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Impact of radiotherapy on implant-based prosthetic rehabilitation in patients with head and neck cancer: A prospective observational study on implant survival and quality of life—Preliminary results

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ABSTRACT

Purpose: To study implant-based prosthetic rehabilitation of head and neck cancer patients with focus on implant survival and quality of life.
Materials and methods: The prospective observational study presents preliminary results of 29 edentulous head neck cancer patients (20 patients after radiotherapy) with 165 OsseoSpeed implants. Implant success after 1-year follow-up was evaluated by means of the Albrektsson criteria. Quality of life was analysed with the EORTC QLQ-C30, QLQ-H&N35, and OHIP 14 questionnaires.
Results: The overall implant survival rate after 1 year was 95.2% (157/165). Implant success measured by the Albrektsson criteria showed a lower success rate of 86.7% (143/165), mainly because of peri-implant marginal bone loss with a mean of 0.8 mm after 1 year. Xerostomia ($p = 0.008$), implant insertion within the radiation target volume ($p = 0.09$), implantation in transplanted bone ($p = 0.05$), and smoking ($p = 0.041$) were the main reasons for implant failure, followed by D4 bone quality, maxillary implant site, and insufficient primary stability. Speaking, swallowing, eating, as well as social integration and individual self-confidence had considerably improved 1 year after denture placement compared to before treatment.
Conclusion: Implant-based prosthetic rehabilitation of head and neck cancer patients is possible at a calculable risk and significantly improves patients' quality of life.

1. Introduction

Patients with head and neck cancer are commonly treated with ablative surgery, which often results in soft and hard tissue defects as well as in the development of functional disabilities and aesthetic deformities. In many patients, radiotherapy leads to adverse effects such as sensitive mucosa, xerostomia, and bone

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healing problems. Dental rehabilitation with conventional prostheses may be impeded by the changed oral anatomy in such patients and the adverse effects of radiotherapy. In these patients, prosthetic rehabilitation with dental implants is potentially more effective with regard to mastication, aesthetics, and speech function than other treatment modalities. So far, data on implant survival in patients undergoing dental rehabilitation after ablative surgery for head and neck cancer have been controversial. Most data originate from retrospective studies that often use different criteria and methods for evaluating implant survival (Watzinger et al., 1996; Niimi et al., 1998; Grotz et al., 1999; Schliephake et al., 1999; Werkmeister et al., 1999; Granstrom, 2005; Shaw et al., 2005; Yerit et al., 2006; Nelson et al., 2007). The extent to which radiotherapy affects implant survival is not yet known (Schliephake et al., 1999; Weischer and Mohr, 1999; Werkmeister et al., 1999; Visch et al., 2002; Granstrom, 2005; Shaw et al., 2005; Yerit et al., 2006; Nelson et al., 2007; Schiegnitz et al., 2014). Functional impairments due to head and neck cancer treatment have the most significant negative impact on patients' quality of life (Rogers et al., 1999; Chandu et al., 2006; Tang et al., 2008). However, little information is available if prosthetic rehabilitation helps these patients to improve their quality of life (Cawood and Stoelinga, 2006; Schoen et al., 2007).

The current work presents the preliminary results of a prospective observational clinical study to analyse the impact of radiotherapy on implant survival in patients with head and neck cancer who underwent oral prosthetic rehabilitation with OsseoSpeed implants (ASTRA TECH Implant System). Additionally, the impact of the treatment on patients' quality of life was evaluated.

2. Material and methods

2.1. Patients and treatment

Between November 2009 and May 2014, patients were consecutively screened for study inclusion at the Departments of Oral and Maxillofacial Surgery and Prosthodontics. The study was approved by the local ethics committee (Ref. No. 09/049). Inclusion criteria were post-surgical treatment or curative primary radio(-chemo)therapy due to primary carcinoma of the oral cavity, nasopharynx, oropharynx, or laryngopharynx with status of a good prognosis following tumour resection (R0-resection) or curative primary radio(chemo)therapy; recurrence-free interval of at least 1 year after tumour surgery or curative primary radio(chemo)therapy; absence of recurrence signs; prosthetic necessity of implant-based rehabilitation of an edentulous mandible or maxilla because of expected stability and retention problems of conventional dentures after oncological (ablative surgery, radiotherapy) treatment; request for prosthetic rehabilitation; and acceptable oral hygiene. Exclusion criteria were poor prognosis (R1- or R2-resection, distant metastases); systematically compromised health; signs of recurrence; insufficient oral hygiene; noncompliance; and pregnancy.

The study investigated the OsseoSpeed implants (ASTRA TECH Implant System, DENTSPLY IMPLANTS, Mölndal, Sweden). For better comparison, implants were placed only in edentulous maxillae and mandibles. All patients received antibiotics (amoxicillin or cefuroxime) perioperatively. Irradiated patients stayed in the hospital and received nasogastral feeding tubes for 7–10 days. Depending on the number of implants, surgery consisted of a 2-stage procedure under local or general anaesthesia. In the maxilla, 4 to 6 implants were inserted, if necessary with internal or external sinus floor elevation. In the mandible, 4 implants were inserted in the interforaminal region. All implants were covered by surrounding mucosa for submerged healing for 4–6 months (mean 20.8 weeks, range 12.7–24.7 weeks), depending on the irradiation dose after which uncovering and abutment connection took place. Individual bar-retained or single-tooth-attached (telescopic crown or locator-retained) overdentures were fabricated for the prosthetic suprastructures.

2.2. Clinical and radiographic assessments

The intraoral situation of the patients was documented by photographs and by clinical and radiographic examination before (UI) and immediately after (UII) implant insertion as well as 6 weeks (UVI), 6 months (UVII), 12 months (UVIII), and 24 months (UIX) after denture placement. Clinically, fixed gingiva, plaque index (Loe, 1997), bleeding index (Loe, 1997), probing depth, and implant mobility were measured. Radiologically, the marginal bone status was evaluated by single-tooth periapical radiographs if possible. In most patients, however, anatomic limitations necessitated the use of panoramic radiographs, which were calibrated by using the known width of the coronal cylinders of the implants. Marginal bone loss was measured by means of the distance from the implant shoulder to the marginal bone level mesially and distally.

2.3. Outcome variables

Primary outcome variables were survival and success of dental implant-based prosthetic rehabilitation, and patients' quality of life.

2.4. Implant success

Implant success was assessed using the Albrektsson criteria (Albrektsson et al., 1986) modified according to Buser et al. (1990) and Weibrich et al. (2001) as follows: loaded in situ implant; absence of persistent pain; no lesion of nerve; absence of peri-implant infection with suppuration (probing depth of more than 4 mm was considered comparable to infection); absence of mobility; absence of continuous peri-implant radiolucency; and absence of peri-implant bone resorption of more than 1.5 mm in the first year of function and of more than 0.2 mm during the subsequent years measured by radiographic investigation. Implants were rated as fully successful if all criteria were met and as failure if one or more criteria were not met.

Additionally, we evaluated the following variables with a possible impact on implant success: bone quality (D1–D4) as described by Lekholm and Zarb (1985) and dimension of the implant bed; native jaw bone or autogenous bone graft (free vascularised or nonvascularised); peri-implant tissue (local gingiva or flap tissue); relation of the implant bed to the planning target volume of irradiation (Fig. 1); period between the end of radiotherapy and dental implantation; site of implantation (maxilla or mandible); implant characteristics (length and diameter); healing time; type of prosthetic suprastructure (bar-retained or single-tooth attached) and patient characteristics (gender, age, oral hygiene, xerostomia, nicotine, alcohol, side diseases, and medication). Xerostomia was diagnosed in the case of an unstimulated salivary flow rate of less than 0.2 ml/min and a stimulated flow rate of less than 0.7 ml/min (Hopcraft and Tan, 2010).

2.5. Quality of life

Quality of life was assessed with the core questionnaire EORTC QLQ-C30 and the head and neck module EORTC H&N35 of the European Organisation for Research and Treatment of Cancer. The core questionnaire consists of 30 items aggregated into 6 functional