Keywords

Prosthodontic rehabilitation; Maxillofacial surgery; Dental implants; Tissue transplantation; Oral rehabilitation

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Received: 11.03.2026
Revised: 16.04.2026
Accepted:13-05-2026
DOI:10.1922/ejprd.v34i2s.1377

Prosthodontic Rehabilitation Strategies for Patients Following Maxillofacial Surgery and Tissue Transplantation

Abstract

Maxillofacial surgery and tissue transplantation remain essential interventions for the management of extensive defects resulting from oncologic, traumatic, congenital, and post-infectious conditions. Despite advances in surgical reconstruction, functional and esthetic rehabilitation frequently requires comprehensive prosthodontic intervention. Evidence evaluating outcomes of different prosthodontic rehabilitation strategies following such complex surgical procedures remains limited. The study aimed to retrospectively evaluate prosthodontic rehabilitation strategies following maxillofacial surgery and tissue transplantation, assess associated functional, esthetic, and prosthetic outcomes, and identify clinical factors influencing long-term rehabilitation success. A retrospective observational study evaluated clinical records of 90 patients who underwent definitive prosthodontic rehabilitation following maxillofacial surgery and/or tissue transplantation at a tertiary care centre. Demographic and clinical variables underwent descriptive analysis. Follow-up duration across rehabilitation modalities was assessed using the mean and standard deviation. Functional and esthetic outcomes between implant-supported and removable prostheses were compared using independent *t*-tests. Correlation analysis examined associations between follow-up duration and prosthetic complications, while multiple linear regression identified predictors of prosthodontic outcomes. Oncologic etiology and maxillary defects predominated within the cohort. Implant-supported rehabilitation demonstrated significantly higher mastication efficiency, speech intelligibility, and esthetic satisfaction compared with removable prostheses ($p < 0.05$). Prosthetic survival remained high, with complications largely limited to minor mechanical issues. Regression analysis identified implant utilisation and reconstructive approach as significant predictors of favourable prosthodontic outcomes. Prosthodontic rehabilitation following maxillofacial surgery and tissue transplantation demonstrated favourable functional, esthetic, and prosthetic outcomes, particularly with implant-supported modalities. A prosthodontic-centred, multidisciplinary approach enhances rehabilitation predictability and long-term performance.

1. Introduction

Maxillofacial surgery and tissue transplantation represent essential therapeutic interventions for managing extensive defects resulting from oncologic resections, traumatic injuries, congenital anomalies, and post-infectious conditions. The interventions assist in the restoration of anatomical continuity and structure of the face, but frequently functional and esthetic rehabilitation is still incomplete after surgical reconstruction itself. The importance of dental factors and prosthodontic role in facial transplantation and maxillofacial reconstruction is great, and to achieve long-term rehabilitation outcomes, it is essential to organise their restorative planning.[1] Maxillofacial resections may also leave behind chronic dysfunctions of mastication, speech, swallowing, facial appearance, and psychosocial functioning. A meta-analysis of the results of post-maxillectomy rehabilitation demonstrates the key role of prosthodontic

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interventions in the
restoration of functions and the increase in the level of patient-reported quality of life indicators.[2] The populations involved in head and neck oncology are further complicated by the aspect of rehabilitation due to tissue loss, change in anatomy, and the morbidity of the treatment, which supports the challenging character of prosthodontic management in this clinical setting.[3] Maxillofacial prosthetics constitutes an advanced form of prosthodontics; it is a particular field that aims at treating intraoral and extraoral deficiencies with specific rehabilitative options. Modern prosthetic designs are focused on the restoration of oral competence, phonetics, and the face shape using the latest materials and fabrication techniques based on precision.[4] Beneficial functional outcomes and social integration of the individual presenting oro-maxillo-facial defects have been proven in long-term retrospective observations after the prosthetic rehabilitation.[5]

Surgical interventions that aim to increase the prognosis of prostitutes, such as reconstructive flaps and bone augmentation procedures, have a significant impact on the prognosis of future restorative outcomes. The maxillary defect management reviews state that the integration of the planning of the prosthodontic during the surgical stage is an advantage that allows predicting the rehabilitation.[6] Prosthodontic care is the cornerstone of oral functions, facial structures, and life quality after maxillectomy.[7] More current developments in implant-supported prosthetic rehabilitation provide an expanded set of treatment options to patients who have complex maxillofacial defects. Retrospective studies indicate positive functional outcomes and prosthesis functionality of cases of implant-borne rehabilitation with adverse anatomical anatomy, such as cleft-related deformities.[8] The oral and maxillofacial prosthodontics interrelationship with oncologic care further makes the rehabilitative applicability of prosthetic interventions in multifaceted cancer treatment strategies eminent.[9] The perspectives of prosthodontics, surgery, and soft-tissue management through a multidisciplinary care approach, including rehabilitation strategies, show encouraging functional and esthetic results in complicated cases.[10]

Although a large amount of the literature on the topic of prosthodontic rehabilitation is documented in the field of maxillofacial care, the current literature is largely biased towards surgical reconstruction or individual case studies. More generalised retrospective studies on the outcome of prosthodontic rehabilitation after maxillofacial surgery and tissue transplantation are scarce. Recent studies on the topic of prosthodontic management usually focus on individuals with systemic conditions, as opposed to defect-specific restoration after complicated surgical procedures.[11] The literature on the topic of prosthetic reconstruction of the maxilla and palate often details the technical features of the operations or isolated types of prosthesis without in-depth comparative analysis of clinical data in relation to the various approaches to rehabilitation.[12] Current discourses provide innovative methods in the form of prosthodontic solutions in patients with head and neck oncology, but there is a lack of standardised evidence to direct the choice of strategies depending on the character of their defects, type of reconstruction, and prognosis.[13] Oral and maxillofacial prosthodontics, pathology, oncology, medicine, and radiology conceptually overlap with each other, although organised prosthodontic-focused clinical models that combine these fields into outcome-based rehabilitation planning are still immature.[14] Innovative methods like the use of zygomatic implants to rehabilitate patients are getting more and more attention, but the reported results are frequently based on small cohorts of patients, which limits the use of the method to a wider population of clinical patients.[15]

The modern tendencies in microvascular reconstruction and tissue transplantation offer more and more complications in the paths of oral rehabilitation that require systematic analysis through the prism of prosthodontics. Changes in the reconstructive approaches after the treatment of maxillary cancer emphasise the changing requirements for the planning of prosthodontic rehabilitation and long-term outcome evaluation.[16] Retrospective clinical assessment provides a useful contribution to the practical clinical outcome of prosthodontics, the pattern of complications and the durability of prostheses used in various rehabilitation methods. The use of implant-supported prosthetic rehabilitation after the treatment of aggressive maxillofacial pathologies shows promising results in terms of survival, but variations observed in clinical practices suggest the necessity to conduct larger cohort-based studies.[17] Other treatment-related variables, such as radiation exposure and technique choice, have a quantifiable impact on the implant success and the prognosis of the prosthodontic restoration, which supports the significance of the outcome-oriented retrospective assessment.[18] Additional supportive care guidelines, especially oral hygiene care in oncologic treatment, can also promote the success of the prosthetic in the long term and patient health.[19] A retrospective evaluation of 90 patients, hence, is of importance to enhance the evidence-based use of the prosthodontic practice and the rehabilitation aim after maxillofacial surgery and tissue transplantation.

Research Objectives

1. To retrospectively evaluate prosthodontic rehabilitation strategies employed in patients following maxillofacial surgery and tissue transplantation
2. To assess functional, esthetic, and prosthetic outcomes associated with different rehabilitation modalities
3. To identify clinical factors influencing prosthodontic success and long-term performance

2. Methodology

2.1 Study Design

This study followed a retrospective observational clinical study design, which aimed to determine the outcome of prosthodontic rehabilitation in the post-

maxillofacial surgery and tissue transplantation. It was designed based on the examination of already reported clinical data obtained in the process of routine patient care, which allowed evaluation of the treatment outcomes without any changes in the treatment plans. With such a design, it was possible to assess actual clinical outcomes of the strategy of prosthodontic rehabilitation in a mixed patient population managed in a tertiary referral centre.

2.2 Study Setting and Duration

The research was conducted in a tertiary care setting that specialises in the provision of maxillofacial surgery and advanced prosthodontic rehabilitation services. Structured assessment of institutional records was done over a long period of review, between five to ten years. This follow-up was found to allow patients of different etiology and different forms of reconstruction, and also was able to assess long-term and medium-term prosthodontic outcomes based on documented follow-up visits and maintenance records.

2.3 Study Population

The study population consisted of 90 patients who underwent definitive prosthodontic rehabilitation following maxillofacial surgery and/or tissue transplantation. Included cases involved individuals treated for oncologic resections, traumatic defects, congenital anomalies, or post-infectious sequelae affecting maxillofacial structures. All selected records reflected completion of prosthodontic rehabilitation and availability of follow-up documentation sufficient for evaluation of functional, esthetic, and prosthetic outcomes.

2.4 Inclusion and Exclusion Criteria

Patient selection followed predefined eligibility criteria to support consistency of outcome assessment. Inclusion required documented evidence of maxillofacial surgery or tissue transplantation, completion of definitive prosthodontic rehabilitation, and availability of a minimum follow-up duration of twelve months. Exclusion applied to records containing incomplete clinical or prosthodontic documentation, along with cases managed exclusively through surgical reconstruction without subsequent prosthodontic intervention, as such records limited comprehensive outcome evaluation.

2.5 Data Collection

Data collection involved a systematic review of archived medical records, dental charts, radiographic images, and prosthodontic treatment documentation. Extracted variables included patient demographic characteristics, etiology and classification of maxillofacial defects, details of surgical reconstruction or tissue transplantation, and type of prosthodontic rehabilitation provided. Additional variables included implant utilisation, prosthetic design characteristics, retention mechanisms, duration of follow-up, and documented biological or mechanical complications encountered during the observation period.

2.6 Outcome Measures

Outcome evaluation focused on functional, esthetic, and prosthetic parameters relevant to maxillofacial rehabilitation. Functional outcomes included documented improvement in mastication efficiency and speech intelligibility following prosthodontic treatment. Esthetic outcomes derived from clinical assessments and recorded patient satisfaction indicators noted during follow-up appointments. Prosthetic outcomes encompassed survival of the definitive prosthesis, incidence of complications, and documented requirement for repair, adjustment, or replacement during the study period.

2.7 Statistical Analysis

Statistical analysis employed appropriate analytical software. Demographic and clinical variables underwent descriptive analysis using frequency and percentage distributions. Follow-up duration across rehabilitation modalities underwent evaluation using mean and standard deviation values. Functional and esthetic outcomes between implant-supported and removable prostheses underwent comparison using an independent *t*-test analysis. Associations between follow-up duration and prosthetic complications underwent evaluation using correlation analysis. Predictors of prosthodontic outcomes underwent assessment through multiple linear regression analysis. Statistical significance followed a predefined threshold of $p < 0.05$.

3. Results

3.1 Demographic and Clinical Profile

The retrospective cohort comprised 90 patients who completed definitive prosthodontic rehabilitation following maxillofacial surgery and/or tissue transplantation. Male patients predominated, accounting for 56 cases (62.2%), while female patients constituted 34 cases (37.8%). Oncologic etiology represented the most common indication, observed in 54 patients (60.0%), followed by traumatic causes in 18 patients (20.0%). Maxillary defects appeared most frequently in 48 cases (53.3%). Reconstruction using flaps or transplantation supported 57 patients (63.3%), as summarised in Table 1.

Table 1. Demographic and clinical profile of the study population (n = 90)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	56	62.2
	Female	34	37.8
Etiology	Oncologic	54	60.0
	Traumatic	18	20.0
	Post-infectious	12	13.3

	Congenital	6	6.7
Defect Location	Maxilla	48	53.3
	Mandible	24	26.7
	Combined	18	20.0
Reconstruction type	Flap/transplantation	57	63.3
	Non-flap	33	36.7

The percentage distribution of key demographic and clinical characteristics within the study cohort is illustrated in Figure 1. The figure summarises patient gender, underlying etiology of maxillofacial defects, anatomical defect location, and reconstruction type, providing an overview of the clinical profile of patients included in the retrospective analysis.

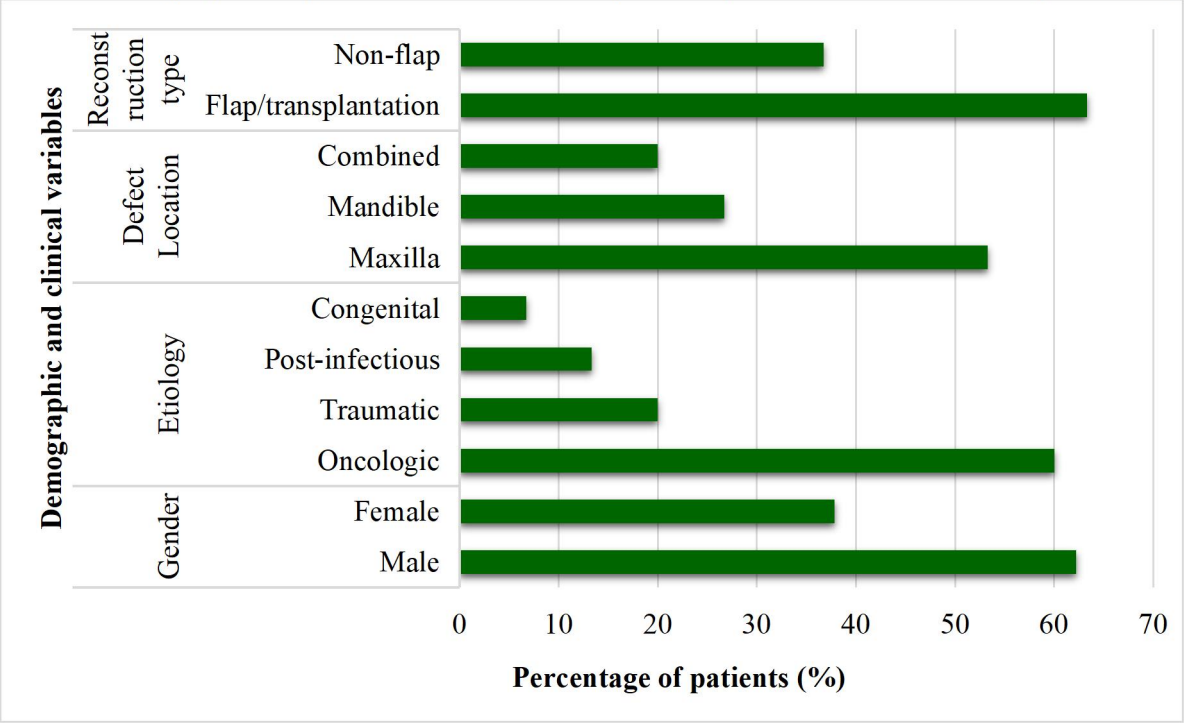

Figure 1. Distribution of demographic and clinical characteristics of the study population

As depicted in Figure 1, male patients constituted a higher proportion of the study population. Oncologic etiology represented the most prevalent indication for maxillofacial surgery, followed by traumatic and post-infectious causes. Maxillary defects predominated among anatomical locations, while flap-based reconstruction or tissue transplantation supported the majority of cases. This distribution highlights the complexity of the rehabilitative challenges addressed within the evaluated cohort.

3.2 Prosthodontic Rehabilitation Modalities (Mean and Standard Deviation)

Mean follow-up duration varied across prosthodontic rehabilitation modalities. Removable prostheses demonstrated a mean follow-up of 28.6 ± 9.4 months, whereas implant-supported fixed prostheses exhibited the longest duration at 42.3 ± 11.1 months. Implant-supported removable prostheses showed a mean follow-up of 38.7 ± 10.6 months, while hybrid prosthetic solutions demonstrated intermediate values of 35.2 ± 9.9 months. These findings indicate longer functional service duration associated with implant-supported rehabilitation modalities (Table 2).

Table 2. Mean and standard deviation of follow-up duration by rehabilitation modality

Rehabilitation modality	Mean follow-up (months) ± SD
Removable prostheses	28.6 ± 9.4
Implant-supported fixed prostheses	42.3 ± 11.1
Implant-supported removable prostheses	38.7 ± 10.6
Hybrid prosthetic solutions	35.2 ± 9.9

3.3 Functional and Esthetic Outcomes

Independent *t*-test analysis demonstrated significantly superior outcomes for implant-supported rehabilitation compared with removable prostheses. Mastication efficiency scores averaged 8.4 ± 1.1 for implant-supported prostheses versus 6.9 ± 1.3 for removable prostheses (p = 0.018). Speech intelligibility scores measured 8.1 ± 1.2 and 7.2 ± 1.4,

respectively (p = 0.041). Esthetic satisfaction scores also favoured implant-supported rehabilitation (8.6 ± 1.0 vs 7.0 ± 1.5; p = 0.026), as shown in Table 3.

Table 3. Comparison of outcomes between rehabilitation groups (t-test)

Outcome parameter	Implant-supported (Mean ± SD)	Removable (Mean ± SD)	p-value
Mastication efficiency score	8.4 ± 1.1	6.9 ± 1.3	0.018
Speech intelligibility score	8.1 ± 1.2	7.2 ± 1.4	0.041
Esthetic satisfaction score	8.6 ± 1.0	7.0 ± 1.5	0.026

Functional and esthetic outcome scores obtained from the comparative analysis between implant-supported and removable prosthetic rehabilitation modalities are illustrated in Figure 2. The figure presents mean values for mastication efficiency, speech intelligibility, and esthetic satisfaction derived from postoperative clinical assessment.

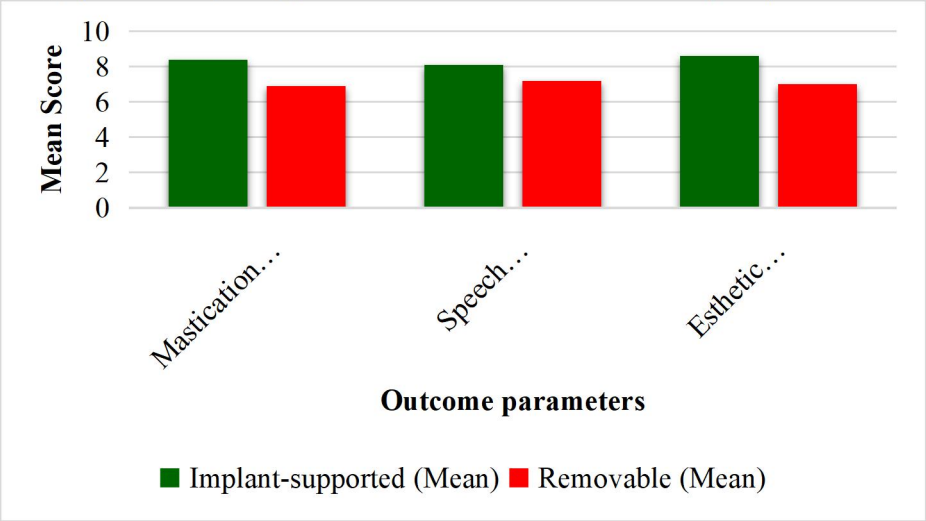

Figure 2. Comparison of functional and esthetic outcome scores between implant-supported and removable prostheses

As shown in Figure 2, implant-supported prostheses demonstrated higher mean scores across all evaluated outcome parameters compared with removable prostheses. Mastication efficiency and esthetic satisfaction displayed the greatest differences between rehabilitation modalities, while speech intelligibility also favoured implant-supported rehabilitation. These findings indicate improved functional stability and patient satisfaction associated with implant-supported prosthodontic rehabilitation.

3.4 Association Between Prosthetic Survival and Complications

Correlation analysis identified a moderate positive association between follow-up duration and mechanical complications (r = 0.42, p = 0.009), indicating increased detection of minor mechanical issues over time. Prosthetic survival demonstrated a moderate negative correlation with complication frequency (r = −0.38, p = 0.014). Biological complications showed a weak and non-significant correlation with follow-up duration (r = 0.21, p = 0.083), suggesting a limited association within the evaluated cohort (Table 4).

Table 4. Correlation between follow-up duration and prosthetic outcomes

Variable pair	Correlation coefficient (r)	p-value
Follow-up duration vs mechanical complications	0.42	0.009
Follow-up duration vs prosthetic survival	−0.38	0.014
Follow-up duration vs biological complications	0.21	0.083

3.5 Factors Influencing Prosthodontic Treatment Outcomes

Multiple linear regression analysis identified implant utilisation as the strongest predictor of favourable prosthodontic outcomes (β = 0.46, p = 0.003). The reconstruction type also demonstrated significant predictive influence (β = 0.39, p = 0.011). Defect location (β = 0.18, p = 0.092) and etiology (β = 0.14, p = 0.117) showed weaker, non-significant associations. These findings indicate the primary influence of implant support and reconstructive approach on rehabilitation success (Table 5).

Table 5. Regression analysis of factors influencing prosthodontic outcomes

Predictor variable	β coefficient	Standard error	p-value
Implant utilization	0.46	0.09	0.003
Reconstruction type	0.39	0.11	0.011

Defect location	0.18	0.12	0.092
Etiology	0.14	0.13	0.117

4. Discussion

Findings of this study indicate that prosthodontic rehabilitation following maxillofacial surgery and tissue transplantation provides meaningful functional, esthetic, and prosthetic benefits when guided by appropriate clinical planning. The number of cases showed the preponderance of oncologic cases, which indicates the rehabilitative load of ablative head and neck surgery. The large numbers of maxillary defects and flap-based reconstructions highlight the level of complexity of the anatomical and functional issues that are handled among the cohort. Outcome analysis showed that there was better performance in connection with the rehabilitation modalities with implant support. Increased mastication efficiency, speech intelligibility, and high esthetic satisfaction scores in the supported groups with implants suggest the stable biomechanical support and better integration of the prostheses. Correlation analysis also indicated that the long period of follow-up helped in the detection of small mechanical complications as opposed to devastating failure of the prosthetic, and this fact supported the long-term sustainability of modern rehabilitation strategies. The regression analysis identified the use of implants and reconstructive status as the main factors determining the success of prosthodontics, which validated the need to evaluate the structural assistance and surgical-prosthodontic alignment during complex restoration situations.

Superiority of implant-supported rehabilitation observed is consistent with the modern literature, which points to using implant-based treatment of complex maxillofacial defects. The treatment models where the rehabilitation of the posterior edentulous maxilla is addressed focus on the biomechanical and functional benefits of the use of implant-supported prostheses, especially when used in the conditions of impaired anatomy.[20] Likewise, such advantageous functions after implant-based rehabilitation after extensive maxillofacial defects based on infectious etiologies have been recorded, and they justify the flexibility of the implant solutions in different clinical settings.[21] There were positive results on long-term survival of vascularised bone flaps reconstruction inferior to those in the current cohort, especially in terms of the life of the prosthetics and the rates of complications.[22] Significance of peri-implant soft tissue management after free-flap reconstruction has been emphasised as an implant outcome determinant supporting the view that reconstruction type is a major predictive factor.[23] Multidisciplinary rehabilitation in the presence of traumatic mandibular defects has shown that the functional and esthetic results can be improved, as witnessed in the results of implant-based rehabilitation in the present analysis.[24] Also, retrospective studies of outcomes after head and neck cancer treatment have shown long-term implant-prosthetic results in line with the current cohort survival trends.[25]

Findings of this study demonstrate implications for the practical use of the study to guide the planning of prosthodontic rehabilitation in maxillofacial surgery patients. This could be improved by integrating the input of prosthodontics into the planning of surgery to increase the feasibility of implant placement and predictability of the prosthetic. Implant-supported rehabilitation proved to have consistent benefits in both functional and esthetic parameters, and this indicates the importance of implant-based solutions when anatomical parameters are favourable. The use of reconstructive methods that include the use of vascularized tissue or flaps seems to help the prostheses attain a better stabilisation and enduring outcome. The findings provide evidence on a multidisciplinary approach of rehabilitation based on prosthodontic centrality and involving surgical reconstruction, implant planning, and prosthetic design as part of overall patient management procedures.

A number of limitations should be taken into consideration. The retrospective study design did not provide control over the consistency of data and measures of outcome assessment. The heterogeneity in complication reporting was created by the variability in the follow-up time in different patients. The research is limited to a single centre, which could restrict the application to various clinical settings as well as the generalised application. The methods of functional and esthetic outcome assessment were based on partially documented clinical assessment and patient-reported measures, and this could add subjectivity variability. Regardless of such limitations, the selection of a defined cohort with standardised rehabilitation procedures enhanced the internal consistency of outcome interpretation.

Future research can be enhanced with the help of prospective, multicentric study designs with the use of standardised functional assessment instruments and objective esthetic evaluation indicators. The larger sample sizes can be used to perform subgroup analysis according to the type of defects, reconstruction procedure, and type of implant. Digital workflow of prosthodontics and high-technology materials should be evaluated with particular attention in the context of complicated maxillofacial rehabilitation. Evidence-based prosthodontic rehabilitation can be improved further by longitudinal studies investigating the maintenance needs and patient-reported quality of life outcomes.

5. Conclusion

The study provides meaningful insight into prosthodontic rehabilitation outcomes following maxillofacial surgery and tissue transplantation within a cohort of 90 patients. The results support the claim that prosthodontic intervention plays an important role in the restoration of oral functionality, facial esthetics, and prosthetic stability in patients with complex maxillofacial defects. The cohort consisted of oncologic etiology and maxillary involvement, as the

rehabilitative needs related to ablative surgery. The rehabilitation modalities using implants had better functional and esthetic outcomes over traditional removable ones. The clinical benefit attached to the use of implants was evident in the higher mastication efficiency, better speech intelligibility, and high esthetic satisfaction scores. Prosthetic survival outcome also provided the support of durability of modern rehabilitation plans, with most complications simply being minor mechanical problems diagnosed during prolonged follow-up, and not failure of the prosthetic. The regression analysis showed that the main factors contributing to the success and long-term performance of prosthodontics were the use of implants and a reconstructive approach. These observations reiterate the need to ensure sufficient structural support and synchronised surgical-prosthodontic planning in ensuring predictable rehabilitation. The correlation analysis revealed that the duration of follow-up was allowed to detect the maintenance-related issues, which made it possible to emphasise the importance of organising the post-rehabilitation monitoring. Comprehensively, the research justifies the implementation of a multidisciplinary approach to rehabilitation involving a prosthodontic-centred approach that incorporates a surgical reconstruction, implant planning, and final prosthetic design. This technique improves functional stability, aesthetics and long-term performance of the prostheses in the case of maxillofacial operations and transplantation of tissues.

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