











Low-cost synthetic model for skin flap training

Modelo sintético e de baixo custo para treinamento de retalho cutâneo

ARTHUR ANTUNES COIMBRA
PINHEIRO PACÍFICO ^{1*} 
ALINE SANTOS CORREIA ¹ 
BÁRBARA MATOS DE CARVALHO
BORGES ¹ 
MATEUS BONFIM COSTA ¹ 
MATEUS PINHEIRO FERNANDES
FEITOSA ARRAIS ¹ 
SAMY LIMA CARNEIRO ¹ 
THIAGO MACIEL VALENTE ¹ 
NELSON GURGEL SIMAS DE OLIVEIRA ¹ 

Institution: University of Fortaleza UNIFOR,
Fortaleza, CE, Brazil.

Article received: August 8, 2019.
Article accepted: July 15, 2020.

Conflicts of interest: none.

DOI: 10.5935/2177-1235.2020RBCP0054

■ ABSTRACT

Introduction: The search for learning surgical techniques within the operating room is linked to difficulties, such as reducing teaching time by surgeons and ethical problems. Models have already been developed to facilitate the practice of surgical techniques, however, with high cost, difficult access, and ethical and moral complications. The present work aims to present a synthetic model, unpublished and practical for the training of skin flap techniques, formulated to be easy to reproduce and low cost, allowing its feasibility. **Methods:** In the model, fabric, sponge for car washing, latex elastic, fine-tipped brush, scalpel, and surgical suture instruments were used. The fabric is fixed by the elastic on the surface of the sponge, simulating skin and subcutaneous. The flap to be made on the surface of the fabric is then drawn. **Results:** The model created was satisfactory, since it improves the handling of surgical instruments and the learning of the proposed flap technique, besides having demonstrated good elasticity and tensile strength. In medical schools, there is a lack of approach to essential topics in plastic surgery. The importance of low-cost and easy-to-execute models, such as the above, is emphasized to facilitate the learning of students interested in the subject, seeking to fulfill the educational function without breaking ethical principles. **Conclusion:** The proposed model is an excellent form of training because it presents logistical and instructive benefits, facilitating learning, without causing harm to animals. **Keywords:** Simulation; Training; Medical education; Surgical flaps; Reconstructive surgical procedures.

¹ University of Fortaleza UNIFOR, Fortaleza, CE, Brazil.

■ RESUMO

Introdução: A busca pela aprendizagem de técnicas cirúrgicas dentro da sala de operação está vinculada a dificuldades, como a redução do tempo de ensino pelos cirurgiões e problemas éticos. Já foram elaborados modelos para facilitar a prática de técnicas cirúrgicas, contudo de custo elevado, difícil acesso e com complicações éticas e morais. O presente trabalho tem como objetivo apresentar um modelo sintético, inédito e prático para o treinamento das técnicas de retalho cutâneo, formulado para ser de fácil reprodução e de baixo custo, permitindo sua exequibilidade.

Métodos: No modelo foi utilizado malha, esponja para lavagem de carro, elástico de látex, pincel de ponta fina, bisturi e instrumentos cirúrgicos de sutura. A malha é fixada pelo elástico sobre a superfície da esponja, simulando pele e subcutâneo. Desenha-se, então, o retalho a ser feito na superfície do tecido.

Resultados: O modelo criado mostrou-se satisfatório, visto que aprimora o manuseio de instrumentos cirúrgicos e o aprendizado da técnica de retalho proposta, além de ter demonstrado boa elasticidade e resistência a tração. Nas faculdades de medicina percebe-se uma carência na abordagem de temas importantes da cirurgia plástica. Ressalta-se a importância de modelos de baixo custo e de fácil execução, como o supracitado, para facilitar a aprendizagem de estudantes interessados no assunto, buscando cumprir a função educacional sem romper princípios éticos.

Conclusão: O modelo proposto é uma excelente forma de treinamento por apresentar benefícios logísticos e instrutivos, facilitando a aprendizagem, sem causar prejuízo aos animais.

Descritores: Simulação; Capacitação; Educação médica; Retalhos cirúrgicos; Procedimentos cirúrgicos reconstrutivos.

INTRODUCTION

The surgical flap consists of a tissue mobilized from one part of the body to another with a vascular peduncle and can be kept intact or sectioned, to perform vascular anastomosis and maintain the blood supply of that tissue. These can be classified according to the composition of the tissue found in it (cutaneous, musculocutaneous, fasciocutaneous, osteocutaneous and sensory), and according to the movement of the skin towards the receptor area (advance, rotation, transposition, and interpolation)^{1,2}.

They are a choice to reconstruct a defect on vital structures, tissues devoid of a perivascular membrane, or implants.

To improve their surgical skills, medical students seek to expand their theoretical knowledge through observation and practice in operating rooms^{3,4}.

However, this learning vehicle has become a restricted alternative due to the increased demand to surgeons for greater effectiveness, seeking to reduce surgical time and, consequently, the time available for teaching; in addition to ethical conflicts that may arise

by allowing the student to practice them in the patient, because of the concept of non-maleficence³.

Given these difficulties, practical models were elaborated to allow their use outside the operating room and resemble human tissue. According to the material used for its manufacture and its purpose, these are classified as high, intermediate, and low fidelity. However, many of these have high costs, difficult access, and ethical complications, making them unfeasible for practice^{5,6}.

Thus, low-cost and synthetic models for the training of surgical techniques, such as the skin flap, are a relevant tool and can present positive results regarding the facilitation of the teaching and learning process of a complex theme, such as surgery. Allowing not only a more effective fixation of theoretical content but improving practical skills so that ethical principles are preserved.

OBJECTIVE

The present work aims to present a synthetic model that is unpublished and practical for the training of skin flap techniques.

METHODS

Its construction is made from the following components (Figure 1): 1) 24cm² of mesh fabric (96% polyester, 4% elastane); 2) car wash sponge (11x13x6cm); 3) latex rubber bands; 4) fine-tipped permanent brush; 5) scalpel (handle # 3, blade # 15); 6) 3-0 nylon threads; 7) surgical suture instruments (needle holder, mouse-tooth forceps and scissors).



Figure 1. Demonstration of the material needed to construct the model.

The assembly consists of covering one of the sponge surfaces with fabric to simulate the skin and the subcutaneous sponge. Besides, in order to have the fabric fixed on the sponge, latex elastics are used for this fixation, remaining immobile and slightly stretched (Figures 2A, 2B, and 2C).

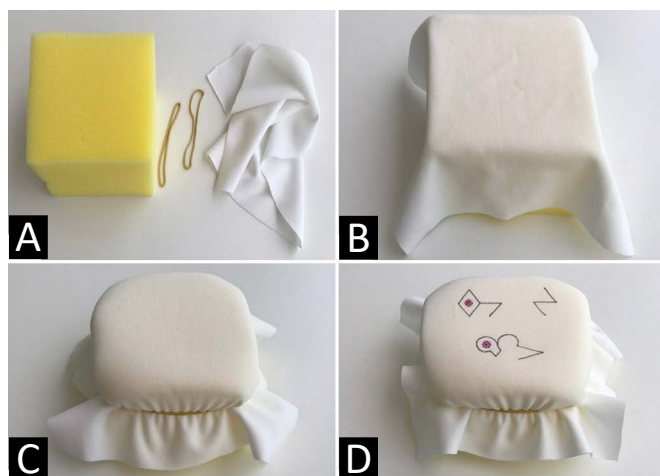


Figure 2. Demonstration of the model construction steps. **A.** Sponge block, rubber bands and mesh fabric; **B.** Positioning the fabric on the sponge; **C.** Fixing the fabric to the sponge with the latex elastic; **D.** Model duly ready and with the flap markings to be made.

After assembly, the fine-tipped brush is used to draw on the fabric's surface the type of flap to be made. Finally, the model can already be used to train the various techniques described using the appropriate surgical instruments (Figure 2D).

Thus, the model mentioned above was made with a maximum cost of 10 reais and simulates this procedure's technique. It is worth mentioning that the fabric is the only component that cannot be reused after use, and that needs replacement.

The model was made at the University of Fortaleza (UNIFOR) by the university's academic league of plastic surgery in January 2019. Moreover, the study mentioned above did not specify the involvement of humans and animals, so there was no need for approval by the Ethics Committee to prepare the skin flap model, which is obtained through synthetic materials.

The model was used in extracurricular activities elaborated by the academic league of plastic surgery of the university; the activities took place in a 4-hour shift under the supervision of academic members of the academic league who had teaching guidance.

RESULTS

The model was used in the event of the academic surgical leagues of a Private University of Fortaleza/CE, in which students from various school periods, approximately 50 students, had contact with the proposed model (Figure 3).



Figure 3. Practice of performing the skin flap using the proposed model.

The model presented satisfactory results in the simulation of the skin flap technique. The fabric, although limited in the simulation of human skin consistency, demonstrated good elasticity and tensile strength, allowing the improvement of surgical instrumentation manipulation and knowledge of principles and practice of procedure. Besides, it

allowed the development of skills also by the instructor students, such as interpersonal communication.

It is added that the presence of students more experienced and trained by the teacher, contributed to the elaboration of a less hostile environment for learning, facilitating the clarification of doubts in a simple and accessible language.

DISCUSSION

During the medical career, most surgical practices are restricted to the hours destined to general surgery and are often insufficient for academics interested in the surgical field. Regarding plastic surgery, there is a lack of treatment for essential themes in this area, such as the cutaneous flap⁷.

Microsurgery is an area of paramount importance in the plastic surgeon curriculum. Many models that allow the practice of this flap have already been developed and tested, demonstrating efficacy in the development of skills in microsurgery. According to the systematic review of non-biological models by Abi-Rafeh et al., in 2019⁸, simulation models should play an even more significant role in developing a microsurgery training curriculum. The model developed in this article was planned for the technique of cutaneous flap; unfortunately, it does not meet the specificities and characteristics of a model that allows the practice of free flap.

The model described was presented to a plastic surgeon, a professor of medicine at the University of Fortaleza. The professor evaluated the simulator and admitted the possibility of applying this model to teaching the procedure since the designs and geometries of some flaps are relatively complex to understand. Moreover, due to its high relevance, being one of the pillars of skin surgery, it is essential to the academic interested in the specialty, the knowledge of its execution through training in practical models of low cost and easy maintenance⁹, since, for better learning, the training repeated several times, with a low-cost material, is something that proves indispensable. The model also allows the execution of rotation, transposition, interpolation, and simple advancement flaps, as shown in Figure 4, and can be used to train various types of flaps.

The model proposed by Denadai et al., In 2012⁵, made from chicken skin, proved to be a complementary alternative to the arsenal of existing simulation models due to its similarity, in texture and consistency, to human tissue¹⁰. However, when it comes to its continuous use in teaching programs, the animal model can be expensive, since it needs a collection and storage service so that it does not bring biological risk to the students of the institutions. Besides, its preparation is time-consuming and delicate, since it is necessary to

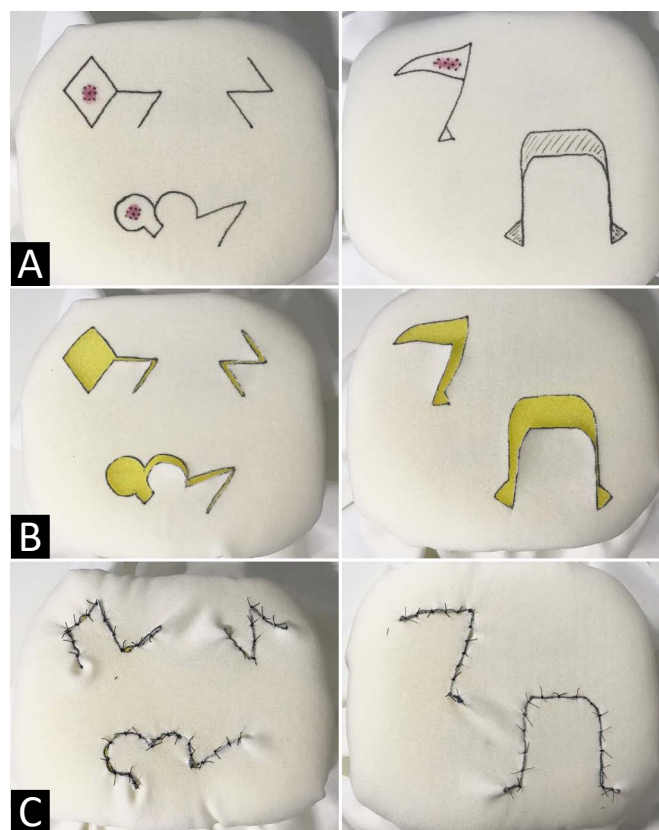


Figure 4. Demonstration of the flap techniques performed on the model. **A.** Markings of the Limberg flaps, Z-plasty, bilobed, triangular and simple advancement; **B.** Incisions and removal of injuries; **C.** Suture and completion of flap techniques.

defrost the parts in advance, a process that, when not done well, can leave the material hardened, causing the loss of needle threads during training and further increasing its cost.

The use of animal material also presents several ethical and bureaucratic complications, since besides being questionable, they conflict with modern concepts of animal welfare. With this, the current diversity and complexity of surgical medical knowledge require a new direction in teaching through innovative means, seeking to fulfill the educational function without harming the animals.

The proposed model, which is based on the use of synthetic fabric overlapping a layer of sponge for car wash, proved to be entirely objective regarding the execution of the technique, as the chosen fabric has good resistance to suture, reducing the probability of dehiscence, doing the practice aimed at improving the skin flap technique viable and safe. Besides, the model is easy to prepare and store, as it does not need to be conserved, and its assembly is simple, practical, and fast.

The proposed model is easy to perform and assembled to facilitate the understanding of the skin flap technique.

CONCLUSION

It is believed that the use of this synthetic model becomes relevant in the training of medical students and residents in plastic surgery, because it allows the practice of this medical skill, with minimal ethical conflicts and without the need to train in animals or the patient himself.

Besides, the surgical simulation of the cutaneous flap, using the proposed synthetic model, is a suggestion for the exercise of this technique because it presents logistical and instructive benefits, such as the use of low-cost materials, easy storage, and preparation.

However, further studies on the effectiveness of training with synthetic models for undergraduate medical students are needed, with the elaboration of questionnaires evaluating students' perception and instructors' perception.

COLLABORATIONS

AACPP	Analysis and/or data interpretation, Conception and design study, Conceptualization, Data Curation, Final manuscript approval, Formal Analysis, Funding Acquisition, Investigation, Methodology, Project Administration, Realization of operations and/or trials, Resources, Software, Supervision, Validation, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing
ASC	Data Curation, Methodology, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing
BMCB	Analysis and/or data interpretation, Conceptualization, Funding Acquisition, Supervision, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing
MBC	Supervision, Validation, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing

MPFFA	Supervision, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing
SLC	Supervision, Validation, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing
TMV	Supervision, Validation, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing
NGSO	Supervision, Validation, Visualization

REFERENCES

- Galimberti G, Ferrario D, Casabona GR, Molinari L. Usefulness of rotation and advancement flap for the closure of skin defects in the malar region. *Surg Cosmet Dermatol*. 2013;5(1):769.
- Townsend Junior CM, Beauchamp RD, Evers B, Mattox K. *Sabiston Tratado de cirurgia: a base biológica da prática cirúrgica moderna*. 19ª edição. Rio de Janeiro: Elsevier; 2015.
- Anastakis DJ, Regehr G, Reznick RK, Cusimano M, Murnaghan J, Brown M, et al. Assessment of technical skills transfer from the bench training model to the human model. *Am J Surg*. 1999 Feb;177(2):167-70.
- Purim KSM, Santos LDS, Murara GT, Maluf EMCP, Fernandes JW, Skinovsky J. Avaliação de treinamento cirúrgico na graduação de medicina. *Rev Col Bras Cir*. 2013;40(2):152-6.
- Denadai R, Saad-Hossne R, Oshiiwa M, Bastos EM. Training on synthetic ethylene-vinyl acetate bench model allows novice medical students to acquire suture skills. *Acta Cir Bras*. 2012 Mar;27(3):271-8.
- Hammoud MM, Nuthalapaty FS, Goepfert AR, Casey PM, Emmons S, Espey EL, et al. To the point: medical education review of the role of simulators in surgical training. *Am J Obstet Gynecol*. 2008 Oct;199(4):338-43.
- Khatib M, Soukup B, Boughton O, Amin K, Davis CR, Evans DM. Plastic surgery undergraduate training. How a single local event can inspire and educate medical students. *Ann Plast Surg*. 2014;1-5.
- Abi-Rafeh J, Zammit D, Jaber MM, Al-Halabi B, Thibaudeau S. Nonbiological microsurgery simulators in plastic surgery training: a systematic review. *Plast Reconstr Surg*. 2019 Sep;144(3):496e-507e.
- Friedlich M, Wood T, Regehr G, Hurst C, Shamji F. Structured assessment of minor surgical skills (SAMSS) for clinical clerks. *Acad Med*. 2002 Oct;77(10 Suppl 1):S39-S41.
- Denadai R, Saad-Hossne R, Souto L. Simulation-based cutaneous surgical-skill training on a chicken-skin bench model in a medical undergraduate program. *Indian J Dermatol*. 2013 May;58(3):200-7.

*Corresponding author:

Arthur Antunes Coimbra Pinheiro Pacífico

Rua Mariana Furtado Leite, 1250, Apart. 1201, Bairro Eng, Luciano Cavalcante, Fortaleza, CE, Brazil.

Zip Code: 60811-030

E-mail: arthurh.pacifico@gmail.com