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CUSTOM PROSTHESES FOR ATROPHIC MAXILLA: INTRAOPERATIVE EVALUATION UP TO 24 MONTHS OF FUNCTION

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RELATO DE EXPERIÊCIA

ABSTRACT

This study aimed to evaluate the clinical outcomes of patients rehabilitated with custom prostheses for atrophic maxillae, focusing on surgical procedure, oral health and functionality, and prosthesis adaptation. This longitudinal observational study followed 21 patients over 24 months. Results demonstrated significant improvements in mastication and phonation, reduction of pain and discomfort, stable functional adaptation, and consistently high esthetic satisfaction from the early postoperative period. Gingival inflammation and oral hygiene remained well controlled throughout follow-up. In conclusion, custom prostheses provide effective and predictable rehabilitation for atrophic maxillae, highlighting the importance of careful planning, continuous adjustments, and regular clinical monitoring.

Keywords: Dental implants, Custom implants, Custom prostheses, Atrophic maxilla, Oral rehabilitation, Functional adaptation.

PRÓTESES CUSTOMIZADAS DE MAXILA ATRÓFICA: AVALIAÇÃO TRANSOPERATÓRIA ATÉ 24 MESES DE FUNÇÃO.

RESUMO

Este estudo teve como objetivo analisar os resultados clínicos de pacientes reabilitados com próteses customizadas em maxilas atróficas, avaliando o procedimento cirúrgico, a saúde oral e funcionalidade, e a adaptação das próteses. Trata-se de um estudo observacional longitudinal, com acompanhamento de 21 pacientes ao longo de 24 meses. Os resultados mostraram melhorias significativas na mastigação e fonação, redução de dor e desconforto, estabilidade na adaptação funcional e alta satisfação estética desde os primeiros meses. Inflamação gengival e higiene oral permaneceram controladas ao longo do tempo. Conclui-se que próteses customizadas proporcionam reabilitação eficaz e previsível em maxilas atróficas, reforçando a importância de planejamento cuidadoso, ajustes contínuos e acompanhamento clínico regular.
Palavras-chave: Implantes dentários, Implantes customizados, Próteses customizadas, Maxila atrófica, Reabilitação oral, Adaptação funcional.

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INTRODUCTION

Custom prostheses for atrophic maxillae are devices specifically designed for patients who have lost a significant amount of maxillary bone due to atrophy. These prostheses are tailored to each patient, often using 3D printing technology and computed tomography imaging to ensure a precise fit, helping restore masticatory function, improve facial esthetics, and enhance quality of life (1). This study conducted a long-term follow-up of patients who received custom prosthetic implants in atrophic maxillae.

During the surgical procedure for custom maxillary implants, strict steps are followed to ensure precise anatomical adaptation. Initially, direct impressions of soft tissues are taken, enabling the construction of bone models. The two-stage technique described by Berman (2012) involves a gingival incision to expose the bone and obtain a mold using a custom tray, initially with flexible materials and later with more precise substances, such as polysulfides, silicones, and polyethers (2). After 3D printing, a wax occlusal record defines the vertical dimension between arches, ensuring the proper height of the implant abutments. Finally, a plaster bone model is created and adjusted. Despite its effectiveness, prolonged bone exposure may cause discomfort, an issue addressed in studies aiming to minimize patient impact.

Oral Health and Functionality. Patients receiving these custom implants reported substantial improvements in masticatory capacity, phonetics, and overall comfort, along with more natural esthetics, resulting in high satisfaction (3).

Prosthesis Adaptation. Prosthesis adaptation faces clinical challenges related to stability, duration of medication use, complications, and removal of conventional implants. Patient-specific implants for severely resorbed maxillae demonstrate greater stability and adaptability compared to traditional prostheses, reducing the need for continuous adjustments and providing more predictable long-term outcomes. Longitudinal evaluations up to 24 months allow monitoring of complications such as inflammatory responses and material-related reactions (4).

This study aims to analyze the clinical outcomes of patients rehabilitated with custom prostheses for atrophic maxillae, focusing on surgical procedure, oral health and functionality, and prosthesis adaptation. The present study seeks to contribute to the field of oral and maxillofacial surgery by providing a detailed analysis of the challenges

and practices associated with rehabilitating patients with atrophic maxillae using advanced custom prostheses, offering critical data to guide clinicians in planning and performing safer and more effective treatments (4, 5).

This study demonstrates that rehabilitation with custom prostheses in patients with atrophic maxillae leads to significant improvements in oral function, including mastication and phonation, as well as enhanced comfort over time. Functional adaptation to the prostheses is generally achieved early and remains stable, while esthetic satisfaction is consistently high throughout the follow-up period. Gingival inflammation and oral hygiene are manageable with proper clinical care, and postoperative pain or discomfort decreases significantly as patients adapt. These findings corroborate existing literature, emphasizing that careful planning, precise prosthesis adaptation, and continuous monitoring are critical to achieving predictable, long-term outcomes in implant-supported rehabilitation for atrophic maxillae.

MATERIALS AND METHODS

Study Design. This longitudinal observational study analyzed data from the medical records of n=21 patients who received custom implants in atrophic maxillae. Researchers did not directly intervene beyond what was necessary for prosthetic rehabilitation and planned evaluations, observing and analyzing outcomes over a 24-month follow-up period (6, 7, 8).

Participants. Data were obtained from 21 clinical records of surgeries performed by five oral and maxillofacial surgeons. A smaller sample allowed for detailed monitoring of each case.

Inclusion Criteria. Patients were included if they had: Diagnosis of severe atrophic maxilla preventing conventional implants; Need for custom prosthesis; Age ≥18 years and good general health; Complete preoperative evaluation including imaging; Written informed consent and comprehensive dental/medical history.

Exclusion Criteria. Patients were excluded for: uncontrolled systemic diseases, active cancer, high surgical risk, use of contraindicated medications, heavy smoking, substance abuse, active oral infection, or allergies to implant/prosthesis materials.

Data Collection

In the characterization of patients, the following variables will be analyzed: age, sex, race, chief complaint, etiology of tooth loss, duration of surgery, complications, infections, hemorrhages, dehiscences, plate exposure, hyperesthesia, paresthesia, type of incision, and assessment of mastication/occlusion.

Data collection was structured around the following time points: (A0) Intraoperative; (A1) 3 months postoperatively; (A2) 12 months postoperatively; (A3) 24 months postoperatively.

Patient records will be evaluated in the following areas:

AREA 1: Intraoperative Assessment – Evaluation of a series of events, both expected and unexpected.

AREA 2: Oral Health and Functionality – Includes the patients' ability to chew food properly, speak without difficulty, and maintain adequate oral hygiene with the prostheses.

AREA 3: Prosthesis Adaptation – Assessment of how patients adapt to the prostheses over time, including initial discomfort, necessary adjustments, and eventual acceptance of the prostheses in their daily routine.

The three areas will be evaluated according to the following items:

Area 1 – Intraoperative Assessment: surgical time, type of anesthesia, intraoperative medications, corticosteroids, antibiotics, anti-hemorrhagic agents, intraoperative complications, hemorrhage, soft tissue laceration, complex extractions, oroantral communications, gaps between the prosthesis and maxilla, and insertion of biomaterials.

Area 2 – Oral Health and Functionality: mastication, phonation, pain or discomfort, gingival inflammation, oral hygiene.

Area 3 – Prosthesis Adaptation: comfort with the prosthesis, esthetic satisfaction, and adaptation to the prosthesis.

Patient Care Protocol and Surgical Procedure (Condensed)

The rehabilitation protocol using custom implants includes patient evaluation, CT

imaging with radiographic guide, design verification, finite element analysis, definition of anchorage areas and prosthesis passivity, additive manufacturing, sterilization, delivery to the surgeon, implant placement, and final prosthetic rehabilitation.

Surgery is performed under general anesthesia with nasotracheal intubation. Intraoperatively, 2 g Cefazolin and 10 mg Dexamethasone are administered, followed by local anesthetic with vasoconstrictor. A crestal incision from the left to right first maxillary molar with relaxing incisions to the zygomatic pillars is performed. Full maxillary exposure is achieved, the cutting guide is fixed, and osteotomy is performed using ultrasonic piezo tips and burs. The custom prosthesis is placed and fixed with screws (2–16 mm), starting at zygomatic pillars and finishing at the palate. Mini-abutments are installed and covered with healing caps; tension-free flap closure is completed with resorbable sutures.

Immediate postoperative care includes IV Cefazolin, Dipyrone, and Hydrocortisone; subsequent at-home care consists of oral antibiotics, anti-inflammatory, analgesics, and 0.12% chlorhexidine rinses. Follow-up is weekly for the first month, then biweekly, and monthly by six months.

Ethical Considerations

Prior to initiating the research, approval was obtained from the Research Ethics Committee. The ethical criteria were as follows.

Informed Consent: Participants were ensured to understand and agree to release their data for the study.

Complete Information and Clarity: Participants received detailed explanations about the study, including its purpose, procedures, duration, risks, benefits, and alternatives. A written consent form was provided, clearly explaining all relevant aspects. After understanding the information, participants signed the form. A signed copy was given to the participant, and one copy was retained by the researcher.

Confidentiality: All personal data were kept confidential and stored securely, accessible only to authorized personnel. Anonymization or coding methods were used to protect participants' identities in collected data and published reports.

Risks and Benefits

Risks: Potential loss of confidentiality of medical record data, which contain detailed patient information on intraoperative and postoperative complications, such as infections, bleeding, damage to adjacent structures, and implant osseointegration failure.

Benefits: Contribution of data to the scientific literature, development of new techniques and materials for custom prostheses, and enhancement of professional training and clinical practice.

Statistical Method

To perform comparative analysis across the five areas at the time points (A0) intraoperative; (A1) 3 months; (A2) 12 months; (A3) 24 months, descriptive and inferential statistical methods were applied. Evaluations were measured by converting Likert scales into a rational scale ranging from 0 (worst score) to 4 (best score). Quantitative variables are presented using measures of central tendency and dispersion. Inferential analysis involved assessing normality with the Shapiro-Wilk test and longitudinal comparisons using the Friedman test. The alpha error was set at 5% for null hypothesis rejection, and statistical processing was performed using BioEstat version 5.3 and SPSS version 27.

RESULTS

The participants were mostly Female (52.4%) and Male (47.6%). The age range showed the following distribution: ≤40 years old (9.5%), 50 to 59 years old (28.6%), 60 to 69 years old (28.6%), and ≥70 years old (33.3%). The intraoperative characteristics are as follows: Surgical time ≥160 minutes (52.4%) was the most frequent. The following characteristics were present in all (100%) participants: general anesthesia, the corticosteroid Dexamethasone, the antibiotic Cefazolin at a dose of 2000 mg, no patients experienced hemorrhage, and there was an absence of oroantral communications. Soft tissue laceration (9.5%), complex extractions (19.0%), there was GAP (9.5%), biomaterial insertion (9.5%). Conventional implant removal (9.5%).

Oral Health and Functionality.

The assessment of oral health and functionality was evaluated across 5 domains: Mastication, Phonation, Pain (and discomfort), Inflammation (gingival), and Oral Hygiene. Below, we present the results of the prospective assessment at the following time points: 3 months, 12 months, and 24 months.

The Mastication domain resulted in a p-value = 0.0006* (statistically significant), with an increasing progression from 3 months (score 2.3), to 12 months (score 3.4), and to 24 months (score 3.7).

The Phonation domain resulted in a p-value = 0.0007* (statistically significant), with an increasing progression from 3 months (score 2.1), to 12 months (score 3.2), and to 24 months (score 3.4).

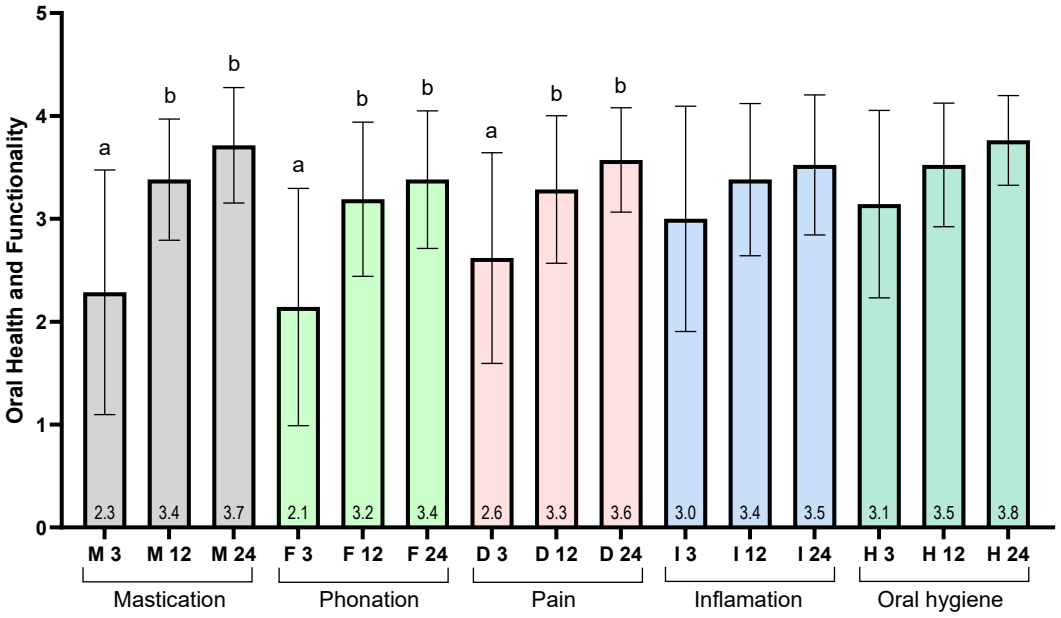
The Pain (or discomfort) domain resulted in a p-value = 0.0043* (statistically significant), with an increasing progression from 3 months (score 2.6), to 12 months (score 3.3), and to 24 months (score 3.6).

The Inflammation domain (mean evolving from 3.0 to 3.5) and Oral Hygiene (mean evolving from 3.1 to 3.8) domains remained without significant variation during the data collection period.

Table: Evaluation of Oral Health and Functionality across five assessment domains, according to Patient Progression (3, 12, and 24 months) during the Rehabilitation and Fitting of Customized Prostheses for Atrophic Maxilla. Brazil, 2024–2025.

	Central tendency			Friedman test			
Domain/time	**MD**	**Mean**	**SD**	**p-value**	**(3 x 12)**	**(3 x 24)**	**(12 x 24)**
Mastigation				0.0006*	<0.05*	< 0.05*	ns
3 months	2	2.3	1.2				
12 months	3	3.4	0.6				
24 months	4	3.7	0.6				
Phonation				0.0007*	<0.05*	< 0.05*	ns
3 months	2	2.1	1.2				
12 months	3	3.2	0.7				
24 months	3	3.4	0.7				
Pain				0.0043*	<0.05*	< 0.05*	ns
3 months	3	2.6	1.0				
12 months	3	3.3	0.7				
24 months	4	3.6	0.5				
Inflamação				0.0911			
3 months	3	3.0	1.1				
12 months	4	3.4	0.7				
24 months	4	3.5	0.7				
Oral hygiene				0.0971			
3 months	3	3.1	0.9				
12 months	4	3.5	0.6				
24 months	4	3.8	0.4				

*Significance of the Null Hypothesis by Friedman Test. ns (not significant). MD (median), SD (standard deviation).



Graph: Mean and Standard Deviation of the 5 evaluative aspects of Oral Health and Functionality, according to patient follow-up (3 months, 12 months, and 24 months) after rehabilitation with custom-made prostheses for atrophic maxilla. Brazil. Period from 2024 to 2025.

Prosthesis Adaptation

The assessment of prosthesis adaptation was conducted across three domains: comfort with the prosthesis, satisfaction with esthetics, and functional adaptation of the prosthesis. Below, we present the results of the prospective evaluation at the following time points: 3 months, 12 months, and 24 months.

The Comfort domain resulted in a p-value = 0.0027* (statistically significant), with an increasing progression from 3 months (score 2.5) to 24 months (score 3.5).

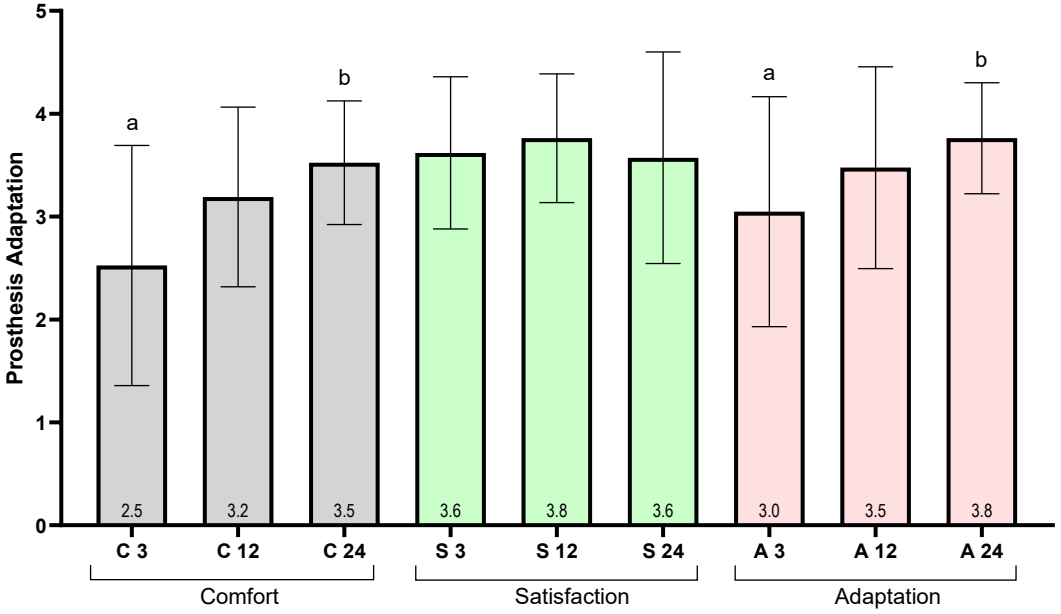
The Satisfaction domain (mean evolving from 3.6 to 3.6) and Oral Hygiene (mean evolving from 3.1 to 3.8) domains remained without significant variation during the data collection period.

The Adaptation domain resulted in a p-value = 0.0412* (statistically significant), with an increasing progression from 3 months (score 3.0) to 24 months (score 3.8).

Table: Evaluation of Oral Health and Functionality across five assessment domains, according to Patient Progression (3, 12, and 24 months) during the Rehabilitation and Fitting of Customized Prostheses for Atrophic Maxilla. Brazil, 2024–2025.

	Central tendency			Friedman test			
Domain/time	**MD**	**Mean**	**SD**	**p-value**	**(3 x 12)**	**(3 x 24)**	**(12 x 24)**
Comfort				0.0027*	ns	< 0.05*	ns
3 months	3	2.5	1.2				
12 months	3	3.2	0.9				
24 months	4	3.5	0.6				
Satisfaction				0.8266	ns	ns	ns
3 months	4	3.6	0.7				
12 months	4	3.8	0.6				
24 months	4	3.6	1.0				
Adaptation				0.0412*	ns	< 0.05*	ns
3 months	3	3.0	1.1				
12 months	4	3.5	1.0				
24 months	4	3.8	0.5				

*Significance of the Null Hypothesis by Friedman Test. ns (not significant). MD (median), SD (standard deviation).



Graph: Mean and Standard Deviation of the 3 evaluative aspects of Prosthesis Adaptation, according to patient follow-up (3 months, 12 months, and 24 months) after rehabilitation with custom-made prostheses for atrophic maxilla. Brazil. Period from 2024 to 2025.

DISCUSSION

The literature, as highlighted by Meijer et al. (9) and Awad & Lun (10), emphasizes that well-fitted, implant-supported prostheses improve masticatory function and peri-implant tissue health, reducing issues such as gingival recession and bone loss. The results of this study support these findings, demonstrating significant improvement in mastication and phonation over time.

Mastication. A statistically significant difference was observed between 3 months (2.3±1.2) and 12 months (3.4±0.6), as well as between 3 months and 24 months (3.7±0.6). This suggests that, after the initial adaptation period, patients experienced substantial functional recovery, consistent with Awad & Lun (10), who highlight prosthesis stability as crucial for masticatory improvement.

Phonation. Significant improvement was also noted in phonation between 3 months (2.1±1.2) and 12 months (3.2±0.7), and between 3 months and 24 months (3.4±0.7). This reinforces the idea that adaptation to custom prostheses contributes to overall oral

function, including speech, as suggested in the literature. Tolman & Desjardins (5) and Naert et al. (11) emphasize the importance of intraoperative medication management to prevent complications such as inflammation and bone loss.

Gingival Inflammation. No significant differences were observed in gingival inflammation across the evaluated periods ($p = 0.0911$), indicating that although inflammation is a common complication, it can be controlled with proper management (51).

Oral Hygiene. A critical factor for long-term success of implant-supported prostheses (11), oral hygiene did not show significant differences between 3 and 12 months ($p = 0.0971$), suggesting that hygiene tends to remain stable over time.

Prosthesis Comfort. The literature (5) emphasizes that adaptation to custom prostheses is gradual, requiring periodic adjustments to ensure comfort and function. Inflammation, discomfort, and excessive mobility are common in the early months but tend to decrease with proper clinical follow-up. Meijer et al. (12) highlight that effective adaptation depends on continuous adjustments and regular clinical assessment, especially during the first 24 months. In this study, prosthesis comfort showed a statistically significant improvement between 3 and 12 months ($p = 0.0027^*$), aligning with the literature regarding the need for time and adjustments to achieve adequate comfort.

The Esthetic Satisfaction is a key factor in the success of custom prosthetic rehabilitation, particularly in atrophic maxillae. Buser et al. (1997) report that satisfactory esthetics is directly related to precise prosthesis adaptation and harmonious integration with surrounding tissues. In this study, esthetic satisfaction did not show statistically significant differences ($p = 0.8266$), but remained consistently high across all periods. This suggests that esthetic satisfaction is generally achieved immediately after prosthesis placement, highlighting the importance of careful initial planning.

The Functional Adaptation of prostheses is critical, especially in atrophic maxillae. Tolman & Desjardins (5) and Zarb (13) emphasize that inadequate adaptation can lead to inflammation, excessive mobility, and implant failure. The literature underscores the need for periodic adjustments and continuous monitoring. Esposito, Grusovin, & Worthington (14) also highlight the importance of antibiotics to minimize complications and promote initial osseointegration. In this study, functional adaptation did not show

statistically significant differences between 3 and 24 months (p = 0.0412*), suggesting that functional adaptation is generally good from the early months but may improve slightly over time. Functional adaptation reaches a high level soon after prosthesis placement, with minor improvements over time, partially aligning with the literature, which emphasizes continuous adjustments but indicates that functional adaptation may be more stable than comfort, for example.

CONCLUSION

This study demonstrates that rehabilitation with custom prostheses in patients with atrophic maxillae leads to significant improvements in oral function, including mastication and phonation, as well as enhanced comfort over time. Functional adaptation to the prostheses is generally achieved early and remains stable, while esthetic satisfaction is consistently high throughout the follow-up period. Gingival inflammation and oral hygiene are manageable with proper clinical care, and postoperative pain or discomfort decreases significantly as patients adapt. These findings corroborate existing literature, emphasizing that careful planning, precise prosthesis adaptation, and continuous monitoring are critical to achieving predictable, long-term outcomes in implant-supported rehabilitation for atrophic maxillae.

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