Clinical Study

Assessment of Quality of Life and Speech after Implant-Retained Oral Rehabilitation in Head and Neck Cancer Patients

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Aim. To assess quality of life and speech after rehabilitation with implant-retained dental prosthesis in head and neck cancer patients. **Material and Methods.** Twenty-six patients who were diagnosed with tumour of the maxilla and mandible were selected for rehabilitation with implant-retained dental prosthesis following resection and reconstructive surgery. They were evaluated for quality of life (EORTC QLQ-C30 and H-N35 questionnaires, version 3), speech, and swallowing (questionnaire and Dr. Speech software, version 4) before implant treatment and at six-, twelve-, and eighteen-month followup. Statistical analysis of quality of life, speech, and swallowing for different duration of their preoperative status was done. Quality of life, speech, and swallowing in grafted and native groups and radiated and nonradiated groups were also compared. **Results.** Quality of life was statistically significant in scale of pain, speech, and trouble with social eating, pain killers, and weight loss. It was insignificant when radiated and nonradiated or grafted and native jaw groups were compared. Improvement in movement of the tongue, swallowing ability, salivation taste, and intelligibility of speech was also observed. **Conclusion.** The surgical treatment of head and neck cancers with microvascular surgery and dental rehabilitation with implants restores function, esthetics, and patient's well-being.

1. Introduction

Improvement in the treatment of head and neck cancer patients has increased the survival rate. The rehabilitation of these survivors to enhance their functions, esthetics, and sense of well being is the primary goal after control of the disease. Osseointegrated implants enable dental rehabilitation in patients treated for tumors of the maxillae and mandibles contributing to quality of life, speech, and swallowing [1–3].

However, oral rehabilitation in this group of patients with compromised oral physiology and biology, following ablative surgery, radiation, and chemotherapy has always been a challenge. All of these have a direct effect on the retention, stability, and support of a dental prosthesis. Reduction and alteration of the saliva following radiation is a deterrent factor for dentition and dental rehabilitation, speech, mastication swallowing, and deglutition [4, 5].

After radical surgery for oral and oropharyngeal cancers it was observed that 63.8% of patients had speech problems and 75.4% had swallowing problems [6]. The evaluation of quality of life and performance outcomes in cancer patients is therefore critical to optimal patient care.

The aim of this study was to assess quality of life, speech, and deglutition after rehabilitation with implant-retained dental prostheses (IRDP). This study was approved by the Hospital Scientific and Ethics Review Committee.

2. Material and Methods

2.1. Patient Data. Twenty-six patients who had completed treatment for head and neck tumors, in need of dental rehabilitation, were considered for IRDP. These patients were disease free and had good general health conditions at a one-year followup.

2.2. Dental Implant Protocol. Eighty-five dental implants were placed in seventeen native jaws and nine free fibular graft reconstructed jaws. In reconstructed patients, defat-tening was done during placement of dental implants (Hi-Tec implants ltd, Galgalei Plada, St. Industrial zone, Herzlia, Israel). To achieve osseointegration, second-stage surgery was performed after three months and six months in non-irradiated and irradiated patients, respectively. Fixed and removable dental prostheses were fabricated.

2.3. Assessment of Quality of Life. Quality of life was assessed by using the quality-of-life core questionnaire EORTC QLQ-C30 (European Organization for Research & Treatment of Cancer) and the head and neck module EORTC QLQ-H & N 35 of the European Organization for the Research and Treatment of Cancer [7]. The core questionnaire consisted of thirty questions: nine items exploring six multiitem functional scales [physical function, role function (ability to carry on with work and leisure activities), social function, emotional function, cognitive function, and general health-related quality of life], three multiitem symptom scales (pain, fatigue, and emesis), and six single items (pain, dyspnea, appetite, sleep disorders, diarrhoea, constipation, and economic sequelae). The maximum score in the functional scales was hundred, which represented maximum function and optimal result. The multiitem symptom scales and the single items had a reversed score. High scores indicated a high level of symptomatology and problems; that is, the best obtainable result in these scales was zero. The head and neck module contained thirty-five items exploring symptoms and side effects of the treatment. It comprised six multiitem scales (pain in the head and neck area, swallowing, nutritional aspects, speech, social function, and body image) and seven single items (coughing, feeling ill, use of nutritional supplements, use of pain killers, use of feeding tubes, weight loss, and weight gain). All scales in this module also had a reversed score, with low levels, indicating good results.

The patients were evaluated with this questionnaire before initiation of implant placement and at six-, twelve-, and, eighteen-month followup after rehabilitation with IRDP.

2.4. Assessment of Swallowing and Speech. Subjective evaluation of articulation, movement, mobility of tongue, salivation, and deglutition based on dietary habits of Indians was done using an indigenous questionnaire designed by Bachher [8].

Objective analysis of speech was assessed with the help of Dr. Speech software version 4 (Tiger DRS, Inc., Seattle) [1]. Dr. Speech software program analyzed the following voice parameters: fundamental frequency (Hz), frequency range (Hz), intensity [(dB)-decibel], maximum phonation time [(MPT) seconds], perturbation parameters such as jitter (pitch perturbation), and shimmer (amplitude perturbation).

2.5. Statistical Analysis. Nonparametric Wilcoxon signed rank test and paired *t*-test were used to compare quality of life scores at six, twelve, and eighteen months after rehabilitation with the IRDP to the preoperative status. The comparisons between grafted and native jaw, radiated and

non radiated group were made using Mann-Whitney *U* test and independent *t*-test as appropriate for non normal and normal data, respectively.

The speech parameters following objective evaluation of speech were statistically analyzed using SPSS (version 14). Paired "*t*" test was used to test the significance preoperatively as well as at different periods (six, twelve, and eighteen months after the implant).

The collected data for subjective evaluation of speech and deglutition was analyzed using Pearson *chi square* test. A *P* value <0.01 was considered to be significant.

3. Results

A total of twenty-six patients were given implant-retained intraoral prostheses. They included seventeen males and nine females with an age range of 13 to 82 years (mean: 46 years). The range of the radiation dose was 20 Gy to 60 Gy. Nine out of twenty-six patients had undergone reconstruction with free fibula graft reconstruction. Out of these, two patients had undergone maxillary reconstruction (one primary and one secondary reconstruction). Seven patients who had mandibular continuity resection were primarily reconstructed. Thirteen patients received implants in native mandible, three patients in native maxilla, and one patient was treated with implants in both the maxilla and mandible. Nine patients were partially edentulous, and seventeen were totally edentulous. A total of sixty-eight implants were inserted.

Histopathology diagnosis was twelve squamous cell carcinoma, three verrucous cell carcinoma, one verrucous hyperplasia, one epidermoid carcinoma, one mucoepidermoid carcinoma, one melanoma, one fibroma, one langerhans cell histiocytosis, one chondroblastic estrogenic sarcoma, one aneurysmal bone cyst, one primary neo-ectodermal tumor, one ameloblastoma, and one undifferentiated carcinoma.

In these twenty-six patients the IRDP fabricated were thirteen complete overdentures, two maxillary obturators, one fixed complete denture, four fixed partial dentures, and three-bar retained dentures.

Three patients (two patients expired after dental implant placement and one after fabrication of obturator) expired due to reasons beyond the scope of this project.

3.1. Quality of Life. The mean was calculated for all the parameters from QLQ-C30 and QLQ-HN35 for practical purposes, and we are showing only the parameter QL from QLQ-C30. The significant *P*-values were obtained for HNPA (*P* = 0.0370), HNRP (*P* = 0.0310), HNSO (*P* = 0.0470), HNPK (*P* = 0.0250), and HNWL (*P* = 0.010). Though the mean for the symptom scale parameters increased from baseline to last follow-up visit, the overall quality of life for all the patients did not show any significant change.

3.2. Grafted versus Native Quality of Life. The table represents the *P*-values calculated with respect to two group of patients that is, IRDP in grafted and native jaws. No significant change was observed from baseline to last follow-up visit. We

TABLE 1: Table showing “P” value for quality of life comparing grafted and native jaws.

	Preimplant	6 months	12 months	18 months
QL	0.106	0.814	0.698	0.505
HNPA	0.074	0.371	0.280	0.517
HNSW	0.008	0.807	0.148	0.725
HNSE	0.051	0.068	0.064	0.079
HNSP	0.033	0.117	0.365	0.891
HNSO	0.024	0.017	0.020	0.318
HNSC	0.939	0.546	0.171	0.495
HNTE	0.250	0.238	0.658	0.746
HNOM	0.186	0.290	0.687	0.824
HNDR	0.914	0.154	0.137	0.505
HNSS	0.485	0.334	0.045	0.205
HNNU	0.173	0.378	0.333	0.877
HNFE	0.740	0.799	0.724	0.877
HNWL	0.376	0.134	0.117	0.591
HNWG	0.770	0.151	0.626	0.877

EORTC QLQ-C30, QL, Global Health Status.

EORTC QLQ-H & N 35, HNPA: pain symptom scale; HNSW: swallowing; HNSE: sense problem; HNSP: speech problem; HNSO: trouble with social eating; HNSC: trouble with social contact; HNTE: teeth; HNOM: opening of mouth; HNDR: dry mouth; HNSS: sticky saliva; HNNU: nutritional supplements; HNFE: feeding tube; HNWL: weight loss; HNWG: weight gain.

TABLE 2: Table showing “P” value for quality of life comparing radiated and non radiated jaws.

	Preimplant	6 months	12 months	18 months
QL	0.580	0.894	0.380	0.919
HNPA	0.240	0.919	0.339	0.578
HNSW	0.625	0.378	0.058	0.140
HNSE	0.232	0.178	0.936	0.315
HNSP	0.069	0.889	0.907	0.945
HNSO	0.822	0.770	0.953	0.750
HNSC	0.274	0.640	0.336	0.539
HNTE	0.242	0.939	0.606	0.925
HNOM	0.720	0.938	0.514	0.552
HNDR	0.329	0.410	0.821	0.098
HNSS	0.519	0.831	0.761	0.101
HNNU	0.173	0.224	0.317	0.352
HNFE	0.303	0.778	0.031	0.352
HNWL	0.023	0.418	0.893	0.591
HNWG	0.526	0.909	0.101	0.877

EORTC QLQ-C30, QL, Global Health Status.

EORTC QLQ-H & N 35, HNPA: pain symptom scale; HNSW: swallowing; HNSE: sense problem; HNSP: speech problem; HNSO: trouble with social eating; HNSC: trouble with social contact; HNTE: teeth; HNOM: opening of mouth; HNDR: dry mouth; HNSS: sticky saliva; HNNU: nutritional supplements; HNFE: feeding tube; HNWL: weight loss; HNWG: weight gain.

conclude that there is no statistical significance observed with respect to quality of life between grafted and native group of patients (Table 1).

3.3. *Radiated versus Non Radiated Quality of Life.* Similarly, no statistical significance was observed with respect to quality of life in radiated and non radiated patients (Table 2).

3.4. *Evaluation of Speech and Deglutition.* No statistical significance was observed with respect to majority of speech and swallowing parameters except for intelligibility of speech and control of salivation. Improvement in intelligibility of speech was statistically significant ($P = 0.096$) at a twelve-month followup; however, no significant change was observed thereafter. Also, due to better tongue mobility and movement, control of saliva improved significantly ($P = 0.066$) at eighteen-month followup. This controlled saliva resulted in better speech intelligibility. Rehabilitation with IRDP also improved speech articulation, thereby resulting in lesser class of errors and better understandable speech (Table 3).

Subjectively, it was observed that with IRDP, patients' swallowing ability was improved. Intake of soft diet was possible in lesser time duration (Table 4).

4. Discussion

Restoration of function and esthetic are the ultimate goals of rehabilitation in IRDP in head and neck cancer patient. Patients who undergo ablative surgery for head and neck cancers are unable to use conventional prosthesis due to an unfavorable environment for tissue-borne prosthesis. Dental implants have proven to be reliable means for dental rehabilitation in patients with sequelae of tumor surgery. Free fibula graft reconstruction due to its reliable anatomy, its low morbidity, and its ability to mobilize the flap at the same time as the ablative procedure, has become a routine procedure.

In this study primary insertion of implant during reconstruction was done in only one patient. In all the other eight patients, implant insertion was done secondary to reconstruction. We preferred secondary placement of implant as it helps in the case selection, and the results of reconstruction are known. Clinical assessment of maxillary and mandibular bone alignment is apparent. Judgment of interocclusal space following defatting of the graft can be done. In case of patients who receive radiation, tissue response and healing can be taken into consideration before case selection. Though secondary placement of implant delays the treatment, it is preferable to be critically selective as the treatment is expensive, with a number of factors contributing to the success of osseointegration, functional loading, and finally to quality of life with speech and swallowing.

4.1. *Quality of Life.* The quality of life was statistically significant in the scales of pain, speech, and trouble with social eating, pain killer, and weight loss. Clinical assessment of the patients in view of resection, reconstruction, esthetics, and function was better with IRDP but could not reach the level of function and esthetics of normal subjects.

The implant patients were more comfortable clinically and had a better appearance due to improved cheek and lip support as compared to patients who did not undergo reconstruction and rehabilitation. The discrepancy in the

TABLE 3: Table showing “P” values for speech parameters at six-, twelve-, and eighteen-month followup.

	6 months	12 months	18 months
Intelligibility	0.518	0.096	0.288
Class of errors	0.674	0.811	0.136
Movement	0.739	0.317	1
Swallowing ability	0.102	0.317	0.18
Salivation	0.577	0.157	0.066
Taste	0.783	0.705	0.655
Daily activity	0.705	0.157	1
Weight	0.102	0.414	0.317
Jitter	0.54	0.624	0.838
Mobility	1	0.303	0.823
Max.Fo [‡]	0.095	0.574	0.38
Min.Fo [€]	0.462	0.17	0.854
Ave.Fo ^π	0.144	0.983	0.873
Min.Int [‡]	1	1	1
Max.Int [*]	0.571	0.517	0.644
Ave.Int ^ψ	0.185	0.104	0.221
Shimmer	0.597	0.618	0.432
Mpt [£]	0.711	0.483	0.766

[‡]Maximum fundamental frequency, [€]minimum fundamental frequency, ^πaverage fundamental frequency, ^{*}maximum intensity, ^ψaverage intensity, [‡]minimum intensity, [£]maximum phonation time.

TABLE 4: Table showing “P” values for deglutition items as per questionnaire [8] at six-, twelve-, and eighteen-month followup.

	6 months	12 months	18 months
d1	0.083	1	0.564
d2	0.317	0.059	1
d3	1	1	0.157
d4	1	0.317	0.564
d5	0.317	1	1
d6	0.18	0.206	0.564
d7	0.317	0.157	1
d8	0.18	0.257	0.564
d9	0.18	0.257	0.564
d10	1	0.317	1
d11	0.317	0.317	0.564
d12	0.739	0.025	0.18
d13	1	1	0.157
d14	0.317	0.046	0.083

quality of life questionnaire is partly due to the patient’s tendency to compare postoperative function to the predisease normal condition.

As reported by Schliephake and Jamil, jaw resection is the most relevant parameter in postsurgery quality of life deterioration assessment. Jaw reconstruction neither contributes to a significant quality of life increase nor means an improvement in mastication as several soft parts of the jaw that coordinate the complex process of mastication will be missing [9]. The beneficial effects of implant-retained dental

rehabilitation therefore favor cosmetic aspects rather than function [10]. Even if masticatory function is restored in head and neck cancer patients, they do not reach the same functional levels as a healthy corresponding control group [11].

Free flap reconstruction and implant placement is worthwhile, but only a small percentage (25%) of patients benefits from complete rehabilitation [10].

As stated by Schliephake et al. [12, 13], good function and improved quality of life for the patients do not necessarily follow restoration of the continuity of the mandible with vascular bone graft even after achieving biomechanical characteristics close to those of native mandibles. There are a number of obstacles to dental rehabilitation of patients after segmental resection and reconstruction of their jaws. These obstacles usually include few (or no) residual teeth, poor condition of existing teeth, lack of both buccal and lingual sulci, and lack of neoalveolar processes, unless special surgical attempts have been undertaken [14–16]. The patients frequently suffer from fragile mucous membranes in the oral cavity and oropharynx and xerostomia as a result of the radiation treatment. Such sensitive soft tissues make dental rehabilitation even more complicated.

Dental rehabilitation enables patients to bite and chew, as well as improve cheek and lip support and give a better appearance. In this study there is a contributing factor of resection of the disease tissue to treat the underlying pathology. Insertion of prosthesis along with altered anatomy and physiology following radiation definitely affected the intraoral comfort affecting the quality of life of patients.

4.2. Speech and Deglutition. On subjective and objective evaluations of speech and deglutition, improvement in movement of the tongue, swallowing ability, salivation taste, and intelligibility of speech was observed. This resulted in improved mastication, swallowing, and speech articulation as compared to patients who did not undergo reconstruction and rehabilitation.

Speaking abilities have been shown to be the single most important contributor to health-related QL after treatment of head and neck cancers [17]. A recent systemic review suggests that the deviant speech characteristics, for example, abnormal articulations and impaired swallowing efficiency, were reported for the majority of surgically treated patients with an advanced stage of cancer [18]. Surgical resection can also have adverse effects on the articulation of labial sounds and speech resonance, but these cases are not often reported in the literature [19]. Patients with oral cancers are associated with pain, loss of taste, trismus, and problems with mastication and oral phase of deglutition [20]. Some patients also experience difficulties related to labial incompetence, facial paresis, and oronasal separation [19, 21], which can affect the ability to keep food in the mouth during mastication and impede food transit to the pharynx.

In the present study, changes in the oral anatomy following cancer surgery patients lead to altered speech intelligibility. Tongue movements were inaccurate with reduced mobility. Rehabilitation with IRDP helped in improving speech

articulation as tongue approximation to other articulators, namely, teeth and palate, was improved. Improved tongue mobility in turn helped in improving the oral phase of swallowing.

4.3. Limitations. Patient's noncompliance and hence failure to turn up for followup at regular six months interval is one of the limitations of the study which affected the statistical results. The second limitation of the study is the heterogeneity of the prosthetic treatment, treating patients with prostheses for completely edentulous versus partially edentulous jaws. This too contributed to the varied response and difficulty in ascertaining the outcomes in the patients and quality of life. Partially edentulous patients will have better mastication, speech, swallowing, and esthetics as compared to totally edentulous patients. The third limitation of this study is that the subjects were from two different groups of anatomical status of the jaw, that is, grafted and native. The fourth limitation is the small sample size which was necessary due to the need for careful selection of patients, the high cost of the implants, and the prognosis of the disease.

5. Conclusion

Although the masticatory forces could not be restored to levels of comparable age and dental status in normal individuals, they were improved as compared to patients who underwent reconstruction of jaws but not rehabilitated with implant-retained dentures. However, the average global quality of life scores remained fairly unchanged eighteen months after IRDP.

Better speech intelligibility, articulation, and prosody were observed. Also improvement in deglutition was noticed due to improved movement of the tongue. There was better perception of taste and reduction of xerostomia. These factors lead to better intake of diet. Improvement in tongue movement also contributed to better quality of speech though statistical analyses of the speech parameters were insignificant. On an average, patients in the grafted group had reduced quality of life scores in comparison to the native group. Further the outcomes of the dentally rehabilitated patients should have been compared with similar patients who had no dental rehabilitation.

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