was considered relevant for clinical practice. This aligns with previous research showing that e-learning can be an effective adjunct in surgical training.[8,9] Studies in surgical education have demonstrated that video-based online learning tools can improve procedural understanding and confidence, particularly when combined with traditional training.[27,28] Our results echo these observations, as surgeons highlighted the added value of the visual materials and its permanent accessibility. At the same time, the absence of audio or narrated videos was perceived as a limitation, which is consistent with literature emphasizing enhanced learning in e-learnings with audio, compared to silent videos.[29]

Strengths and Limitations

The development of the module was strengthened by a multidisciplinary design team, which allowed integration of clinical and scientific expertise, and educational principles. Including surgeons with diverse experience levels provided valuable insights into different learning needs and helped tailor the module to a broad target group. The thoroughness, visual materials and permanent accessibility were also recognized as a particular strength, supporting engagement and knowledge retention.

Several limitations should be addressed. First, the pilot sample was small and drawn exclusively from only Dutch plastic surgeons, possibly limiting generalizability. Second, evaluation was qualitative and based on self-report, without objective measures of knowledge gain or performance. Third, no control group was included, which prevents conclusions on the efficacy of the module compared to traditional training. Finally, all participants were volunteers, possibly introducing selection bias.

Future Recommendations

Now that the module has been pilot tested and finessed, future studies should include quantitative assessment, such as pre- and post-module testing, validated questionnaires, or clinical performance data. Larger-scale evaluations are needed to validate the efficacy of the module. Comparative studies with in-person or hybrid training could determine whether e-learning is equally effective or more cost-efficient. Long-term follow-up is also necessary to examine whether the

module translates into sustained changes in surgical practice and possibly therefore, patient outcomes. For now, the principles and operative techniques are described adequately to train residents, but not yet to implement this technique in global healthcare. To achieve this, adaptations to local regulatory and healthcare contexts should be carefully addressed.

Conclusion

We developed and pilot-tested the feasibility of an e-learning module for AFT in total breast reconstruction. The module was positively evaluated and considered valuable for surgical training, although further refinement and rigorous evaluation are required. Despite limitations related to sample size and study design, this work represents an important step towards standardized training in this novel reconstructive technique.

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Disclosure

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