



## Response of head and neck radiotherapy in patients with dental implants

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### 1. Introduction

Radiotherapy (RT) plays an important role in the treatment of the patients with head and neck cancer. Clinical changes in the surrounding healthy tissue have often been unavoidable. Deleterious effects on bone and mucosae of the mouth have been considered a contraindication for rehabilitation with dental implants. Nevertheless, over the past few years, the installation of implants in irradiated patients has established itself as a valuable treatment option, holding variable success. The aim of the present study was to evaluate the effect of RT on the survival of osseointegrated dental implants in patients with head and neck cancer.

### 2. Methodology

The electronic search was performed on August 16, 2021, in the MEDLINE database to retrieve articles published during the last five years. The key words used were "radiotherapy", "dental implants" and "head and neck cancer" using the following combinations: ("radiotherapy" [MeSH term] OR "radiotherapy" [All Fields] OR "radiotherapy" [ All Fields] OR "radiotherapy" [MeSH subtitle] OR "radiotherapy" [All Fields] AND ("dental implants" [MeSH Terms] OR ("dental" [All Fields] AND "implants" [All Fields] OR "dental implants" [All Fields]) AND ("neoplasms of head and neck"[ MeSH term] OR ("head" [All Fields] AND "neck" [All Fields] AND "neoplasms [All Fields] Fields)) OR "head and neck neoplasms" [All fields] OR ("head" [All Fields] AND "neck" [All Fields] AND "cancer" [All fields]) OR "head cancer and neck" [All fields])). To track the review, the following question was structured: is there a change in the survival rate of implants installed in patients undergoing head and neck RT? Search strategies retrieved a total of 67 articles, among which, after reading the titles and abstracts, a sample of 14 articles was analyzed in full. The following inclusion criteria were used: (1) studies in individuals with head and neck cancer who underwent rehabilitation with dental implants who underwent RT as a test group and individuals not treated with RT as a control group; (2) studies with a minimum follow-up period of 12 months. After reading in full, a final sample of four articles was obtained. In each of the included studies, the following data were extracted and arranged in a comparative way: (1) author and year of publication; (2) number, age and gender of the patient; (3) location and number of implants installed; (4) type of prosthetic rehabilitation; (5) type of tumor; (6) technique and radiation dose used; (7) follow-up time and implant survival rate.

### 3. Results and Discussion

Ernst et al., 2016, [1] developed a retrospective study in patients treated at the Department of Maxillofacial at Charité, Berlin. The goal was to evaluate changes in the marginal bone level of dental implants in irradiated and nonirradiated patients after tumor resection in the mandible, and to identify possible influencing factors that could impair the osseointegration of dental implants. In all cases, the implants were installed six months after completion of RT. Statistical analysis showed no significant difference between bone level changes and age, or and gender, or augmentation procedure. However, there was a correlation between crest bone loss and RT ( $p < 0.001$ ). The mean amount of bone alteration after three years was twice as high in irradiated patients than in nonirradiated patients. Due to the location of the tumor, the maxillary bone was not directly included in the field of radiation; however, analyses of periimplant bone loss showed a significant difference in the alteration of the level crestal maxillary bone, with bone loss being greater in irradiated patients than in nonirradiated patients. Due to these observations, the authors assume that factors such as xerostomia and progressive fibrosis also play a decisive role in bone losses, in addition to the dosimetric distribution at the implant site.

Patel et al., 2020, [2] evaluated data collected from cancer patients in the United Kingdom on the survival of implants in irradiated and non-irradiated sites. In this study, 70% of the implants were installed after primary tumor resection, a factor that increases the time from diagnosis to implant placement. In this study, it was not possible to statistically determine whether the placement time in relation to surgery influenced the survival of the implants. These authors suggest that there is a growing trend of implant placement during primary resection, significantly reducing the time for oral rehabilitation in this patient population, while considering that this management increasing complications that prevent restoration through implants, such as obtaining well-placed implants and risk of implant failure associated with backscattering during RT. Radiotherapy, placement of the implant in the maxilla, placement of the implant in the graft negatively influenced the survival of the implants, but were not significant results ( $p > 0.005$ ).

Albrega et al., 2020, [3] evaluated the performance of dental implants placed in two situations: immediately after extraction of teeth in the mandible during tumor ablative surgery or preceding to primary RT. The authors used the following clinical periodontal parameters as analysis methods: plaque index, bleeding index, gingiva index and probing pocket depth; there was no significant difference between irradiated and nonirradiated patients, except for the bleeding index which was higher in the nonirradiated group ( $p = 0.004$ ). Radiographic analysis revealed greater bone loss around the implants in the irradiated group, but there was no statistical difference ( $p = 0.17$ ). The authors showed that RT had a negative effect on implant survival, as all implant losses occurred in irradiated patients, but due to the small sample size no conclusions can be confident about the survival rate of the implants; a factor that may have influenced the loss of these implants was that the osseointegration process was not complete when RT was started. Oral function and patient satisfaction were also assessed using questionnaires when the prosthesis had been in function for a minimum period of six months, the results showed reasonably satisfied patients, and there was no significant difference between the irradiated and non-irradiated groups. The study concluded that placing implants in mandible when removing remaining teeth and preceding head and neck cancer treatment is a favorable option considering the potential benefits such as reduced rehabilitation time and fewer surgical procedures and increased quality of life. The study was conducted at the head and neck center of the University Medical Center Groningen, Netherlands, between 2014 and 2017.

Pierallu et al., 2021, [4] evaluated in a retrospective study the clinical outcome and those reported on implant-supported rehabilitations in a group of patients who received two therapeutic modalities for head and neck cancer: surgical tumor resection (TR) or TR associated with RT, compared to a healthy control group (C). All treatments were performed at the Department of Bucomaxillofacial Surgery of Charité, Berlin. The authors concluded that irradiated and nonirradiated patients presented similar survival rates at the implant and prosthesis level. A possible explanation is given by special care with minimally invasive surgical procedures in nonsmokers, soft tissue management and strict maintenance of oral hygiene.

Table I: Characteristics of the studies included on the analysis.

Author/ Year of publ.	Number of patients/ age	Number de implants	Type of prosthetic rehabilitati on	Tumor type	Tec. / RT dose	Follow-up / SR
Ernst et al., 2016 [1]	7 women and 29 men.  from 39 to 90 years old	194 (73 in the maxilla e 121 in the mandible)	prosthesis bar- retained  locators  fixed bridge	squamous cell carcinoma	IMRT  55 a 72 Gy fractions over 6 weeks	average follow- up: 52,92 months (24 a 117 months)  SR=98,4%
Patel et al., 2020 [2]	55 women and 45 men  from 18 to 91 years old	376	31% overdenture	squamous cell carcinoma (n=55)	average dose of 61 Gy	average follow- up 3,91 (0,11- 12,76 years)  SR=97%
Albrega et al., 2020 [3]	14 women and 15 men  from 31 to 81 years old	58	overdenture bar-clip	HNC	IMRT  postoperative RT (46-70 Gy implant site)  primary RT (27-40 Gy implant site)	SR=93,1%
Pierallu et al., 2021 [4]	28 women and 29 men  from 39 to 91 years old	322 (198 in the mandible and 124 in the maxilla)	overdenture bar-clip  fixed bridge	squamous cell carcinoma (n=34)	IMRT (n=9) VMART (n=4) 2D-RT (n=3) 3D-RT (n=6)  2 Gy fraction for 30 days	average follow- up 81,2 ± 50,3 months. SR= 98,1% (HNC-TR); 98,2% (HNC- TR/RT); 100% (C)

Abbreviations: 2D-RT: conventional radiotherapy, 3D-RT: three-dimensional conformal radiotherapy, C: control group, HNC-TR: head and neck cancer treated with tumor resection, HNC-TR / RT: head and neck cancer treated with resection tumor and adjuvant radiotherapy, IMRT: radiotherapy with modulation of beam intensity, RT: radiotherapy, SR: survival rate.

#### 4. Conclusions

Dental implants installed in the irradiated area have high survival rate, if strict clinical and dose monitoring is instituted as a treatment protocol. Since the late RT effects can be present years after treatment, prognostic studies and controlled clinical trials in humans with long follow-up periods shall be required to confirm potential clinical changes and limitations on implant installations and response.

## References

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