The Use of Implant-Supported Prostheses in the Functional and Psychosocial Rehabilitation of Tumor Patients

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Purpose: The present study investigated the residual functional constraints as well as the psychosocial rehabilitation of tumor patients following prosthetic treatment with implant-supported dentures. *Materials and Methods:* A clinical examination and semistructured interview were performed in 66 of 132 consecutive patients who underwent tumor resection and subsequent implant-supported restoration between 1985 and 1997. *Results:* Functional and psychosocial constraints were improved by between 91% (general comfort) and 47% (social reintegration) of all cases, but these constraints were never fully compensated for. Restrictions in tongue mobility, loss of sensation, and radiotherapy-induced hyposalivation led to problems in chewing and swallowing, which were hardly improved by prosthetic rehabilitation. The best subjective assessments referred to appearance, followed by masticatory improvement and denture retention. *Conclusion:* Functional impairment cannot be fully compensated by implant-supported prosthodontic reconstructions, but such treatment contributes essentially to general well-being and relief of disease-related social restrictions. *Int J Prosthodont 2004;17:512–517.*

Primary-site surgery of malignant tumors in the orofacial region might result in an extensive loss of functionally important structures. Adjuvant radiotherapy leads to additional deterioration, which further complicates prosthodontic restoration.¹ Tumor treatment might lead to bony and soft tissue defects of varying size and topography, a reduced dentition, scarred and vulnerable tissues, loss of sensation, radiotherapy-induced

hyposalivation, impaired motor function, reduced mouth opening, as well as respiratory and masticatory deficiencies. Impaired general health and life expectancy, but also psychosocial and economic factors, might further affect the dental rehabilitation.¹ Sophisticated but mostly protracted surgical reconstructions play a key role in the rehabilitation of tumor patients but often fail to create a preprosthetic situation that allows adequate compensation for functional deficiencies by conventional prosthetic means.² In addition to masticatory and esthetic constraints, psychosocial restrictions present major problems for patients.³⁻⁷ Their reintegration into their personal, professional, and social environments is clearly enhanced by functional improvements in mastication, speech, and physiognomy of the lower face. Extensive clinical experience with osseointegrated implants in conventional situations⁸ suggested their use in postoperative therapy after radical head and neck surgery. The use of dental implants to improve retention and function of defect dentures is now generally accepted.1,2,9-17

The hypothesis of the present study was that functional impairment cannot be fully compensated by

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Table I Posisulgical Outcomes in oo Tumor Patien	Table 1	Postsurgical	Outcomes	in 66	Tumor	Patien
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Parameter	No. of patients
Localization of postsurgical defect	
Segmental mandibulectomy during primary-site operation (15 with subsequent bony reconstruction with iliac crest grafts)	24
Marginal resection of mandible	12
Resection of floor of mouth (3 with additional small bony defects)	15
Resection of maxilla (7 with open connection of sinus/nasal cavity; 2 defects subsequently closed by plastic surgery, 5 defects subsequently closed by obturator)	8
Partial resection of tongue (1 with additional small bony defect)	3
Partial resection of lip and/or cheek	2
Resection in epipharyngeal area	2
Tissue defects	
Bony and soft tissue (20 reconstructed with iliac crest grafts)	48
Soft tissue only	18
Tongue mobility	
Restricted (34 with tongue fixed during operation)	42
Lost or impaired sensation	
Localized permanent impairment or loss of sensation of trigeminal nerve	49
Salivary function	
Reduced salivary flow after radiotherapy	20

Table 2 Type of Implant-Supported Prosthodontic Reconstru	uction
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Reconstruction	No. of patients
Mandible	
Overdenture with Dolder bar (27 Dolder bars with cantilever extensions on 4 abutments, 3 in combination with telescopic crowns on natural teeth)	41
Overdenture with milled bar (4 in combination with telescopic crowns on natural teeth)	8
Fixed restoration	8
Maxilla	
Overdenture with implant-supported Dolder bar (1 on 2 abutments with extensions supporting an obturator, 4 on 4 abutments with cantilever extensions, 1 on 6 abutments supporting an obturator)	6
Overdenture including obturator with implant-supported milled bar (2 combined with telescopic crowns on natural teeth, 1 combined with ball attachment on a remote implant)	3
Fixed restoration	2

implant-supported prosthodontic reconstructions, but that such treatment contributes essentially to the relief of disease-related social restrictions and would be subjectively assessed positively.

Materials and Methods

The study comprised consecutive patients who were admitted between 1985 and 1997 for tumor surgery to the Clinic for Maxillofacial Surgery, University of Mainz, Germany, and were subsequently provided with implant-supported restorations in the Department of Prosthetic Dentistry. Patients presented initially with a malignant tumor, mostly squamous-cell carcinoma, or benign noninflammatory conditions. Patients with facial epitheses were excluded from this study. From a total of 132 patients, 36 had passed away when the study began, 6 patients were too ill to participate, 13 patients could not be contacted, and a further 11 were not motivated to participate. Ultimately, 66 patients took part in this retrospective study; they included 45 men and 21 women with a mean age of 59.2 years (standard deviation [SD] 14.0 years, range 18 to 85 years).

The localization of the postsurgical defects and the functional restrictions are listed in Table 1. Eighteen patients presented with soft tissue defects, and 48 patients showed additional bony defects, of which 8 affected the maxilla. Of the 24 patients who underwent a segmental mandibulectomy during the primary-site operation, 15 were reconstructed using grafts from the iliac crest. In addition to surgery, therapy included radiotherapy in 26 patients. In the 66 patients investigated, a total of 288 implants were placed, 40 in the maxilla and 248 in the mandible.

First, a comprehensive clinical examination was performed, and the type of implant-supported prosthesis was categorized (Table 2). In both the maxilla and mandible, mostly removable prostheses were inserted. Implants were wherever possible splinted by either milled or Dolder bars and, if natural teeth were present, were combined with telescopic crowns.



Fig 1 Responses to preworded statements concerning changes in life brought about by implant-supported prostheses (n = 66).

Table 3	Reported	Difficulties with	Chewina	and Eating'
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Difficulty	No. of patients
Reduced tongue mobility	26
Swallowing	18
Dry-mouth sensation	16
Chewing efficiency	15
Incising	9
Localized numbness of tissues	9
Reduced gape	7
Total time required to finish meal	6
Bite injuries during mastication	5
Pain while chewing	4
Gag reflex	2
Chewing force	2
None reported	6

*Each patient (n = 66) could give up to four answers.

A semistructured questionnaire was developed specifically to evaluate the clinical difficulties of tumor patients. Patients were requested to rate their masticatory efficiency, handling of the prostheses, as well as esthetic treatment outcome. Preworded statements concerning mastication and speech, but also psychosocial rehabilitation, were to be either agreed or disagreed with. Reasons for the general satisfaction or dissatisfaction with the present situation were collected using open questions. All interviews were conducted by a single operator who was unknown to the patients. The interviews took place in a quiet and private atmosphere, with a mean time lapse of 38.4 months (SD 27.6) since insertion of the dentures.

Results

In 21 patients (32%), the implants potentiated wearing a prosthesis successfully for the first time after primarysite surgery. Forty-three implants (15%), 7 in the maxilla and 36 in the mandible, were lost. Nine implants could not be used for prosthodontic reconstruction. The mean time the implants had been loaded at the time of examination was 38.4 months (SD 27.6). Thirty-five patients continuously wore their prostheses, 22 wore them only during the day, 4 removed the dentures for eating, 3 wore them only on social occasions, and 2 never wore their dentures.

Most study participants (91%) claimed to feel more comfortable since they had their dentures made. Improved chewing ability was reported by 83% of the patients, and better speech was claimed by 68%. Of the patients, 57% stated that they had again begun to smile unrestrainedly, and 47% of the interviewed subjects felt they were able to socialize more often (Fig 1). In an open question, 28 of the 66 patients described an increase in social contacts, 18 described improved chewing capability, and 14 described increased general well-being as the biggest changes in their lives following prosthetic rehabilitation. Eating in the company of others (n = 13), leading a "normal" life (n = 12), improved speech (n =9), and appearance (n = 2) were further mentioned as the biggest changes. Seven patients reported no changes to their lives following insertion of the prostheses.

The appearance and handling of the dentures were rated by the majority of patients (95% and 86%, respectively) as satisfactory, good, or very good. However, 32% of the patients rated their masticatory ability as less than satisfactory. Satisfaction with the prostheses was



Fig 2 Responses to preworded statements concerning chewing difficulties (n = 66).

mostly attributed to improved appearance (n = 51), improved chewing ability (n = 40), good denture retention (n = 37), and speech (n = 34). Open questions revealed dissatisfaction related to chewing problems in 14 patients and difficulties speaking in 8 patients. Eleven patients did not specify dissatisfaction. Reduced mobility of the tongue, swallowing difficulties, dry mouth, and reduced chewing efficiency were reported as the most common problems in mastication (Table 3). Preworded statements elicited reduced tongue mobility (47%), lack of saliva (31%), and reduced opening (20%) as causing problems in chewing (Fig 2). Thirty patients claimed not to have changed their eating habits in comparison to before their primary tumor resection. Of the remainder, 19 subjects ate exclusively soft or minced foods with increased periods of mastication.

Discussion

It is well-known that patients tend not to reveal dissatisfaction in follow-up reviews; therefore, their statements have to be interpreted carefully.¹⁸ This newly developed questionnaire was tailored to the specific problems of tumor patients and therefore should not be compared with other studies.^{19–21} Furthermore, the great variety of influences on the rehabilitation process after tumor surgery make a multivariate statistical analysis difficult.

The present study verified the hypothesis that implant-retained defect dentures contributed effectively to improvement of patients' general and psychosocial well-being. However, the reverse causality of a fulfilling daily life reflected in satisfaction with conventional complete dentures was shown for elderly edentulous patients²² and cannot be excluded for the investigated cohort. No denture can ever fully compensate for the functional impairment and structural deficits caused by the loss of teeth, the tumor, and/or the therapy. Nevertheless, the defect denture provided, in addition to improvement of oral function, an effective aid in gaining subjective confidence in overcoming the tumor-related problems and in social reintegration. Smiling is in general considered a sign of physical and mental well-being. The majority of interviewed patients claimed to laugh more unrestrainedly after the implant-supported rehabilitation had been inserted. More patients considered increased social contacts as the biggest change after insertion of the prostheses, followed by other social aspects like eating in the company of others and leading a "normal" life.

It is well-known that masticatory deficiencies are one of the major constraints after tumor resection.²³ With the preworded statements, 83% of the patients claimed masticatory improvements, but these might have been small, considering that nearly one third of the investigated patients rated their chewing ability as worse than satisfactory. However, in the open questions concerning the biggest changes, improvements in masticatory function were mentioned most frequently (n =18), after more social contacts (n = 28). Especially in the edentulous jaw, enhanced retention was claimed to be an essential gain when comparing the new implant-supported prostheses with the transitional denture. The loss of attached mucosa, radiation-induced xerostomia, lacking neuromuscular feedback, and/or reduced tongue mobility disturbed the function of a conventional mandibular complete denture. The placement of dental implants provided effective retention and support. All the same, many patients felt restricted in speech and mastication. The main chewing problems occurred in collecting the bolus from the space between the scarred and handicapped tongue and

the lingual aspect of the mandibular denture. These difficulties occurred in combination with problems in deglutition such that the food bolus could not be transported to the pharynx to induce swallowing as a result of restricted mobility of the tongue and/or radiation-induced xerostomia. Lack of mucosal sensation was blamed for difficulties in locating and directing the bolus in the oral cavity by some patients. Poor food comminution was reported, possibly because of impaired motor coordination, diminished muscle force, and reduced occlusal surface. Disturbed mucosal sensibility also led to unnoticed bite wounds in the cheek, lip, or tongue. Patients with subjectively reduced salivation and radiated patients rated their chewing ability especially poorly, a finding also described for patients with conventional complete dentures.²⁴ In four patients, the masticatory problems were so aggravating that the denture was removed for eating, and in five cases, they were worn only on social occasions or not at all. Despite numerous clinical modifications, these problems could not be solved satisfactorily. Consequently, those patients changed to a liquid or minced diet that could be swallowed with little saliva.

In the present study, speech problems were mainly reported by patients with mandibular defects. Articulation was impeded by limited mobility of the tongue and could not in all cases be improved by the prostheses. Although full compensation for the speech problems was not possible in all patients with maxillary defects, these patients claimed subjective satisfaction with their speech function when the obturator was inserted.

A study assessing conventional prosthetic reconstruction in tumor patients reported that despite prosthetic rehabilitation, patients with mandibular defects suffer more from persistent functional constraints than do patients with maxillary resections.¹⁸ These findings correspond with the results from the present study and with clinical experience that prosthodontic rehabilitation is less successful in mandibular than maxillary defects, probably because of the unfavorable anatomic situation and interference with the tongue. Maxillary defects often provide sufficient undercuts to gain retention, and the residual palate often has a large enough surface to support the prosthesis. Given an open connection to the sinus or nasal cavity, eating is severely handicapped; it should be borne in mind that the patient has no option but to adapt to the obturator, which surely influences his or her attitude and subjective assessment.

The limitations of implant therapy are reached when local anatomy is unfavorable or patient compliance is insufficient. Often, there is a rather long time lapse until the ultimate reconstruction, which would be reduced by implant placement at the stage of osteoplastic reconstruction²; this might, however, increase the

risk of loosing the graft unless the implants are placed in local bone. The relatively poor 5-year survival rate of oral squamous-cell carcinoma patients, but also considerations of the patient's age, psychologic, and physical condition, might suggest a treatment concept with an adequately low endurance and time burden to the patient. An adequate prosthetic rehabilitation and improved quality of life are not in all cases achieved by the most sophisticated prosthetic solution. However, despite the described shortcomings of the treatment, the results of this study do indicate an essential benefit to patients that justifies the investment of time and effort required for an implant-supported reconstruction. Clearly, implant therapy is now an essential module in the therapeutic spectrum for the rehabilitation of tumor patients. Early collaboration with psychotherapists or psychologists should be attempted.²⁵ Jüde's postulate²⁶ for patients with epitheses should also apply for patients with intraoral defects: "All efforts have to be undertaken to reerect the self confidence of these hard hit patients and to re-integrate them into their social environment."

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Literature Abstract

Shear strength of core-veneer interface in bilayered ceramics

This investigation studied the strength of the substructure and veneering porcelain interface in all-ceramic systems. The ceramic systems tested were IPS-Empress2 with Eris (IE), Procera AllCeram with AllCeram (PA), Procera AllZircon with CZR (PZ), and DC-Zircon with Vita D (DC). The manufacturer recommended veneering porcelain for each material be fired to the ceramic core. A metal ceramic (MC) combination was used as a control. Twelve specimens were made for each group from a master die. A 2.4-mm-diameter cylinder of veneering porcelain was applied using a specially designed mold. After firing, the specimens were subjected to shear stress in a universal testing machine. Load was applied until failure occurred. Average shear stress was analyzed with one-way analysis of variance and the Tukey test. Failed specimens were examined at magnification ×20 to classify the failure as cohesive in the core, in the veneer, or at the interface. The results demonstrated that the mean shear strengths (MPa) were the following: MC control = 30.16 ± 5.88 ; IE group = 30.86 ± 6.47 ; PZ group = 28.03 ± 5.03 ; DC group = 27.90 ± 100 4.79; and PA group = 22.40 ± 2.40 . The bond strengths of IE, PZ, and DC were not significantly different from the control MC. Microscopic examination showed that failure mainly occurred near the interface with residual veneering porcelain remaining on the core. IE showed cohesive failure in both the core and the veneer. AllCeram applied to the Procera (PA) alumina core showed significantly lower bond strength when compared to the other systems tested. Because the bonding of veneering porcelain to a ceramic core for the materials tested were similar to that of the metal ceramic control, the authors projected that the clinical behavior may be similar.

Al-Dohan HM, et al. J Prosthet Dent 2004;91:349–356. References: 20. Reprints: Dr Peter Yaman, Department of Cariology, Restorative Sciences and Endodontics, University of Michigan, 1101 N. University Ave, Ann Arbor, MI 48109. e-mail: pyam@umich.edu—Ansgar C. Cheng, Singapore Copyright of International Journal of Prosthodontics is the property of Quintessence Publishing Company Inc. and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.