Original Article

Low-cost, synthetic model for training and simulation of open and semi-open rhinoplasty

Modelo sintético e de baixo custo para o treinamento e simulação de rinoplastia aberta e semiaberta

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■ **ABSTRACT**

Introduction: Rhinoplasty is indicated for performing aesthetic repairs in the nose, being functional when it also seeks to improve respiratory function. Procedure results are based on improved quality of life and patient satisfaction. It is a complex surgery that requires adequate training. In this sense, several strategies were introduced, such as educational videos, simulations, studies on cadavers and in clinical skills laboratories; however, the basis of training remains the master-apprentice relationship in surgery. **Methods:** The base materials used in the construction of the model were: hot glue, basin, water, detergent, epoxy putty, spatulas for crafts, nose mold, suture threads, white acetic silicone, disposable cup and spoon and coloring agents. **Results:** The resulting low-cost model has remarkable similarity with the external appearance and with the cartilages of the nose, allowing easy identification and handling of each structure. Allows good simulation of some steps of the open and semi-open techniques of rhinoplasty. **Conclusion:** The new synthetic model developed avoids ethical and legal questions that alternative methods such as animals and fresh cadavers raise. Although it requires skill for its manufacture, it has characteristics such as low cost, which favor its dissemination among medical schools. The exposed model can positively impact the learning process of rhinoplasty, revealing itself as an accessible and helpful tool for training in various stages of the technique of this complex surgery.

Keywords: Simulation; Professional training; Rhinoplasty; medical education; Elective surgical procedures.

■ **RESUMO**

Introdução: A rinoplastia é indicada para a realização de reparos estéticos no nariz, sendo designada funcional quando também objetiva melhorar a função respiratória. Os resultados do procedimento são baseados na melhora da qualidade de vida e na satisfação do paciente. Trata-se de uma cirurgia complexa, que requer adequado treinamento. Nesse sentido, várias estratégias foram introduzidas, como vídeos educacionais, simulações, estudos em cadáveres e em laboratórios de habilidades clínicas; no entanto, a base do treinamento continua sendo a relação mestre-aprendiz em cirurgias. **Métodos:** Os materiais-base utilizados na construção do modelo foram: cola quente, bacia, água, detergente, massa epóxi, espátulas para artesanato, molde nasal, fios de sutura, silicone acético branco, copo e colher descartáveis e corantes. **Resultados:** O modelo resultante, de baixo custo, apresenta grande similaridade com o aspecto externo e com as cartilagens do nariz, permitindo fácil identificação e manuseio de cada estrutura. Permite boa simulação de algumas etapas das técnicas aberta e semiaberta da rinoplastia. **Conclusão:** O modelo sintético inédito desenvolvido evita questionamentos éticos e legais que métodos alternativos como o uso de animais e cadáveres frescos suscitam. Apesar de requerer habilidade para sua confecção, tem características como o baixo custo, que favorecem a sua disseminação entre as escolas médicas. O modelo exposto tem o potencial de impactar positivamente o processo de aprendizagem da rinoplastia, revelando-se uma ferramenta acessível e útil para o treinamento de várias etapas da técnica dessa complexa cirurgia.

Descritores: Simulação; Capacitação profissional; Rinoplastia; Educação médica; Procedimentos cirúrgicos eletivos.

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INTRODUCTION

Rhinoplasty is the surgery indicated for performing aesthetic repairs in the nose, being functional when it aims to improve respiratory function. Its first report was described in India, around 500 BC, by Sushruta, considered the father of plastic surgery, who used various reconstructive techniques on individuals who had their nose cut off. From this report, the techniques were improving more and more, and publications about this procedure became common. In the late 1500s, Professor Gaspare Tagliacozzi showed the possibility of nasal reconstruction using an arm flap; in the mid-1800s, Johann Friedrich Dieffenbach's textbook entitled "Operative surgery" described techniques for reducing the size of the nose. Since then, rhinoplasty has become increasingly refined based on theoretical and practical training provided by trained professionals[1].

Today, rhinoplasty is a widespread procedure. The evaluation of its results is based on improving the quality of life and patient satisfaction, which also depends on factors such as preoperative appearance, expectations and the doctor-patient relationship, and adequate training[2]. According to Oni et al. (2011) [3], more than half of the residency program directors evaluated did not feel confident in the residents' ability to perform rhinoplasty. Much of this is due to the absence of early exposure and little training time[4]. Despite this, several techniques were introduced, such as educational videos, simulations, studies on cadavers and clinical skills laboratories, but the training base remains the master-apprentice relationship in surgical procedures, which limits the resident's development[5]. It is essential to emphasize that many alternative educational tools involve high financial costs and training in patients may face restrictions due to the lack of hospital structure and resources for the procedure.

Rhinoplasty is considered the most difficult of all cosmetic surgeries, as the nasal anatomy is highly variable, the procedure must correct form and function, and the result must meet the expectations of patients[6]. Therefore, it is necessary to reinforce surgical learners' anatomical knowledge and technical skills, using strategies to increase training time and tools that, preferably, are low-cost and easily accessible.

OBJECTIVE

This article aims to present a synthetic, novel and practical model for training in rhinoplasty techniques, developed to be easy to perform and low cost.

METHODS

The study was carried out at the University of Fortaleza (UNIFOR), in Fortaleza/CE, from September 2020 to December 2020. All ethical aspects of the research were followed and respected.

To assemble the proposed model, the following materials were used: hot glue, basin, water, detergent, epoxy putty, spatulas for crafts, nose mold (Carnival mask), suture threads and white acetic silicone (Figure 1). To color the parts of skin and cartilage, it is necessary to use dye and a disposable cup and spoon.

Figure 1. Materials needed for making the model.

The construction of the model was done in three stages

The bone structure of the face:

With hot glue, the structure was made in layers and molded while still hot in the mask to replicate the bone structures of the face (Figure 2). The first nasal structure to be made was the septum, followed by the nasal bones themselves.

Cartilages

Cartilage construction was made from acetic silicone and an epoxy mass mold (Figure 3). This mold was handcrafted, simulating the shape of the upper and lower lateral cartilages (Figure 4).

The epoxy putty was prepared and allowed to rest for 10 minutes to gain sufficient consistency to be carved with the craft spatulas. After the mass had dried, the silicone was poured into the mold and kept until it hardened. Then, it was removed from the mold and placed in a ventilated place for complete drying and reduction of the intense odor (Figure 5).

Figure 2. Bone part made with hot glue.

Figure 3. Silicone cartilages and the material for their manufacture.

Figure 4. Cartilage molds made of epoxy putty using a craft spatula.

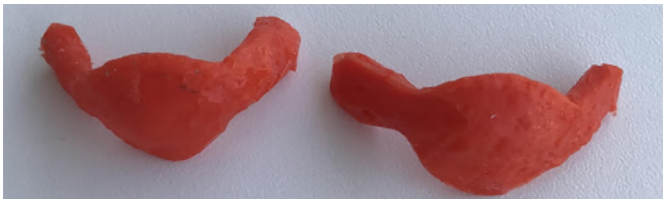

Figure 5. Inferior lateral cartilages ready.

Skin

For confection, the dye was added to white acetic silicone in a disposable container. Then, the mixture was placed in a basin with water and neutral detergent, being kneaded and rolled by hand until, after a few minutes, a slight hardening of the mass was observed (Figure 6).

Figure 6. Ready-made leather and the materials needed for its construction.

The most consistent silicone was placed in a plastic mold similar to a nose greased with oil and left to dry. Silicone has a powerful smell and, in contact with the skin, can cause dry hands. So, protection with gloves and a mask is essential.

With the cartilages adequately dried, they were fixed to the bone structure with suture threads (Figure 7). After that, the skin was used to cover the structure and fixed with a suture to remain immobile (Figure 8).

The skin was made to provide a better visual appearance to the model, as its construction will not significantly influence the training period.

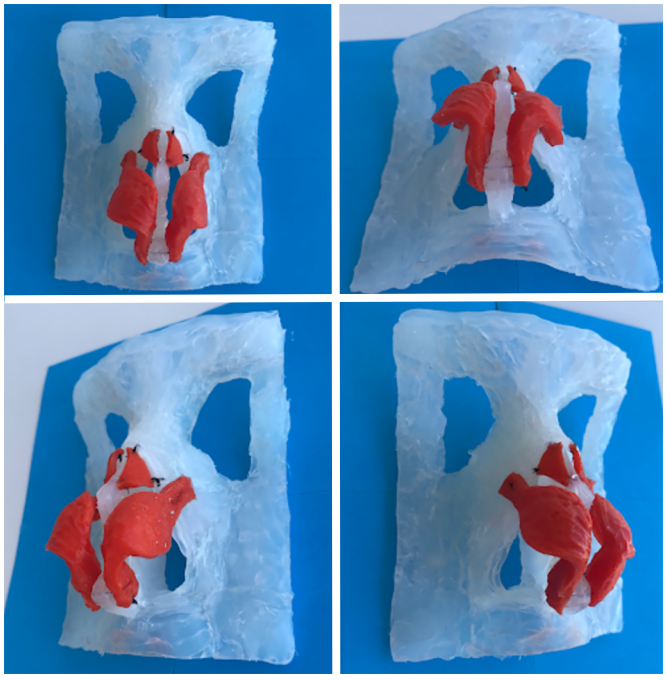

Figure 7. Cartilages attached to the bone structure.

Figure 8. Fixed skin covering the structure.

RESULTS

A format similar to the real one was obtained regarding the bone and cartilaginous structure, as shown in the following images. In addition, color differentiation between cartilages and nasal bones helps identify each structure (Figure 9).

The complete structure allows for a very real rhinoplasty simulation, making it possible to perform a columellar incision for open access and perform maneuvers on the nasal tip and the back, such as the execution of sutures and the eventual placement of grafts (Figure 10).

DISCUSSION

Surgical training involves complex practical and theoretical concepts, mainly related to the surgical technique and its fundamental bases, among which the development of skills is considered essential. In

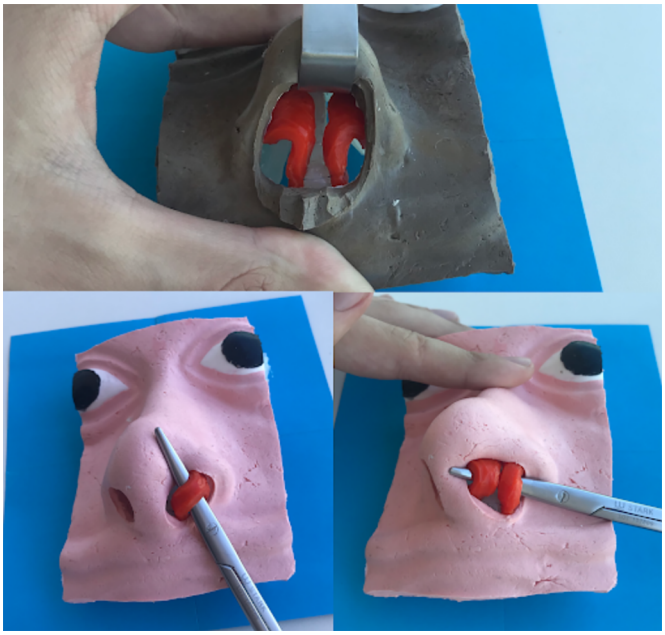

Figure 9. Cartilage exposure using open and semi-open techniques.

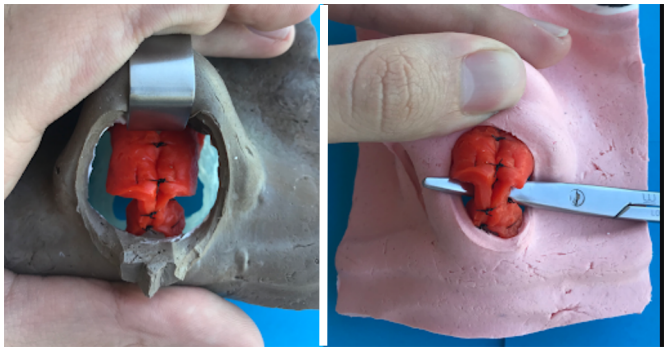

Figure 10. Completion of the simulation using open and semi-open techniques.

general, psychomotor skills are acquired through the observational model, known as "see, do and repeat" [7].

In order to expand skills training beyond operating rooms, it is essential to develop viable options with as much similarity as possible to the patient's tissue. An obvious option would be to study fresh cadavers, but due to legal obstacles that make it challenging to obtain this material in Brazil, it is still scarcely available[8].

Some experimental models for training surgical skills related to rhinoplasty have already been published, such as the animal model proposed by Dini et al. (2012)[8], which revealed great applicability. However, the use of a non-human material also presents several ethical and bureaucratic complications and does not show complete similarity. Furthermore, there is a conflict with modern concepts of animal welfare. Students' misinformation about ethics and the use of animals, associated with the obligation to participate in educational activities that use this teaching method, without the legal right to conscientious objection or the option of alternatives, have been related as a cause of desensitization professionals[9].

Therefore, the current diversity and complexity of medical-surgical knowledge require a new direction in teaching through innovative strategies. Several alternative precepts, also called "substitutives," have been exercised to ensure the acquisition of skills, seeking to fulfill the educational/scientific function without harming the animals. The intention should be to disseminate, at the ideal time, the knowledge necessary for adequate professional training, enhancing learning and reducing or abolishing the use of animals[7].

The new synthetic model developed allows for excellent identification of structures, adequate mobilization of nasal cartilages and easy handling of the overlying synthetic skin, with consistency, texture and resistance similar to the real thing. Allows good simulation of some steps of the open and semi-open techniques of rhinoplasty. The upper and lower lateral cartilages made with silicone, when sutured, provide a tactile sensation close to that of this surgical stage in patients. Synthetic skin has a certain elasticity, like what is observed when performing an open rhinoplasty. It should be noted that this model has already been used in a hands-on course, at the XV North-Northeast Congress of Otorhinolaryngology, in August 2019, when several surgeons were able to learn about the model and realize its similarity to the real one.

In addition to all these technical characteristics of the model, it should be noted that it does not raise ethical or legal questions that animal models or training in fresh human corpses inevitably impose due to its synthetic nature. In addition, another strong point is its low cost, which favors its replication in medical schools. In this way, it can provide more time and training options for apprentices in this refined surgery.

On the other hand, the main limitation of this model is that it requires relatively complex manual skills for its construction. In addition, some steps, for example, making the bone structure with hot glue, require some abstraction capacity for construction, as there is no sketch of the three-dimensional shapes of the face.

Finally, with the presentation of this model, the authors hope to make a relevant contribution to medical education and, at the same time, encourage the emergence of new models that improve it, based above all on the creative use of simple, easily accessible materials and low cost.

CONCLUSION

The exposed model has the potential to positively impact the rhinoplasty learning process, revealing itself as an accessible and helpful tool for training in the various stages of the technique of this complex surgery.

COLLABORATIONS

AACPP Analysis and/or data interpretation, Conception and design study, Conceptualization, Final manuscript approval, Funding Acquisition, Methodology, Realization of operations and/or trials, Resources, Supervision, Writing - Original Draft Preparation, Writing - Review & Editing.

BMCB Conception and design study, Conceptualization, Final manuscript approval, Realization of operations and/or trials, Software, Supervision, Validation, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing.

ALSP Conception and design study, Conceptualization, Final manuscript approval, Methodology, Realization of operations and/or trials, Supervision, Writing - Original Draft Preparation, Writing - Review & Editing.

MALF Conception and design study, Formal Analysis, Realization of operations and/or trials, Supervision, Validation, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing.

SLC Conception and design study, Realization of operations and/or trials, Resources, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing

MPFFA Conception and design study, Resources, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing.

DSG Analysis and/or data interpretation, Conception and design study, Final manuscript approval, Project Administration, Realization of operations and/or trials, Resources, Supervision, Validation, Visualization.

REFERENCES

1. Lalwani AK. Otorrinolaringologia, cirurgia de cabeça e pescoço: diagnóstico e tratamento. 3ª ed. São Paulo: Artmed; 2013.
2. Esteves SS, Ferreira MG, Almeida JC, Abrunhosa J, Sousa CA. Evaluation of aesthetic and functional outcomes in rhinoplasty surgery: a prospective study. Braz J Otorhinolaryngol. 2017 Set/Out;83(5):552-7.
3. Oni G, Ahmad J, Zins JE, Kenkel JM. Cosmetic surgery training in plastic surgery residency programs in the United States: how have we progressed in the last three years?. Aesthet Surg J. 2011 Mai;31(4):445-55.
4. Wright EJ, Khosla RK, Howell L, Lee GK. Rhinoplasty education using a standardized patient encounter. Arch Plast Surg. 2016 Set;43(5):451.
5. Dokuzlar U, Miman MC, Denizoğlu İİ, Eğrilmez M. Opinions of otorhinolaryngology residents about their education process. Turkish Arch Otorhinolaryngol. 2010 Set;53(3):100-7.
6. Daniel RK. Aesthetic reconstructive rhinoplasty. In: Daniel RK, ed. Mastering rhinoplasty. Berlin: Springer Heidelberg; 2010. p. 407-40.

7. Martins Filho EF, Daleck CR, Costa Neto JM. Métodos alternativos no ensino da técnica cirúrgica veterinária. São Paulo: Universidade Estadual Paulista (UNESP); 2015.
8. Dini GM, Gonella HA, Fregadolli L, Nunes B, Gozzano R. Novo modelo animal para treinamento de rinoplastia. Rev Bras Cir Plást. 2012;27(2):201-5.
9. Greif S, Tréz T. A verdadeira face da experimentação animal: a sua saúde em perigo. Rio de Janeiro: Sociedade Educacional Fala Bicho; 2000.

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