Low-cost synthetic model for skin flap training

Modelo sintético e de baixo custo para treinamento de retalho cutâneo

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 The present work aims to present a synthetic model, unpublished and practical for the training of skin flap techniques, formulated to be easy to reproduce and low cost, allowing its feasibility.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.
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-maleficence\(^3\).

Given these difficulties, practical models were elaborated to facilitate the practice of surgical techniques, 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. **Resultado:** 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.

**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.

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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).

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). 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 flap.

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 2019, 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 maintenance, 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 2012, 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 tissue. 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
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, 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


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