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Original Article

Development and evaluation of a low-cost facial model for training in sutures, incisions, and biopsies

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Abstract: Surgical simulation activities are fundamental in academic environments in the field of Dentistry. This practice serves to plan and simulate basic skills such as making incisions, biopsies, and sutures, allowing students to refine their techniques through repetitive training, improving manual skills and enabling the formation of more secure and confident professionals. Thus, a low-cost facial model was developed for evaluation and simulation by faculty for the training of sutures, incisions, and biopsies. This is a cross-sectional, quantitative, and observational study, conducted with 10 professors from the areas of Periodontics, Surgery, and Stomatology of the Dentistry Course at the University of Fortaleza (UNIFOR), using the Phrase Completion scale and their levels of personal satisfaction. The results showed a good evaluation in all criteria, resulting in a positive assessment of the model's similarity to real facial tissues, the handling of the model, as well as its utility in clinical practices with training in incisions, biopsies, and sutures. The use of the low-cost facial model in pre-clinical practices offers advantages for various specialties in the undergraduate Dentistry program, especially areas such as Periodontics, Oral Surgery, and Stomatology. The training on the model that simulates incisions, biopsies, and sutures proved effective in this study for the development and refinement of student skills.

Keywords: Educational Assessment; Oral Surgical Procedures; Anatomical Models; Suture Techniques.

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1. Introduction

Surgical operations generally require health professionals to have sufficient skills to ensure precision and mastery at the time of intervention on patients. To avoid complications, it is essential that those qualified for the function have a vast knowledge of each operation performed. Thus, the risks of complications that may arise are considerably reduced or even eliminated, resulting in greater safety for patients [1]. From the perspective of Dentistry in general, there is a variety of surgical procedures that encompass most of the soft and hard tissues of the craniofacial region. Therefore, the dental surgeon needs not only an extensive knowledge of procedures and techniques, but also motor skills for the real clinical operational environment [2].

The Dental Surgeon (DS) plays an essential role in diagnosing pathological changes involving the mouth. In this context, conducting an excellent clinical examination is mandatory, along with an analysis of meticulous tests, where there is a direct possibility of performing biopsies. Biopsy is a complementary method, extremely important, and for the execution of this technique and with the intention of correct handling of the collected sample, the surgeon must know the physical types of lesions that can be encountered and their characteristics [3]. Facial trauma is a common finding in hospital routines. Various studies have sought its epidemiology and given that the most frequent cause of these traumas is traffic accidents, followed by physical assault, with men being more affected than women, especially adults who are economically active [4].

In this regard, the Maxillofacial Surgeon plays an important role in caring for this type of patient, with functions including controlling nasal bleeding through tamponade, managing intrabuccal hemorrhage through cleaning, debridement of wounds, vessel ligation, as well as sutures intra and extraorally, reduction and stabilization of mandibular fractures, among others [4]. It is fundamentally important that the specialist knows how to identify and treat soft tissue injuries, restoring function and aesthetic damage, especially those dedicated to the care of emergencies and traumas of the face. Firstly, it is necessary for the surgeon to perform appropriate exploration and cleaning of the wound. Additionally, good surgical technique is crucial to minimize potential infections [5].

The most common methods for closing wounds include suturing, application of adhesives, and stapling. Whenever possible, layered closure is necessary to eliminate dead space under the wound. However, facial injuries vary according to clinical characteristics and complexity, requiring an individual approach for each case [4]. The type of injury that most often requires closure by sutures is lacerations, which correspond to penetrating damage to the epithelial structure, thus having various extensions and depths. Therefore, cleaning the area is essential, as well as it being prudent that the lacerated part is repositioned to its original condition through internal and external sutures, with their respective techniques, in the minimum possible number to favor healing. If the edges are beveled and uneven, they should be excised cautiously to provide perpendicular edges and avoid undesired healing [4].

Sutures or synthesis are procedures of extreme relevance in the day-to-day of those who perform surgeries, whether they are doctors or dental surgeons. However, most students do not develop such complex and satisfactory surgical skills during their academic training, particularly regarding the maxillofacial complex, often limiting oral surgeries, resulting in a great and valid demand for specialization courses, improvements, and extracurricular activities that use training models useful for this development, as these practical activities with patients infringe ethical, moral, and social aspects [6]. Performing sutures is a form of manual activity that requires training so that this competence reaches satisfactory levels; it is a stage that encompasses all maneuvers performed to reposition the tissues that were displaced, restoring the anatomy and function of the tissue [7, 8, 9].

The courses of improvement in Oral Surgery, in recent times, demonstrate constant growth, with an almost immediate demand by recent graduates, as well as more experienced professionals, aiming to reinforce basic principles and clarify clinical life issues daily, instructing them through theoretical, laboratory, and practical activities, which expand the teaching/learning process. This improvement leads the professional fundamentally based on scientific and practical aspects, enhancing the services provided from the principles of patient care, evaluation, and physical examination in a cohesive manner, requesting and interpreting radiographic examinations, diagnosis, and planning of surgical acts, among others [10].

Surgical simulation has been valued in academic environments and in theoretical-practical courses in the education of health professionals. This practice serves to plan and simulate a surgery, in order to obtain basic surgical skills, allowing students and professionals, through repetitive work, to improve their situational analytical capabilities and reduce operative time, which is very valuable in clinical and hospital environments, without compromising the patient [7, 10-12]. Some forms and materials for suture training have been used and tested for decades, yet financial difficulty presents an obstacle to their use in the university environment, which hampers this change in teaching and learning in practice for undergraduates [1]. Moreover, low-cost models available on the market, such as sponge simulators and molding materials, despite having the similitude of human tissue, do not simulate clinical conditions [1, 2].

The present work aims to evaluate the development of an alternative educational method, simple and low-cost, such as the silicone facial model, for the training of sutures, incisions, and biopsies, conducted by faculty of the Dentistry course at the University of Fortaleza (UNIFOR), between the months of April to May 2023, with the following specialties: Oral Surgery, Periodontics, Implantology, and Stomatology.

2. Methodology

2.1 Study Characterization, Ethical Aspects, and Sample

This work is a cross-sectional, observational, and quantitative study based on a questionnaire answered by faculty members from surgical areas of the Dentistry course at UNIFOR, to evaluate the effectiveness of a low-cost facial model (LCFM) for training in sutures, incisions, and biopsies. During the first contact, all participants were given the Informed Consent Form – ICF, which presents the general aspects of the study, as well as risks and methods of minimization, benefits, and forms of assistance. Therefore, the faculty members established their agreement or disagreement with the research, requiring their signatures.

For the process of analyzing the participants' perception, the Phrase Completion scale was used, as described by Junior et al. [13]. The questionnaire gathered information on the gender of the participants, age, specialty in Dentistry, and years since graduation, without revealing their names and/or images. They responded about the five levels of satisfaction regarding the similarity of the model to real tissues, its handling, and indications for performing incisions, sutures, and biopsies.

The training of the model with the faculty was conducted at the Integrated Clinic of the Dentistry Course at Unifor, from March to April 2023. The target population consisted of professors from the specialties of Maxillofacial Surgery, Periodontics, and Stomatology, who perform surgical practices in their work environment and at the institution.

2.2 Model Fabrication

Two plaster molds (Figure 1A) were made using common plaster (NOVO GESSO® Manaus- AM, Brazil), obtained from a realistic facial mannequin. After the plaster had fully set, a silicone model was fabricated on the plaster mold, using blue-colored silicone-based rubber (SIQMOL SIQUIPLÁS® São Paulo, Brazil) with its proper catalyst. This process was repeated 4 times, before the training, totaling four models, reproducing anatomical structures of the mannequin, which participants enjoyed using, with each model being usable two to three times by different participants (Figure 1B).

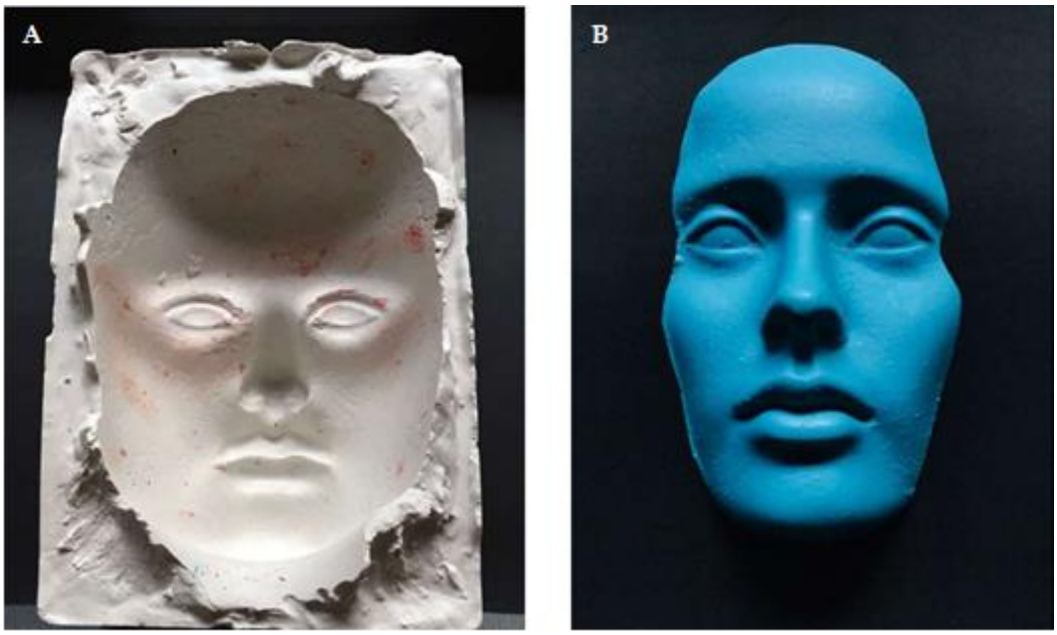

Figure 1: A. Common plaster mold. B. Silicone rubber model.

2.3 Training Instruction

Participants were given a basic suture kit, containing the following items: 1 scalpel handle, 1 number 15 scalpel blade, 1 Dietrich forceps, 1 Mayo needle holder, 1 straight iris scissors, 2 Nylon 3-0 sutures, as well as personal protective equipment (PPE). Subsequently, everyone was instructed to perform the following steps:

1. Incision with a number 15 scalpel blade on a previously marked area with a black permanent marker on the frontal region of the face on the model (Figure 2).

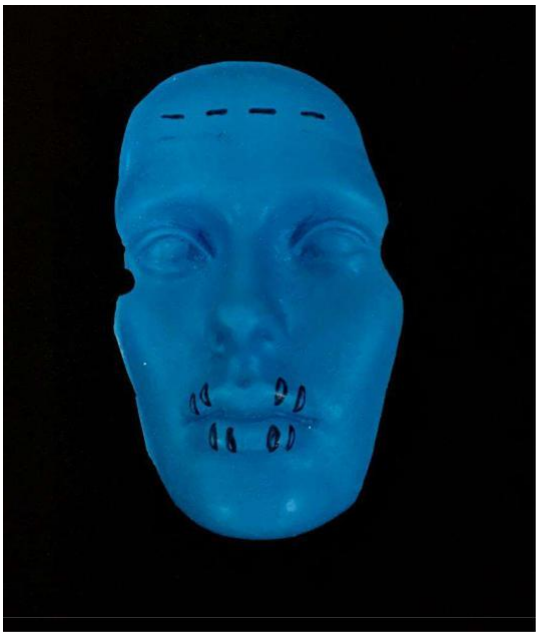

Figure 2: Marking made with a permanent marker.

2. Simulation of an oval-shaped incisional biopsy on a previously marked area with a black permanent marker on the upper and lower lip of the model. After the incision, the participant removes the incised material (Figure 3).

Figure 3: Marking made with a permanent marker.

3. Execution of a simple suture on the incision in the frontal region of the model with 3.0 silk thread, followed by an "X" shaped suture in the region of the labial biopsy (Figure 3).

At the end of the training, the faculty members responded to a questionnaire developed by the research authors themselves to evaluate the facial models.

3. Results

The sample consisted of 10 faculty members from the surgical areas of the Dentistry course at the University of Fortaleza (Unifor), with 5 (50%) being male and 5 (50%) females, ranging in age from 30 to 55 years, with an average age of 40 years. The faculty members specialized in Periodontics (50%), Oral and Maxillofacial Surgery and Traumatology (30%), and Stomatology (20%). These professionals had a minimum of 18 years and a maximum of 30 years of experience, with an average of 25 years. Figure 4 shows that, regarding the tactile similarity of the synthetic model, the majority of participants rated it positively, with 70% marking the option as very good, 20% as moderate, and 10% as satisfactory.

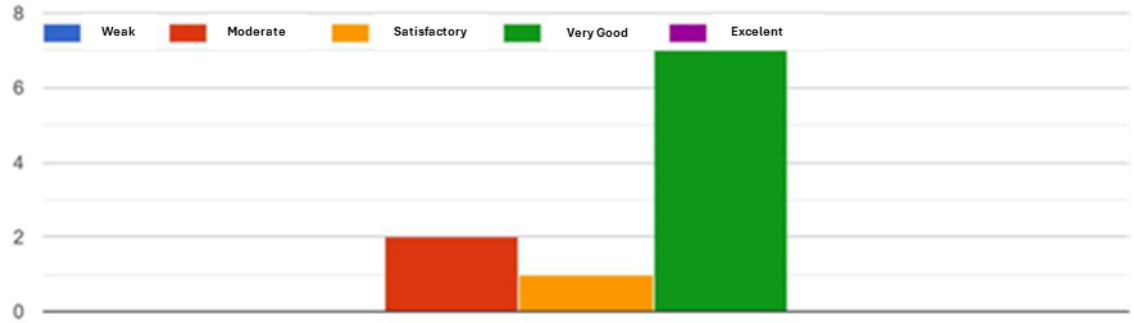

Figure 4: Satisfaction level regarding the model's similarity to real facial tissues.

Regarding the handling of the facial model, all participants rated the model positively, with 60% rating it as very good. Additionally, the remaining results were equally distributed among the satisfaction levels of satisfactory and excellent, totaling two evaluations for each response. In the assessment of simulating an incisional biopsy on the upper and lower lip, 70% of the faculty rated it very positively, with 40% rating it excellent and 30% very good (Figure 5). Furthermore, 20% of the participants marked the option as satisfactory, and another 10% as moderate, as can be seen in Figure 6.

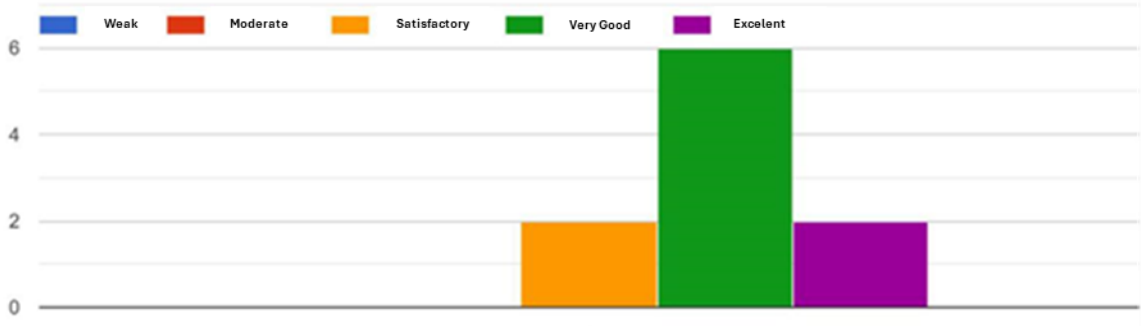

Figure 5: Satisfaction level regarding the handling of the model.

Regarding the use of the model for incision training, it was possible to analyze in Figure 7 that 40% of the participants evaluated it positively, marking the option as excellent, while another 30% also indicated responses as very good. In the less satisfying alternatives (Satisfactory and Moderate), the results were similar, with 20% of the participants marking the option as satisfactory and 10% as moderate.

Figure 6: Satisfaction level regarding the performance of biopsies on the upper and lower lip.

Figure 7: Satisfaction level regarding the usefulness of the model in the practice of incisions.

The evaluation of the practice of specific types of sutures that could be performed on the model was conducted. From this, it can be seen in Figure 8 that 50% of the participants rated the model positively, choosing the excellent option, while another 30% rated it as satisfactory and 20% as moderate. The last inquiry analyzed the faculty's opinion on the utility of the model in pre-clinical disciplines in the Dentistry undergraduate program. According to what was seen in Figure 9, 20% of the faculty marked the option as excellent, while 50% demonstrated a very good level of satisfaction. Moreover, 10% of the participants rated it as satisfactory.

4. Discussion

In Dentistry, it is crucial to integrate theoretical knowledge with practical application [12]. Therefore, students' practical skills need to be built and enhanced in a functional and facilitating manner for learning. To this end, higher education courses in Dentistry utilize simulation activities during the pre-clinical period, where students' confidence and manual dexterity are increased, especially in basic activities and their progression over the following years [9]. Pre-clinical training in incision and suture is usually performed using simulators such as sponges, orange peels, animal models, human tissues, among others [14]. Furthermore, repetition is essential for acquiring surgical skills

throughout academic and professional life [15]. Thus, the development of a low-cost, easily made model that assists students and is functional in routine practice training is necessary.

The present study used satisfaction levels, based on a Phrase Completion scale [13], where participants evaluated various aspects related to the training facial model: similarity to soft tissues of the face, handling, applicability in pre-clinical activities, simulation of incisions, biopsies, and sutures. This allowed the measurement of opinions and levels, which were grouped into weak, moderate, satisfactory, very good, and excellent. The chosen data collection technique offered advantages such as time-saving and quick, precise responses, with a lower risk of distorting results. The Phrase Completion scale seeks to measure the intensity of a particular construct directly on the scale itself, providing the possibility of applying a questionnaire with levels of measurement. Moreover, the scale is constructed more thoughtfully and logically elaborated, and also presents advantages from the point of view of statistical operationalization.

The research demonstrated, through faculty evaluation, that the silicone facial model could have good utility for prior training in surgical procedures [16]. Silicone has the essential flexibility for moldings and similarities to facial tissues, as well as excellent release properties, meaning that the rubbers separate easily from a model and can be used repeatedly [17]. This fact may explain the good results obtained in this study regarding the tactile similarity of the model compared to the soft tissues of the face.

Regarding similarity to real facial tissues, studies have shown that the model does not necessarily need to be faithful to color or texture, what matters most is the transfer of skills from the clinical laboratory to clinical practice [16]. Simulators are characterized by inanimate models designed to provide, through training of a particular practice, the necessary technique/motor skills. The simulation also aims to develop a more functional and straightforward training methodology [8]. From the training conducted and the responses collected, it was observed that none of the participants reported that the silicone facial model was weak in terms of simulating incisions, biopsy, and sutures, and they also demonstrated high levels of satisfaction regarding its usefulness in pre-clinical practices in the Dentistry course. Simulation-based training exercises in surgical practices serve as teaching aids using a substitute that can be reused repeatedly to complement learning, for those who are improving their skills, resulting in greater safety for patients [1].

With the need to obtain simulation training prior to surgical procedures, seeking improvement in motor skills, understanding of anatomy, and gaining confidence for preclinicals, several researchers worldwide are bringing a new way to approach the topic within universities [18]. In 2018, Goerlich and colleagues [18] compared the impact of repetitive training with simulators versus repetitive practice on patients, with the goal of analyzing learning skills in the Dentistry course over a specified period. In this study, a suture training on pig mandibles was set up and conducted, where a group of students participated in Group A, practicing repetitively day-to-day, while Group B participated in simulator training, both groups receiving feedback from the research instructor. However, Group B achieved better results in the evaluation, as well as demonstrating greater dexterity in suturing skills. These findings align with the results of the present work, showing that the inclusion of simulators in undergraduate courses will enable a better form of learning by the students and consequently promote the acquisition of skills during surgical procedures.

In the items mentioned in the questionnaire, it was observed and highlighted that none of the participants marked the option weak, which demonstrates good acceptance by all, resulting in positive responses. However, moderate and satisfactory alternatives were obtained, mainly concerning suture training and similarity to real facial tissues, deriving from a lower level of personal satisfaction, which may have a direct relationship with the different dental specialties and their daily clinical practices. Aquino [19] reports in his study that regardless of the professional's time since graduation, what determines promising post-graduation practices is repetition, the routine where skills are built and refined. Thus, healthcare professionals should have diversified experiences, independent of the duration of their graduation or specialization.

The participants' time since graduation was verified in the questionnaire, reaching a minimum of 18 years of training. Considering this aspect, the time since graduation of the participants becomes proportional to their acquired clinical experiences and theories passed on to the students, potentially having a direct influence on the results and the practice of incisions, sutures, and even biopsies on silicone. Advances made in recent years concerning non-biological models have been well accepted, and the simulations performed on these allow margins for errors, training, and repetitive exercises until the correct execution of the addressed surgical technique is achieved, thus leading to excellence and safety in the surgical procedure, avoiding accidents and complications in the trans and post-operative clinical reality [20].

5. Conclusion

The low-cost facial model proved acceptable for training in incisions, biopsies, and sutures, potentially contributing to the development and refinement of students' skills in pre-clinical disciplines. Although the LCFM yielded excellent results in the faculty evaluation in this initial study, it is suggested that further studies be conducted, assessing its use for training undergraduate and postgraduate students in Dentistry.

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Conflicts of Interest: None.

Supplementary Materials: None.

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