UNIVERSIDADE DE UBERABA
LHORRANY ALVES DE SOUZA

SUGADORES LÚDICOS EM BIOPOLÍMERO PARA USO EM ODONTOPEDIATRIA

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Dissertação apresentada como parte dos requisitos para a obtenção do título de Mestre em Odontologia, do programa de Pós-Graduação em Mestrado de Odontologia da Universidade de Uberaba.
Área de concentração: Clínica Odontológica Integrada.

Orientadora: Prof. Dra. Maria Angélica Hueb de Menezes Oliveira

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BANCA EXAMINADORA:

ProP Dr° Maria Angeʹica Hueb de M. Oliveira
Orientadora
Universfdade de Uba raba

ProP. Dr°|. Ruchele Dias N ogueira Geraldo Martins
Unversidade de Uberaba

Prof°. Dr*. Erika CaIvano Kuchler
Universidade de Tuiutí do Paraná

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RESUMO

A odontologia pediátrica enfrenta desafios ao utilizar instrumentos originalmente concebidos para adultos, como os sugadores odontológicos, que podem aumentar o desconforto e a ansiedade infantil, impactando a saúde bucal a longo prazo. Para melhorar essa experiência e melhorar a eficiência clínica, este estudo propõe um sugador lúdico em biopolímero, promovendo um atendimento mais humanizado. O dispositivo foi desenvolvido em dois *designs* diferentes, remodelando sugadores convencionais, e seu processo de criação incluiu concepção, modelagem 3D e impressão do protótipo em PLA (ácido polilático), um biopolímero sustentável escolhido por sua resistência e facilidade de modelagem. O *design* priorizou ergonomia, conforto e facilidade de conhecimento pelo profissional, e os testes demonstraram funcionalidade eficiente, ergonomia aprimorada e apelo visual atraente para crianças. Assim, a reformulação do sugador odontológico, aliando *design* lúdico e sustentabilidade, mostrou-se eficaz na redução do desconforto infantil e viável para produção em larga escala a baixo custo, configurando-se como uma solução inovadora e acessível para a odontopediatria.

Palavras-chave: Odontopediatria. Inovação tecnológica. Instrumentos Odontológicos.

ABSTRACT

Pediatric dentistry faces challenges when using instruments originally designed for adults, such as dentais suction devices, which can increase discomfort and anxiety in children, negatively impacting long-term oral health. To enhance this experience and optimize clinical efficiency, this study proposes a playful suction device made of biopolymer, promoting a more humanized dental care approach. The device was developed in two distinct designs, remodeling conventional suction devices, with its creation process involving conception, 3D modeling, and prototype printing using PLA (polylactic acid), a sustainable biopolymer chosen for its durability and ease of shaping. The design prioritized ergonomics, comfort, and ease of handling by professionals, and tests demonstrated efficient functionality, improved ergonomics, and an appealing visual design for children. Thus, the redesign of the dental suction device, combining playful design and sustainability, proved effective in reducing children's discomfort and viable for large-scale, cost-effective production, establishing itself as an innovative and accessibles

Keywords: Pediatric dentistry. Technological innovation. Dental Instruments.

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LISTAS DE ABREVIAÇÕES E SIGLAS

3D	Tridimensional
ATC	Autoclavável
ATF	Aromatizado sabor tutti-frutti
C	Celsius
COR	Possui opções em cores
D	Dureza
DLP	Processamento de luz direta
FLE	Flexível
G/CM³	Grama por centímetro cúbico
INPI	Instituto Nacional de Propriedade Intelectual
NEST	Não – estéril
NM	Nanómetro
OCDE	Organização para a Cooperação e Desenvolvimento Econômico
PAL	Ponta de aspiração lúdica
PAR	Ponta de aspiração arredondada
PCOP	Produzido em copolímero
PLA	Ácido polilático
PPVC	Produzido em policroleto de vinilo
PVC	Policroleto de Vinilo
RIG	Rígido
SEG	Segundos
TRA	Transparente
UV	Ultravioleta

SUMÁRIO

INTRODUÇÃO

A inovação começa com a concepção de novas ideias, um conceito ou pensamento inicial. Quando esses pensamentos intelectuais se transformam em um produto ou processo, ocorre a invenção. As invenções, por sua vez, devem ser associadas a atividades comerciais viáveis para contribuir com o crescimento das empresas (Trott, 2012; Vanin, 2024).

De acordo com Manual de Oslo da Organização para a Cooperação e Desenvolvimento Econômico (OCDE) a inovação pode ocorrer em qualquer setor da economia, incluindo serviços governamentais como saúde e educação. Para o desenvolvimento de novos produtos com direcionamento social desejável, é essencial compreender e assimilar a maneira com que a inovação tecnológica acontece no setor da saúde (OCDE, 2005)

Durante o complexo processo de inovação até culminar na aplicação prática, estão envolvidos diversos fatores e agentes, que influenciam na maneira e no curso com que o avanço tecnológico no setor da saúde acontece. Envolvendo variados ativos como, profissionais da área, servidores, financiadores de ordem pública ou privada, indústrias e empresas, e variadas circunstâncias como regulamentações, questões financeiras, corporativas e de mercado (Rauem, 2016).

Apesar dos avanços tecnológicos das últimas décadas, observam-se situações precárias em diversas áreas da sociedade. Quando se trata da qualidade de vida de pacientes e profissionais, a área da saúde, principalmente no que se refere ao público infantil, apresenta elevado contraste (Bataglion; Marinho, 2024).

Essa disparidade é acentuada, pois a indústria de equipamentos médicos não apresenta resultados quanto ao desenvolvimento e pesquisa em produtos para esse público, diferente do interesse demonstrado ao público adulto (Amantini, 2014; Aktaş e Ciftci, 2024).

Apesar dos avanços na Odontologia com novos materiais e técnicas, muitos pacientes ainda experimentam sentimentos desagradáveis ao longo do atendimento, especialmente quando iniciado na infância. Embora a Odontologia busque proporcionar tratamentos rápidos e indolores, é comum que os pacientes sintam ansiedade, medo, dor e desconforto. (Felix *et al.* 2016).

A ansiedade infantil durante consultas odontológicas é uma preocupação frequente que afeta milhões de crianças globalmente. Melhorar a experiência odontológica infantil transcende

o conforto, constituindo uma questão de saúde pública, uma vez que experiências negativas podem desencorajar visitas futuras ao dentista (Côrrea 2013; Lima, 2024).

Ainda para Corrêa (2013), a intervenção na cavidade bucal é dificultada pelo acesso e visibilidade devido à presença de estruturas anatômicas, como a bochecha e a língua, a disposição dos dentes na arcada e pela própria saliva.

O olhar dos profissionais de Design de Produto para criação de produtos inovadores que colaborem com as abordagens clínicas pode ser aliado de grande importância para favorecer a prática clínica do profissional em Odontopediatria (Barbosa, 2019; Cunha, 2019).

Assed (2005) destaca que o atendimento a crianças frequentemente exige um campo de atuação livre de umidade, o que torna indispensável o uso de sugadores. Este projeto propõe o desenvolvimento de um sugador inovador em biopolímero[1], projetado para ser mais confortável e eficaz para crianças.

A proposta de um novo sugador requer um *design* inovador, que pode se tornar uma ferramenta essencial para a geração de soluções e um diferencial competitivo para as empresas. Um novo design é um componente estratégico crucial, como indicado por Franzato e Celaschi (2017), facilitando o processo de inovação e promovendo o desenvolvimento econômico e sociocultural (Krucken, 2009).

O desenvolvimento de sugadores lúdicos em biopolímero para uso odontopediátrico visa melhorar a experiência das crianças durante procedimentos odontológicos, reduzindo o medo e a ansiedade, e promovendo a saúde bucal infantil e um ambiente mais acolhedor.

Essa inovação contribui significativamente para a odontologia ao integrar *design*, psicologia infantil e tecnologia de materiais, resultando em métodos mais eficazes e humanizados. A escolha do tema foi motivada pela experiência clínica, observando a inadequação de materiais projetados para adultos no atendimento infantil, e busca oferecer soluções que tornem os tratamentos mais confortáveis e eficazes.

Essa iniciativa amplia o escopo de estudos e práticas na área, ao incorporar aspectos multidisciplinares como design de produtos, psicologia infantil e tecnologia de materiais. Além do mais, ao buscar soluções que atendam às necessidades específicas das crianças durante o tratamento odontológico.

[1] Biopolímeros são polímeros de organismos vivos, compostos por unidades monoméricas como açúcares (celulose, amido, quitina), aminoácidos (proteínas, peptídeos) e nucleotídeos (ADN, ARN). Podem ser quimicamente sintetizados de materiais biológicos. Decompõem-se rapidamente, tornando-se alternativa sustentável aos plásticos fósseis, com estudos em andamento para ampliar suas aplicações. (Brito; Agrawal; Mélo, 2011)

Desta maneira, a necessidade de desenvolver sugadores lúdicos em biopolímero específicos para uso odontopediátrico surge como uma solução para proporcionar uma experiência mais positiva e confortável para as crianças durante os procedimentos odontológicos, contribuindo para a eficácia do tratamento e para a construção de uma relação de confiança entre o paciente infantil e o profissional de odontologia.

Nesse sentido, o presente projeto propõe uma reformulação do sugador, tanto em relação ao design, quanto ao material, visando melhorar seus aspectos ergonômicos, de usabilidade e visual para os pacientes infantis.

Em levantamentos e pesquisas realizados previamente, em relação à propriedade intelectual, junto ao órgão Instituto Nacional de Propriedade Intelectual (INPI), não foram encontrados registros referentes ao projeto proposto, portanto paralelamente ao seu desenvolvimento, foi realizado, juntamente ao núcleo de inovação tecnológica, as proteções possíveis e necessárias, quanto à propriedade intelectual.

1 OBJETIVOS

1.1 Objetivo Geral

O objetivo do presente estudo é investigar e desenvolver estratégias para promover o design, a pesquisa e a produção de sugadores lúdicos em biopolímero para uso odontopediátrico, que seja atóxico, com aroma de tutti-frutti, com tamanhos adequados para o público infantil.

Com foco na melhoria da experiência do paciente infantil durante procedimentos odontológicos, este estudo busca preencher a lacuna existente na indústria de equipamentos odontológicos, que geralmente não prioriza produtos específicos para o público infantil. Pretende-se, assim, contribuir para o avanço na oferta de sugadores lúdicos inovadores e adaptados às necessidades das crianças, visando a promoção da saúde bucal infantil e o conforto durante as consultas odontológicas.

1.2 Objetivos Específicos

- Desenvolvimento dos critérios que novo *design* deve atender
- Criação do *design*
- Desenho Tridimensional (3D)
- Impressão 3D
- Ajuste e refinamento final
- Avaliação *in vitro*

2 CAPÍTULO 1 – ARTICLE: DEVELOPMENT OF A PLAYFUL SUCTION DEVICE FOR PEDIATRIC DENTISTRY USING 3D PRINTING

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Research Article: Biomaterials and Bioengineering in Dentistry –

Development of a Playful Suction Device for Use in Pediatric Dentistry Using 3D Printing

Concise Title: 3D Printing of a Playful Suction Device

Lhorrany Alves de Souza
Master's Student, Department of Biomaterials, School of Dentistry, University of Uberaba, Uberaba-MG, Brazil. Email: lhorranya@gmail.com

Erika Calvano Kuchler
PhD, Associate Professor, Department of Orthodontics, Medical Faculty, University Hospital Bonn, Welschnon- nenstr. 17, Bonn, Germany. Email: erikacalvano@gmail.com

Maria Angélica Hueb de Menezes Oliveira*
PhD, Associate Professor, Department of Biomaterials, School of Dentistry, University of Uberaba, Uberaba-MG, Brazil. Email: angelicahueb@hotmail.com

*Corresponding Author:
Maria Angélica Hueb de Menezes Oliveira
PhD, Associate Professor, Department of Biomaterials, School of Dentistry, University of Uberaba, Uberaba-MG, Brazil. Email: angelicahueb@hotmail.com

2.1 ABSTRACT

Background: Pediatric dentistry faces challenges due to the inadequacy of instruments designed for adults, such as suction devices, which increase children's discomfort and anxiety during procedures. This anxiety can negatively impact long-term oral health, making the development of adapted equipment essential. Playful design strategies emerge as an innovative solution, offering flexibility, comfort, and visual appeal for children.
Objectives: This study aims to develop a playful suction device using biopolymer, focusing on enhancing the child's experience and clinical efficiency, thereby contributing to a more

humanized dental service. Materials and Methods: The suction device was designed in two different playful models. The innovation involved remodeling existing suction devices. The prototype development followed a rigorous process. Initially, a conceptual design was created and approved, which was then converted into a three-dimensional (3D) model for printing. The first prototype was made using Anycubic Tough Resin, while the second was manufactured with PLA (polylactic acid), a sustainable biopolymer known for its strength and ease of molding. The device was designed to minimize discomfort during use, ensuring ergonomic efficiency, practicality, and easy handling for professionals.
Results: Tests demonstrated that the prototype exhibits efficient functionality, enhanced ergonomics, and an attractive design for children. The modifications in shape and material made the device more suitable for pediatric dentistry, improving comfort.
This device serves as a tool to facilitate passive distraction in children during dental treatment. Furthermore, the project considered aspects that enable low-cost production, presenting an innovative and accessible solution for routine use in pediatric dentistry.

Keywords: Suction devices, Pediatric dentistry, Innovation.

2.2 **INTRODUCTION**

Innovation begins with the conception of ideas that, when transformed into products or processes, result in inventions. For these inventions to effectively contribute to the growth of sectors and companies, it is essential that they are associated with viable commercial activities [1]. According to the *Oslo Manual* of the Organization for Economic Cooperation and Development (OECD), innovation can occur in any sector of the economy, including government services such as healthcare and education. In the healthcare sector, understanding and assimilating the dynamics of technological innovation is essential for the development of products that meet specific social demands [2].

The process of innovation in healthcare is multifaceted, involving various factors and agents, such as professionals from different fields, public and private funders, regulations, and market issues. These variables directly influence technological advancement and its practical application, especially in complex contexts such as pediatric dentistry [3]. Despite technological advances in recent decades, the medical equipment industry still shows deficiencies in the development of products aimed at the pediatric population, in contrast to the attention given to adult products [4,5].

In the dental context, instruments such as suction devices are often developed with a focus on the adult population, which can cause discomfort and increase anxiety in children during procedures. This project proposes the creation of a playful suction device made of

biopolymer, specifically designed for pediatric dental use, aiming to enhance the child's experience, minimize anxiety during dental treatment, and facilitate children's cooperation during procedures [5].

Pediatric dental anxiety is a global issue affecting millions of children, constituting a public health concern. Negative experiences in the dental office can discourage future dental visits, compromising long-term oral health. Additionally, interventions in the oral cavity are challenged by anatomical factors and the presence of saliva, requiring tools that offer both efficiency and comfort [6,7]. In this context, collaboration between design and dental professionals is crucial for creating innovative solutions that address both the clinical and emotional needs of this specific audience.

Innovative design is a key strategic component in the innovation process, facilitating economic and sociocultural development [8,9]. In this project, the suction device's design not only enhances ergonomics and usability but also fosters a more humanized dental environment, contributing to a positive experience for both the pediatric patient and the professional.

During the project development, research was conducted with the National Institute of Industrial Property (INPI), confirming the absence of similar registered products [10]. Alongside prototype development, the necessary protections were secured through the technological innovation center, ensuring intellectual property rights.

Thus, the creation of a pediatric suction device in biopolymer represents an innovative and strategic solution for child dental care. The proposal seeks not only to meet functional demands but also to reimagine the role of design and technology in the pediatric healthcare sector.

The integration between pediatric dentistry and the development of innovative instruments is essential for optimizing clinical practice, reducing fear and anxiety in children, enhancing treatment effectiveness, fostering trust between patients and professionals, and increasing children's acceptance of dental care [11-13].

This innovative perspective enables the restructuring and improvement of tools, making children's experiences more pleasant. Based on this premise, this in vitro study aimed to redesign pediatric dental suction devices by reviewing their design and material, enhancing ergonomics, functionality, and visual appeal for the pediatric audience.

2.3 MATERIALS AND METHODS

2.3.1 Target Audience Definition and Problem Identification

In the initial phase of the project, an investigation was conducted to understand the target audience's needs and the challenges associated with using suction devices in pediatric dental care. It was observed that traditional devices, designed for adults, were inadequate for children. Consequently, the target audience was defined as children and infants. The development of the playful biopolymer suction device was guided by these needs, aiming to create a product beneficial to both patients and dentists.

2.3.2 Analysis of Similar Products and Evaluation Criteria for the New Product Design

Existing dental suction devices available on the market were researched using sources such as manufacturer websites [14-19]. The keywords used in the research included suction device, dental suction, pediatric suction, pediatric dental suction, and saliva ejector. Subsequently, an analysis of the characteristics of similar products available in the market was conducted.

To systematically compare the analyzed products, Table 1 was developed, presenting the evaluated characteristics using a color-coding system: green for met characteristics and red for absent characteristics. Additionally, a list of abbreviations (Table 1) was created to facilitate the identification and interpretation of the analyzed criteria.

The analysis of existing products, along with suggestions from pediatric dentistry specialists, guided the definition of the criteria for the development of the new design. These criteria include:

I - **Effective Suction and Moisture Control:** The new design must allow efficient saliva suction, enabling the dentist to work in a dry field.

II - **Unobstructed Access to the Tooth:** The design should not interfere with access to the tooth during dental care.

III - **Flexible and Comfortable Material**: The device should be made of a flexible material that is easy to handle and does not cause discomfort to the patient.

IV - **Playful Appeal:** The product should be designed to make dental visits more enjoyable for children, reducing fear and anxiety.

V - **Colorful Presentation:** The design should be visually appealing to attract children's interest.

VI - **Pleasant Aroma and Flavor:** The device should have a tutti-frutti aroma and flavor to increase children's acceptance.

VII - **Ease of Handling:** The product should be easy to use for dental professionals.

VIII - **Mass Production Feasibility:** The device should be manufacturable on a large scale at a low cost.

In Table 2, it is possible to verify the analyzed similar products and the requirements that meet the selected criteria for the development of the new design. This analysis allowed for the identification of characteristics and functionalities present in existing products, serving as a basis for defining the essential parameters for the playful suction device project, ensuring its differentiation from other products.

2.3.3 Design Creation and 3D Modeling

Initially, the suction device was designed and modeled in 3D using 3DSMax software for prototyping in STL file format. Two different-sized designs were created.

2.3.4 Firts Prototype - 3D printing with resign and post-curig of the printed piece

The first prototype was generated using an Anycubic Photon Mono X5Pro 3D printer to define the ideal shape of the suction device. The 3D design file was imported into the printer's software, Anycubic Photon Workshop, where resin parameters, product dimensions, and support structures were configured to ensure high-quality printing. Once the setup was completed, the image was exported to the printer via a USB device (pen drive) for the printing process.

The printer builds each layer using ultraviolet (UV) light, directed by X and Y scanning mirrors. Before each printing cycle, a recoating blade moves across the surface to ensure an even distribution of each thin layer over the object. This cycle continues, creating 3D objects from the bottom up [20].

The Photon printer utilizes Digital Light Processing (DLP) technology, which employs a parallel matrix UV light. The resin used for 3D printing was Anycubic Tough Resin [20].

After 3D printing, the pieces underwent a post-curing process to ensure complete polymerization of the resin and to improve their mechanical and chemical properties. Initially, the printed pieces were washed in 99% isopropyl alcohol to remove excess uncured resin, using

a gentle methodology in a designated container. The pieces were then left to dry completely at room temperature, ensuring full solvent evaporation.

Subsequently, final curing was performed in a UV light chamber for 10 minutes on each side of the piece, with uniform rotations to ensure total exposure. This process guaranteed full solidification of the material and stabilization of the product's final characteristics.

2.3.5 Second Prototype – 3D Priting with PLA (Polylactic Acid) and post - processing

For the fabrication of the playful suction device prototype, a Creality 3D Ender 3 printer [25] was used, known for its precision and versatility with various filament types. The methodology followed these steps: The 3D file was exported in STL format and processed in a slicer software compatible with the Ender 3, Ultimaker Cura. Printing parameters were adjusted in the software, including:

- Layer height: 0.1 mm (for greater resolution and finish precision);
- Infill: 30%, aiming for a balance between lightness and strength;
- Print speed: 50 mm/s;
- Extruder temperature: 200 °C;
- Heated bed temperature: 60 °C.

The material used for the prototype was PLA Speed Premium Blue (3D LAB) [26], a biodegradable polymer widely used in 3D printing.

Once everything was configured, the image was exported to the printer via USB (pen drive) for printing. The prototype was manufactured in a controlled environment, ensuring temperature stability and the absence of vibrations that could interfere with the product's quality.

After printing, the prototype underwent a finishing process, including:

- **Support Removal:** Carefully performed to preserve design details;
- **Sanding**: To smooth edges and provide a more uniform finish.

2.3.6 In vitro evaluation – Suction test in a controlled environment

Initially, the prototype was connected to a standard dental suction system and tested with a falcon tube of water to verify its efficiency in liquid aspiration. During the test, the following aspects were evaluated:

- Continuous suction capacity without obstructions;
- Flow of aspirated liquid, measured to ensure uniform performance;
- Ease of handling by the professional during use;
- Testing on a Representative Pediatric Model.

The prototype was tested on a pediatric anatomical model (Pediatric Manikin PLP - Orais), compatible with the proportions of a six-year-old child. This test aimed to simulate the pediatric dental clinical environment, allowing for a practical evaluation of the suction device's functionality. The following criteria were analyzed:

- Ergonomic adaptation to the dimensions of the child's oral cavity;
- Easy positioning and handling by the professional;
- Efficient control of the liquid during use in the model.

2.4 **RESULTS**

The functionality tests performed on the playful suction device prototype demonstrated highly satisfactory results in terms of efficiency, ergonomics, and clinical applicability. Initially, the device’s functionality was tested in a controlled environment using a Falcon tube to assess suction capacity. The prototype performed efficiently, ensuring continuous aspiration without interruptions in flow, confirming its structural stability and essential functionality.

In the next phase, the prototype was tested on a representative pediatric anatomical model (Pediatric Manikin PLP - Orais), corresponding to the oral cavity proportions of a six-year-old child. The device demonstrated excellent adaptation to the simulated anatomy, allowing effective liquid removal during the simulated dental procedure. Additionally, its design enabled precise positioning in the oral cavity, facilitating handling by professionals and reinforcing its clinical feasibility.

Ergonomic analysis revealed that the device's shape and size meet the target audience's needs, ensuring practicality in use by dentists. The playful design, the prototype’s main innovation, demonstrated great potential for increasing acceptance among pediatric patients, thanks to the incorporation of visually attractive and friendly elements. This factor suggests that the device can significantly contribute to reducing children's fear and anxiety, aspects frequently observed in dental care.

These findings suggest that pediatric dentists, due to their direct interaction with children, more clearly recognize the benefits of the playful design and its clinical applicability in pediatric care. Thus, the results reinforce the prototype's suitability for pediatric dental offices while also indicating opportunities for adjustments to increase acceptance among other dental specialists.

In summary, this study highlights not only the functionality and ergonomics of the prototype but also the positive impact of the playful design in pediatric dental care. The playful suction device emerges as an innovative and promising tool for humanizing pediatric dental treatment, making the experience more comfortable for children and reducing their anxiety levels, without compromising the efficiency and practicality required for clinical use.

2.5 **DISCUSSION**

Comparing the results of this study with existing literature, it is observed that the limitations of traditional suction devices have already been widely discussed, particularly regarding children's discomfort during dental treatments [5]. The innovation of this project lies in the development of a playful suction device that, in addition to meeting the anatomical needs of the pediatric population, seeks to engage children emotionally, providing a more pleasant and humanized experience. This approach aligns with literature guidelines that emphasize the importance of humanized approaches in pediatric dentistry [11-13, 21].

A comparison with similar devices available on the market reveals that, although some models feature attractive characteristics such as varied colors and scents, they still fail to fully integrate these elements into functional design. Furthermore, the rigidity of materials used in conventional models compromises flexibility and comfort during pediatric dental care [14-19]. The new playful suction device stands out by combining functionality with a child-friendly design, with the potential to reduce children's fear and anxiety, an aspect widely discussed in the literature [22,23]. This approach reinforces the importance of making the dental environment more welcoming for pediatric patients [11,13,24].

The results obtained confirm the feasibility of the new device. During functionality tests, the prototype demonstrated continuous and efficient suction, without interruptions in flow, ensuring structural stability and adequate ergonomics for clinical use. Additionally, its

adaptation to the pediatric anatomical model validated its ability to effectively remove liquids, favoring proper positioning within the oral cavity and facilitating handling by professionals.

An important factor to consider is the low production cost of the prototype through 3D printing. The development of the playful suction device used only 4g of PLA (Polylactic Acid) filament, resulting in an estimated unit cost of R$ 0.39, based on a price of R$ 98.00 per kilogram of material. This aspect highlights that, beyond ergonomic and playful benefits, the suction device also presents significant economic feasibility.

Despite the promising results, the need for some improvements was observed, such as the need to adapt the suction device to different types of pediatric mouth and the possibility of varying the available sizes. Additionally, the prototyping phase was limited by the material used in 3D printing, which does not yet correspond to the desired final biopolymer. After testing the biopolymer for large-scale production, new tests will be carried out on child patients. Future tests will be necessary to fully validate the device's performance in real clinical situations.

Thus, the findings of this study indicate that the playful suction device has great potential to improve children's experience during dental procedures while also meeting the ergonomic and functional demands of professionals. The device stands out as an innovative solution for humanizing pediatric dental care, contributing to a more welcoming and efficient environment for the pediatric population.

2.6 **CONCLUSION**

It is concluded that, despite the limitations encountered, this study establishes a solid foundation for future research and innovations in the field of pediatric dentistry, highlighting the importance of integrating functional and emotional elements into the design of dental devices for children. The project contributes to the creation of an innovative solution in pediatric dentistry, with the potential to enhance the child patient’s experience and make dental care more humanized and effective.

The initial prototype represents a significant advancement, involving changes in design and material, demonstrating its functionality, improving ergonomics, and enhancing visual appeal. It has proven to be a tool that aids in passive distraction for children during treatment. Furthermore, the project considered aspects that enable low-cost production, presenting an innovative and accessible solution for routine use in pediatric dentistry. The positive impact of

this type of innovation reinforces the role of research in developing solutions that combine functionality, comfort, and well-being.

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2.8 ACKNOWLEDGMENTS

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2.9 CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

2.10 **TABLE**

Table 1 – Characteristics present in similar products

CHARACTERISTICS	**ACRONYM**	**MANUFACTURER**	**RIG**	**FLE**	**ATC**	**NSTE**	**FAT**	**RAT**	**MCOP**	**MPVC**	**FTL**	**TRA**	**COR**
Rigid	RIG	Flexsuctor kids Angelus											
Flexible	FLE	Suctor Angelus											
Autoclavable	ATC	Suctor High Volume Angelus											
Non - Sterile	N-STE	Suctor SSPlus (QLB)											
Fun aspiration tip	FAT	Suctor MaxClean (QLB)											
Rounded aspiration tip	RAT	Suctor SugPlus (QLB)											
Made of Copolymer	MCOP	Suctor SugPrime (QLB)											
Made of PVC	MPVC	Suctor WA											
Flavored tutti-frutti	FTF	Suctor A&G											
Transparent	TRA	Suctor AllPrime											
Available in different colors	COR	Suctor Euronda											
Indication of meeting the characteristic:													
Does not meet the characteristic:													

Source: Angelus; QLB; WA; A&G; Allprime; Euronda (2024). **Org.:** SOUZA, L. A. (2025)

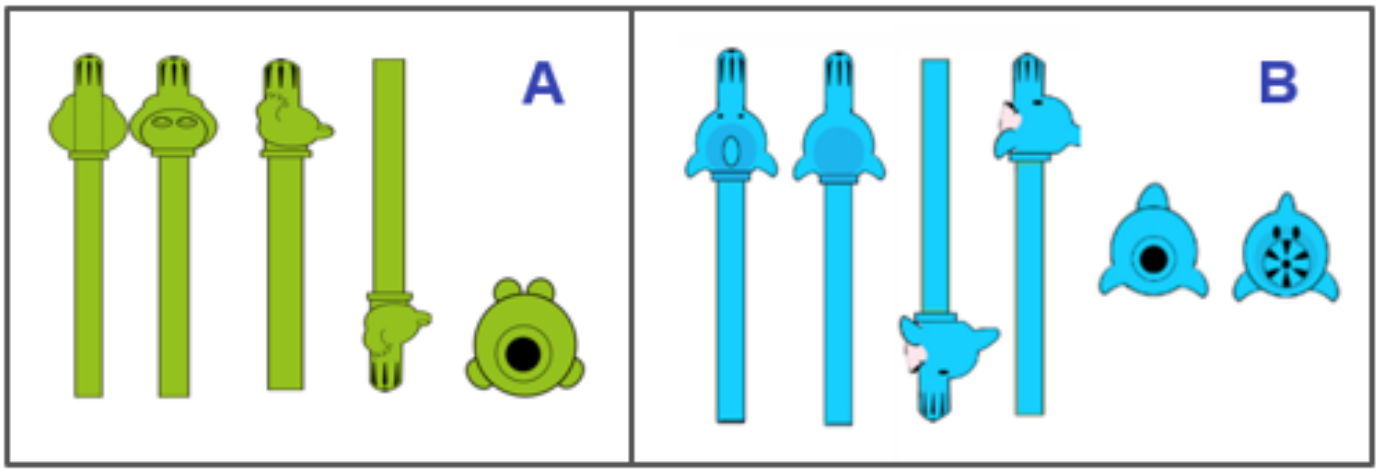
Table 2 - Assessment of compliance with the criteria of similar products

MANUFACTURER	I	II	III	IV	V	VI	VII	VIII
Flexsuctor kids Angelus								
Suctor Angelus								
Suctor High Volume Angelus								
Suctor SSPlus (QLB)								
Suctor MaxClean (QLB)								
Suctor SugPlus (QLB)								
Suctor SugPrime (QLB)								
Suctor WA								
Suctor A&G								
Suctor AllPrime								
Suctor Euronda								
Does not meet the characteristic:								
Indication of meeting the characteristic:								

Source: Angelus; QLB; WA; A&G; Allprime; Euronda (2024). **Org.:** SOUZA, L. A. (2025)

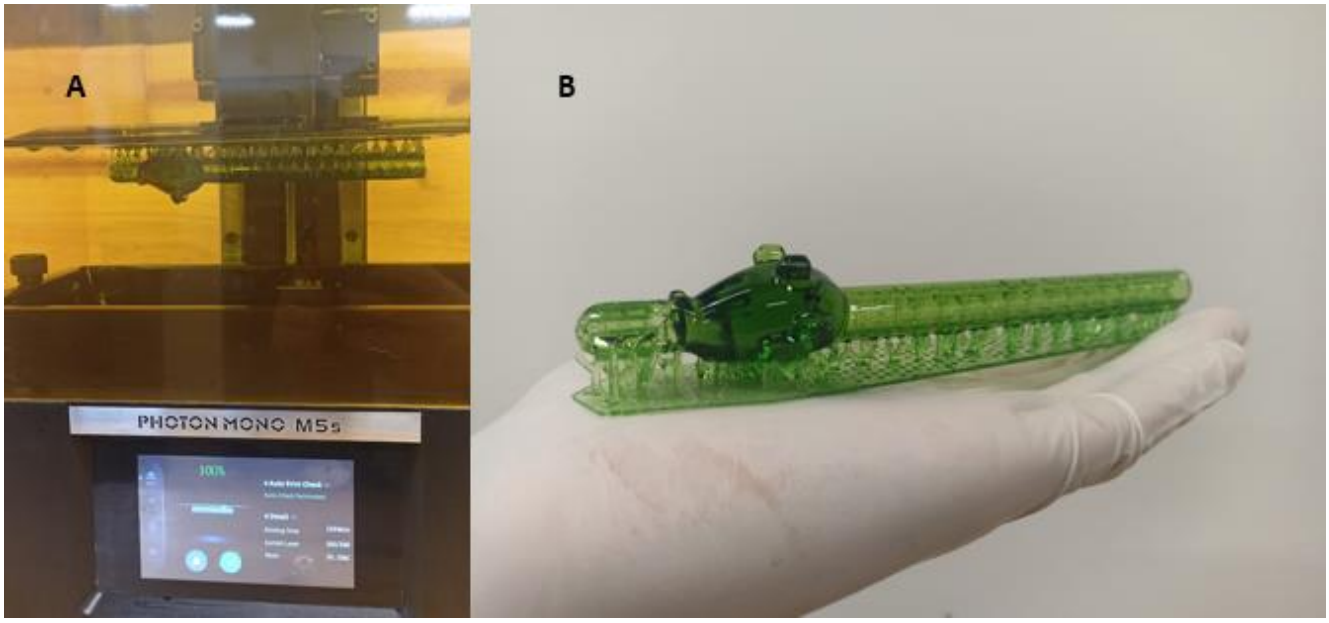
2.11 **Figures**

Figure 1 - Playful sucker design. Figure 1-A represents model 1. Figure 1-B represents model 2.



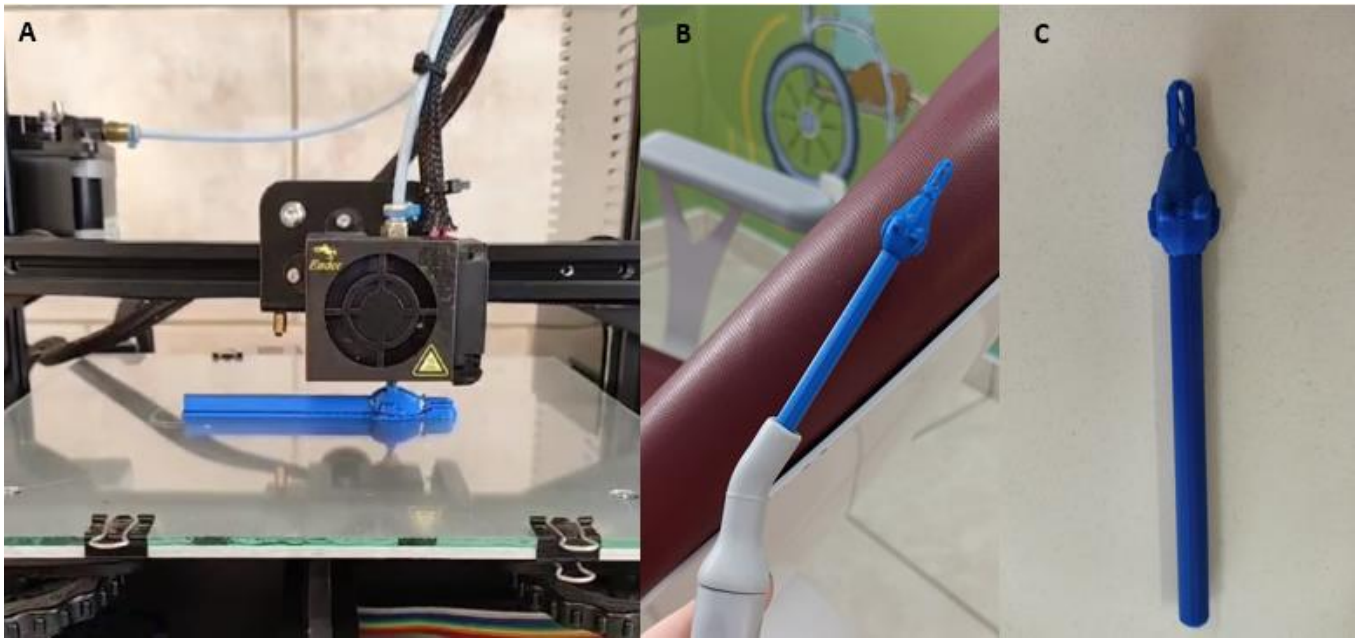
Source: Souza, L. A. (2025)

Figure 2 - First prototype. Figure 2-A Printing of the prototype made by the Anycubic Photon Mono X5Pro 3D printer. Figure 2-B Printed prototype.



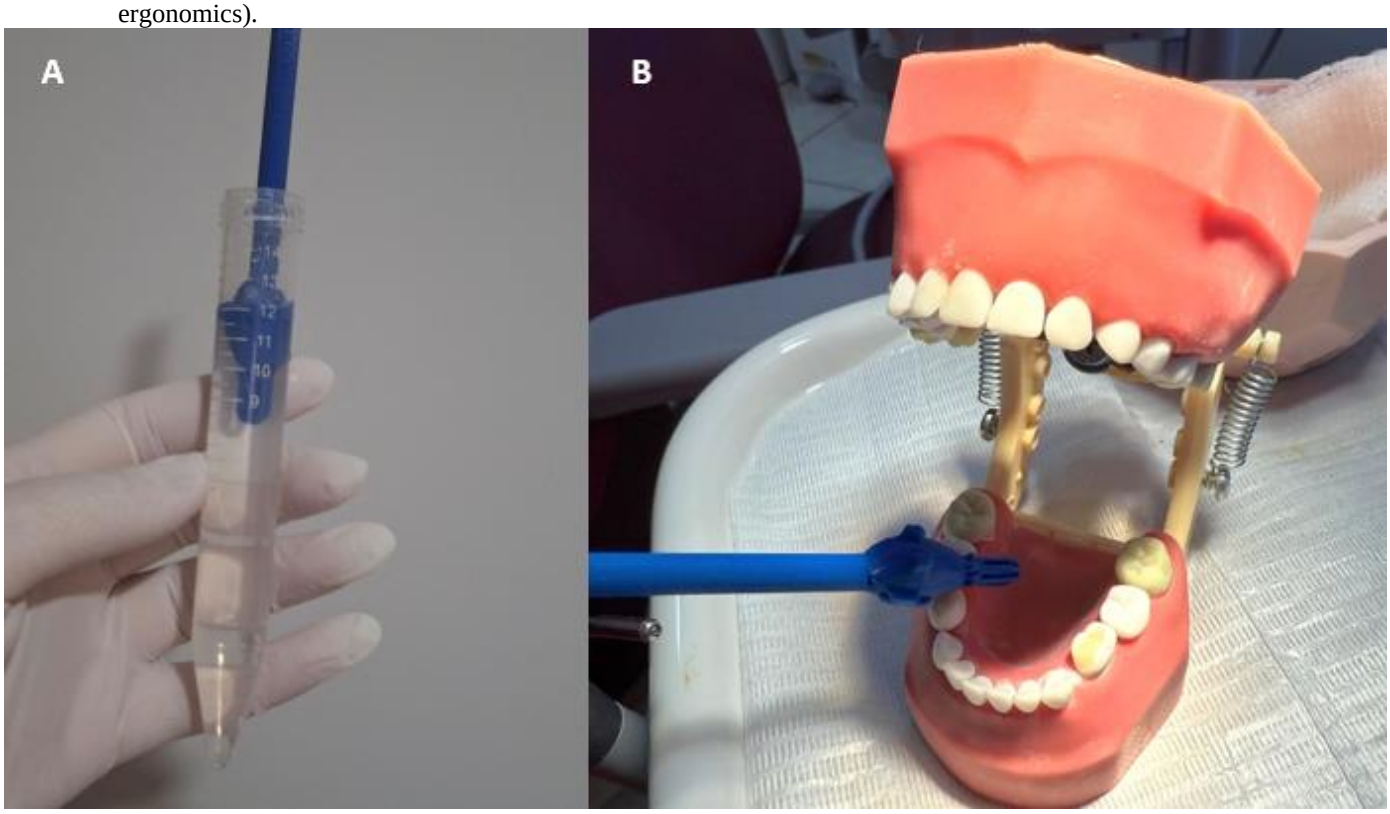
Source: Souza, L. A. (2025)

Figure 3 - Second prototype. Figure 3-A Printing of the prototype made by the Ender 3 3D printer. Figure 3-B/C Printed prototype



Source: Souza, L. A. (2025)

Figure 4 – Functionality tests. Figure 4-A Functionality test (suction). Figure 4-B Handling test (ease of use and ergonomics).



Source: Souza, L. A. (2025)

3 CONCLUSÃO

O desenvolvimento do sugador lúdico em biopolímero para odontopediatria mostrou-se uma solução inovadora ao aliar funcionalidade, ergonomia e humanização no atendimento infantil. O protótipo atendeu às necessidades do público pediátrico ao incorporar elementos lúdicos, como design atrativo, além do uso de materiais sustentáveis. Esses atributos contribuem para reduzir o medo e a ansiedade das crianças, tornando o atendimento mais acolhedor.

A pesquisa confirmou as limitações dos sugadores tradicionais, que, embora funcionais, não consideram plenamente as necessidades anatômicas e emocionais do público infantil. A ausência de características lúdicas e ergonômicas reforça a relevância do novo dispositivo, que preenche essa lacuna e proporciona uma experiência mais confortável e envolvente.

Apesar dos avanços, ainda são necessários ajustes no material final e testes mais extensivos para garantir segurança clínica, sustentabilidade e conformidade regulatória. Por fim, este estudo reafirma a importância de integrar inovação tecnológica, design e sustentabilidade ao desenvolvimento de dispositivos odontológicos voltados para o público infantil. Ao propor um produto que une funcionalidade técnica e abordagem lúdica, contribui-se para uma prática odontológica mais humanizada, capaz de transformar a experiência das crianças e promover avanços significativos na odontopediatria.

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Halpern SD, Ubel PA, Caplan AL. Solid-organ transplantation in HIV- infected patients. N Engl J Med. 2002; 347:284-7.

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