Evidence of dental screening for oral foci of infection in oncology patients
Schuurhuis, Jennifer Marleen

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Patients with periodontal disease before intensity modulated radiation therapy are prone to develop bone healing problems: a 2-year prospective follow-up study

JM Schuurhuis, MA Stokman, MJH Witjes, H Reintsema, JA Langendijk, A Vissink, FKL Spijkervet
Abstract

Background and Purpose: Intensity modulated radiation therapy (IMRT) has changed radiation treatment of head and neck cancer (HNC). However, it is still unclear if and how IMRT changes oral morbidity outcomes. In this prospective study we assessed the efficacy of reducing post-radiotherapy sequelae of IMRT by means of pre-radiation dental screening and eliminating oral foci of infection.

Materials and Methods: All consecutive dentate patients >18 years, diagnosed with primary oral or oropharyngeal carcinoma, referred for pre-treatment dental screening between May 2011 and May 2013, were included and followed for 2 years. Patients were treated with IMRT or IMRT with chemotherapy (CHIMRT). Dental screening data, demographic data and data on oral sequelae during follow-up were recorded.

Results: Oral foci of infection were found in 44/56 (79%) patients, consisting predominantly of periodontal breakdown. Bone healing problems after radiotherapy occurred more often in patients with periodontal pockets ≥6 mm at baseline (p<0.05). Osteoradionecrosis developed in 4/56 patients (7%) during follow-up.

Conclusions: Patients with periodontal disease before IMRT/CHIMRT are prone to develop bone healing problems during post-radiotherapy follow-up.

Introduction

HNC patients treated by radiotherapy are at risk of developing severe oral sequelae for their remaining lifespan. Periodontal disease, radiation-induced xerostomia and radiation-related caries may require dental extractions and consequently result in an increased risk of developing osteoradionecrosis (ORN) of the jaw [1-3]. ORN is radiation-induced destruction of the bone. It is difficult to treat, is not self-limiting, and may require extensive invasive surgery and/or adjuvant treatment with hyperbaric oxygen. Hypovascularity and hypocellularity of irradiated bone and soft tissues are considered the predominant underlying pathophysiologic mechanisms, which have low reparative ability [4,5]. The majority of ORN cases develop within 3 years after radiotherapy [6].

Risk factors for developing ORN include post-irradiation extractions [1], periodontal loss/periodontitis [2], oral surgical interventions [7] and dental status [8]. To prevent such oral morbidity after radiotherapy, in particular ORN, pre-radiation dental screening is commonly performed to locate and eliminate oral foci of infection, although the efficacy of these interventions is unclear [3]. An oral focus is defined as a pathologic process in the oral cavity that does not cause major problems in healthy individuals, but may lead to severe local or systemic inflammation under certain circumstances [1,9].

During the last decade, treatment of HNC has changed substantially, particularly due to the introduction of intensity modulated radiation therapy (IMRT) and concomitant chemoradiation [10]. The effects of IMRT on the oral tissues and jaw bone in particular are not yet clearly understood. IMRT results in less xerostomia due to sparing of the parotid and/or submandibular glands [11]. However, dose redistribution resulting from salivary gland sparing may lead to higher doses to the other tissues in the radiation field, in particular to the mucosa of the oral cavity, which can result in “beam path toxicities” [12]. These potentially higher doses to jaw bone and oral cavity entail a higher risk of developing ORN during post-radiotherapy follow-up [5]. However, current pre-radiation dental screening protocols are based on conventional radiotherapy and require an update to take account of the effects of IMRT. We therefore conducted a prospective 2-year follow-up cohort study to assess the efficacy of pre-radiation dental screening and elimination of oral foci of infection in HNC patients treated with IMRT. Results were compared to those of a historical control group treated with conventional radiotherapy [2].

Methods

Patients
All consecutive dentate or partially dentate patients >18 years, diagnosed with primary oral or oropharyngeal squamous cell carcinoma, who were referred to the University Medical Center Groningen (UMCG), the Netherlands, for pre-treatment
dental screening between May 2011 and May 2013 were included in this study if definitive radiotherapy to the head and neck region was part of the treatment plan. Patients who had undergone previous oncologic treatment (surgery and/or radiotherapy and/or chemotherapy) to the head and neck region were excluded as well as patients with unknown primary or parotid gland tumors. A standardized follow-up of 2 years post-oncologic treatment related to oral and dental morbidity was completed (JMS). Written informed consent was obtained from all patients. The medical ethical committee of the UMCG approved the study protocol (METC 2012/091).

Dental screening

All patients were evaluated before their oncologic treatment as part of routine clinical practice by means of oral and dental screening, including radiographic examination [13]. Plaque and bleeding scores were assessed as a percentage of the total number of sites with plaque respectively bleeding on probing. To quantify periodontal disease, the periodontal inflamed surface area (PISA) was used [14]. Patients were asked about their smoking and drinking habits. Self-reported smoking options were ‘current smoker’, ‘past smoker’, or ‘never smoked’ and self-reported alcohol consumption options were ‘never drink alcohol’ or ‘drink alcohol’.

All data obtained at baseline and follow-up visits (Table 1) were collected in pre-determined order and recorded using a standardized study form designed for this study.

IMRT

All included patients were subjected to definitive primary or postoperative IMRT or definitive primary or postoperative chemoradiation (CHIMRT). IMRT was given according to standard protocol as previously described [2]. Chemotherapy was given concurrently with fractionated IMRT and consisted of Carboplatin on day 1 (300–350 mg/m² in 30 min intravenously) and 5-fluourouracil (5-FU) from day 1 to 4 by continuous infusion (600 mg/m²/24 h), consisting of 3 courses given with an interval of 3 weeks. Postoperative chemotherapy consisted of 6×50 mg Cisplatin weekly. When chemotherapy was considered to be infeasible, patients were treated with cetuximab using a loading dose of 400 mg/m² one week prior to radiotherapy and a weekly dose of 250 mg/m² during radiotherapy.

Treatment of oral foci of infection

Before onset of IMRT or CHIMRT, oral foci of infection were eliminated (Table 2), if teeth related to the foci were within the radiation field or likely to be within the radiation field receiving a cumulative dose >40Gy. An oral focus of infection was defined as [3]:

- deep caries in which excavation may lead to pulpal exposure;
- active periodontal disease with pockets ≥6mm, furcation ≥grade 1, mobility >grade 1, gingival recession ≥6mm and especially a combination of these periodontal problems;
- non-restorable teeth with large restorations, especially those extending beyond the gum line or with root caries, or those with severe erosion or abrasion;
- periapical granuloma and avital teeth;
- impacted, partially impacted or partially erupted teeth not fully covered by bone or showing radiolucency;
- cysts and other radiographic abnormalities.

Dental pathology not defined as an oral focus of infection was treated according to professional standards. Before the onset of IMRT or CHIMRT, patients were seen by a dental hygienist for dental prophylaxis and oral hygiene instructions.

Oral care during radiotherapy

During IMRT and CHIMRT, patients were seen daily (Monday to Friday) by a dental hygienist for spraying the oral cavity with saline according to standard protocol [15]. Instructions were given to continue normal daily oral care (tooth brushing and/or interdental cleaning) as long as possible, and to rinse the mouth with salt-baking soda solution at home, 8-10 times per day [13]. Dentate IMRT and CHIMRT patients received custom-made fluoride trays and were prescribed a neutral 1% sodium fluoride gel to be used every second day [13,16,17].

Follow-up

Regular oncology follow-up visits to the OMS, dental hygienist and/or hospital dentist were combined with visits to the researcher (JMS) to collect study data (Table 1). Dental follow-up by the dental hygienist and hospital dentist is standard for IMRT and CHIMRT patients every 3-6 months, depending on the patient’s needs, during at least 5 years after treatment. Oral sequelae during follow-up were recorded, including caries, periodontal disease, restorative problems, bone healing problems and ORN. According to the prevailing definition, ORN is an area of exposed devitalized irradiated bone that fails to heal over a period of 3 months in the absence of local neoplastic disease [4,18-20]. If oral sequelae occurred during follow-up, and an irradiated patient needed treatment, radiation fields were always verified with the department of Radiation Oncology. Antibiotic prophylaxis was given in case of surgical intervention and, if the dose in the specific region where treatment was needed was >400Gy, hyperbaric oxygen therapy was considered depending on patient factors, such as smoking, general health and complexity of the removal of the affected teeth. If oral sequelae occurred during follow-up and if they were within the radiation field (≥40Gy), all efforts were made to prevent tooth extraction. All data (dental screening and follow-up visits) were recorded using the standardized study form. Dental hygienists were instructed by the researcher on how to use the study form.

Statistical analysis

Data were analyzed using IBM SPSS Statistics 22.0 for Windows. Values of p<0.05
were considered significant. Testing for significance was done using Chi-square tests for binary data (developing ORN, having bone healing problems) and Kruskal-Wallis tests for quantitative data (PISA scores). The Wilcoxon signed rank test was used for comparing baseline PISA scores with follow-up data.

## Results

### Demographics

Between May 2011 and May 2013, 56 patients met the inclusion criteria (Fig. 1). Follow-up ranged from 11 to 24 months, with a median of 24 months (Fig. 2). Demographics, clinical characteristics and baseline dental data of all patients are summarized in Table 3.

After dental screening and pre-radiation treatment of oral foci, 5 patients needed a full mouth clearance (Fig. 1). The results on oral sequelae during follow-up are therefore based on the 51 remaining dentate patients. The results on dental screening and bone healing problems are based on the original 56 patients.

### Dental screening and treatment of oral foci of infection

Out of 56 patients, 44 (79%) had 1 or more oral foci at dental screening (Fig. 3). The periodontal condition at baseline was healthy (no pockets) in 3 patients, pockets of 4-5mm in 25 patients and pockets $\geq 6$ mm in 28 patients. This means that 53 out of 56 patients (95%) had periodontal disease to some extent at baseline.

Pre-radiotherapy dental extractions were needed in 44 patients, including full mouth clearance in 5 patients (11%). A median of 7 teeth were extracted per patient (IQR [2-10]). One patient had a dental cyst (premolar region mandible) that was surgically removed. After focus elimination, the periodontal condition of the 51 dentate patients was healthy in 3 patients, while 48 patients had pockets of 4-5 mm.
Oral foci of infection at dental screening in 56 patients

Figure 3. Oral foci of infection were found in 44 out of 56 patients. Since patients were occasionally diagnosed with more than one oral focus, the sum of the numbers exceeds 44. Patients had 1 to 6 oral foci with a mean of 2.3 foci per patient (SD=1.1).

Oral sequelae during follow-up

Oral hygiene and fluoride prophylaxis
All 51 dentate patients were instructed to brush their teeth daily and to use fluoride gel every other day during follow-up, occasionally with the exception of a short period during or after radiation related to radiotherapy-related sensitivity of the gums or oral mucosa.

Comparing baseline and 2 years of follow-up, plaque and bleeding scores decreased significantly. Plaque scores were reduced from a median of 50% to 30% (p=0.016) and bleeding scores from 30% to 10% (p=0.027).

Post-radiotherapy periodontal health
Post-radiotherapy, 12 out of 51 dentate patients (24%) had progression of periodontal pocket depth (4-5mm pockets deepened) and/or development of new periodontal pockets (4mm or deeper measured on a site that was ≤3mm before) (24%). Eight out of these 12 patients had teeth removed after dental screening before radiation because of pockets ≥6mm, and all of them had remaining pockets of 4-5mm (not considered as oral foci) before the onset of radiotherapy.

PISA scores decreased significantly during follow-up when baseline PISA scores (Table 3) were compared with PISA scores at 6 months (median 225; IQR[139-08]; p=0.006) and 2 years after IMRT (median 149; IQR[77-357]; p=0.003). This was probably due to the elimination of oral foci of infection and improved oral hygiene.

Post-radiotherapy tooth extractions
Six patients (12%) needed one to three post-radiotherapy tooth extractions because of caries profunda (n=4) or periodontal disease (n=2).

Post-radiotherapy dental caries
Out of 51 dentate patients, 13 (25%) developed 1 or more carious lesions.

Post-radiotherapy periapical pathosis
Out of 51 patients, 3 patients (6%) developed caries profunda with periapical pathosis during follow-up, discovered on radiographs or from symptoms. Endodontic treatment or tooth extraction was performed.

Post-radiotherapy bone healing problems and ORN
Bone healing problems were observed in 11 out of 56 patients (20%): 6 patients were diagnosed with delayed wound healing after pre-radiotherapy (n=5) or post-radiotherapy (n=1) tooth extraction, 1 with lingual mandibular sequestration (unrelated to tooth extraction) and 4 with ORN (more details below). Of these 11 patients, 1 patient developed bone healing problems after pre-radiotherapy full mouth clearance. The other 10 patients had teeth left after elimination of oral foci and during the 2 years of follow-up.
Of the 28 patients with baseline periodontal pockets ≥6 mm, 6 developed bone healing problems, not yet diagnosed as ORN, during follow-up (21%). An increased risk of bone healing problems was found in patients with periodontal pockets ≥6 mm at baseline compared to patients with pockets <6mm at baseline (p=0.043).

Of the 28 patients with periodontal pockets ≥6 mm at baseline, 2 developed ORN (7%). No increased risk for developing ORN was found in patients with periodontal pockets ≥6 mm at baseline compared to patients with pockets <6mm at baseline (p=1.000).

None of the 3 patients without periodontal pockets at baseline developed bone healing problems or ORN during 2-year follow-up.

Grade I ORN [4] developed in 1 patient, 3 months after completion of postoperative IMRT in an area where a periodontally affected mandibular molar was removed pre-radiotherapy.

Grade II ORN [4] developed in 1 patient, 7 months after postoperative CHIMRT. Due to a restricted mouth opening, scar tissue of the cheek and pain, the patient had problems cleaning the molar in the mandible (right side) after oncologic treatment. Caries developed in the most distal molar and eventually caused pain of endodontic origin. Endodontic treatment was impossible to perform and the molar was extracted post-radiotherapy resulting in a non-healing socket and eventually ORN. This patient was free of oral foci of infection at baseline, but had pockets of 4-5mm at baseline.

Grade III ORN [4] was seen in 2 patients. Idiopathic grade 3 ORN of the angle of the mandible resulting in a pathologic fracture developed in one patient 2 months after CHIMRT had ended. This patient was free of periodontal disease during follow-up. In the other patient, ORN was unrelated to pre- or post-radiotherapy tooth extractions, as it was observed 2 months after postoperative IMRT in the transplanted fibula bone used for reconstruction of the mandible. The patient did have post-RT surgery, however, to remove reconstruction plates. This patient had periodontal pockets 4-5mm at baseline.

Many factors might influence the development of bone healing problems after radiotherapy. Patients with (n=11) and without (n=45) bone healing problems were compared for number of teeth extracted after dental screening (p=0.105), number of teeth at dental screening (p=0.282), T-stage of the tumor (p=0.257), having diabetes (p=0.263), smoking at baseline (p=0.432), drinking alcohol at baseline (p=0.220), baseline plaque (p=0.725) and bleeding score (p=0.384), baseline PISA-score (p=0.076), and having periodontal pockets ≥4mm (p=0.379) or ≥6mm at dental screening (p=0.093).

<table>
<thead>
<tr>
<th>Assessed tooth problems</th>
<th>Treatment if cumulative dose &gt;40Gy</th>
<th>Treatment if cumulative dose &lt;40Gy or outside the radiation portal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caries profunda</td>
<td>Tooth extraction</td>
<td>Restoration, if necessary combined with endodontic treatment, or tooth extraction</td>
</tr>
<tr>
<td>Periapical pathosis (on radiographs) without symptoms and/or additional problems</td>
<td>In teeth without root canal filling; Endodontic treatment and/or apicification</td>
<td>In teeth without root canal filling; Endodontic treatment combined with initial periodontal treatment</td>
</tr>
<tr>
<td>Extensive periapical pathosis (on radiographs) combined with periodontal disease, in afunctional teeth or with symptoms</td>
<td>In teeth with root canal filling; Endodontic treatment/ or apicification</td>
<td>In teeth with root canal filling; Endodontic re-treatment, apicification or tooth extraction</td>
</tr>
<tr>
<td>Avital pulp with symptoms without periapical radiolucency on radiographs</td>
<td>Endodontic treatment or tooth extraction (which might be necessary in case of pre-radiotherapy time limitations)</td>
<td>Endodontic treatment or tooth extraction depending on the prognosis</td>
</tr>
<tr>
<td>Avital pulp without symptoms and without periapical radiolucency on radiographs</td>
<td>Endodontic treatment or tooth extraction (needed in case of pre-radiotherapy time limitations)</td>
<td>Endodontic treatment (which can be postponed until after radiotherapy)</td>
</tr>
<tr>
<td>Periapical disease with pockets 4-5mm</td>
<td>Initial periodontal therapy</td>
<td>Initial periodontal therapy</td>
</tr>
<tr>
<td>Gingival recessions ≥6mm</td>
<td>Tooth extraction</td>
<td>Initial periodontal therapy</td>
</tr>
<tr>
<td>Impacted teeth or roots fully covered by bone without radiographic abnormalities</td>
<td>No treatment</td>
<td>No treatment</td>
</tr>
<tr>
<td>Impacted teeth or roots not fully covered by bone or with radiographic abnormalities (e.g., cysts, apical radiolucency)</td>
<td>Tooth extraction</td>
<td>No treatment or, in case of symptoms, surgical removal</td>
</tr>
<tr>
<td>Cysts</td>
<td>Surgical removal</td>
<td>Surgical removal</td>
</tr>
<tr>
<td>Internal or external root resorption</td>
<td>Tooth extraction</td>
<td>Endodontic treatment or tooth extraction depending on the prognosis</td>
</tr>
</tbody>
</table>

* If an irradiated patient needed treatment, radiation fields were always verified with the department of Radiation Oncology, and depending on the dose in the specific region where treatment was needed, antibiotic prophylaxis was given to the patient.
Discussion

This study showed that patients with periodontal disease before IMRT/CHIMRT are prone to develop bone healing problems during post-radiotherapy follow-up. The assessed protocol for elimination of oral foci of infection pre-IMRT was compared to a historical control group treated with conventional radiotherapy [2]; the protocol was equally effective for patients treated with IMRT/CHIMRT. Post-radiotherapy oral and dental morbidity seen in IMRT/CHIMRT patients is comparable to that seen in patients treated with conventional radiotherapy.

The relationship between periodontal disease and bone healing problems is supported by our finding that baseline PISA scores and the presence of periodontal pockets ≥6mm at dental screening were different between patients with and without bone healing problems, although the difference was not significant. There seems to be a trend, however, and our study may have been underpowered to find a significant difference.

Oral foci of infection

Compared to our retrospective study [2] that included 80 patients between January 2004 and December 2008 with a mean follow-up of 26 months subjected to conventional radiotherapy, a comparable percentage of patients presented with oral foci of infection (75% vs. 79%). Again, oral foci consisted mainly of periodontal disease, which is comparable to the percentage of patients with periodontal problems (68%) in the small study of Bueno et al [21]. Approximately 10% of Dutch adults have severe periodontal disease [22]. Apparently, poor periodontal health is common amongst HNC patients [2,23,24] and might be the cause of bone-related oral sequelae post-radiotherapy.

Bone healing problems and ORN

Bone healing problems were observed in 11 out of 56 patients (20%). We diagnosed 6 patients with delayed wound healing and 1 with lingual mandibular sequestration, which was not defined as ORN because healing occurred within 3 months after minimally invasive surgery (sequestrectomy). The immediate surgical intervention in case of exposed bone, as done in our hospital, may result in a more rapid healing compared to observation. This approach seems to give a lower incidence of low-grade ORN.

ORN was reported in 7% of our patients after IMRT compared to 11% in our retrospective 3-dimensional conformal radiation therapy (3D-CRT) study [2]. The prevalence of ORN as reported in the literature is highly variable [6] and the reported outcomes on occurrence of ORN after IMRT are limited. Our findings suggest a reduced rate of ORN following the clinical introduction of IMRT [25-27]. It has been suggested, however, that the latency time to develop jaw complications after IMRT is longer. Nevertheless, after 3 years the risk of developing jaw complications appears to be equal to that for non-IMRT treatment [28]. Nabil et al [6]

Table 3. Demographics, clinical characteristics and baseline dental data of the study group (n=56)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Number of patients dentate during follow-up Total n=51</th>
<th>Number of patients edentate during follow-up Total n=5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics Age, years</td>
<td>Mean (SD)</td>
<td>59 (8.5)</td>
<td>62 (5.4)</td>
</tr>
<tr>
<td>Gender Male / Female</td>
<td>32 / 19</td>
<td>4 / 1</td>
<td></td>
</tr>
<tr>
<td>Tumor site Oral cavity</td>
<td>25</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Oropharynx</td>
<td>26</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>T-classification T1</td>
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<td>1</td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>17</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>T3</td>
<td>6</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>T4</td>
<td>17</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>N-classification N0</td>
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<td></td>
</tr>
<tr>
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<td>0</td>
<td></td>
</tr>
<tr>
<td>N2</td>
<td>25</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>N3</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Cumulative IMRT dose 5 / week</td>
<td>70 [66-70]</td>
<td>70 [70-70]</td>
<td></td>
</tr>
<tr>
<td>Frequency of IMRT 6 / week</td>
<td>9</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Primary IMRT</td>
<td>10</td>
<td>1</td>
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</tr>
<tr>
<td>Postoperative IMRT</td>
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<td>0</td>
<td></td>
</tr>
<tr>
<td>Primary CHIMRT</td>
<td>17</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Postoperative CHIMRT</td>
<td>10</td>
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<td></td>
</tr>
<tr>
<td>Chemotherapy type Carboplatin / 5-FU</td>
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<td>4</td>
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<tr>
<td>Cisplatin</td>
<td>7</td>
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<td>Cetuximab</td>
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<tr>
<td>Wound closure Primary</td>
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<td></td>
</tr>
<tr>
<td>Skin graft / flap</td>
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<td></td>
</tr>
<tr>
<td>Self-reported smoking Yes / No In the past</td>
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<td>4 / 0 / 1 / 0</td>
<td></td>
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<tr>
<td>Alcohol consumption Yes / No</td>
<td>40 / 11</td>
<td>3 / 2</td>
<td></td>
</tr>
<tr>
<td>Number of teeth Median (IQR)</td>
<td>24 [18-27]</td>
<td>11 [8.5-17]</td>
<td></td>
</tr>
<tr>
<td>Pilea score Median (IQR)</td>
<td>50 [25-75]</td>
<td>70 [45-80]</td>
<td></td>
</tr>
<tr>
<td>Bleeding score Median (IQR)</td>
<td>50 [20-60]</td>
<td>70 [32-95]</td>
<td></td>
</tr>
<tr>
<td>PISA</td>
<td>349 [131-863]</td>
<td>533 [170-1509]</td>
<td></td>
</tr>
<tr>
<td>DMFS</td>
<td>77 [60-102]</td>
<td>118 [88-120]</td>
<td></td>
</tr>
</tbody>
</table>

* After dental screening and pre-radiotherapy treatment of oral foci, 5 patients needed a full mouth clearance.

SD= standard deviation; IQR= inter quartile range; IMRT= intensity modulated radiation therapy; CHIMRT= intensity modulated radiation therapy with chemotherapy; DMFS= decayed missing filled surfaces. The range of scores is 0-128. NR; Not reported
suggested a median/mean follow-up of >3 years, since 90% of ORN cases were reported within 3 years after radiotherapy. Our median follow-up was shorter than in the studies referred to, and more cases of ORN may develop in our cohort in the future. However, all cases of ORN in this study occurred in the first 7 months after IMRT had ended, so we do not expect many new cases to occur.

Studer et al. [25] reported 5 cases of ORN in 304 patients (1.6%) with oropharyngeal or oral cavity carcinoma treated with IMRT, with a follow-up between 5 and 86 months [25]. Gomez et al. [27] included 168 patients with a follow-up between 0.8 and 89.6 months; they reported a low incidence of ORN (1%). However, 54% of the included patients in the latter study had a tumor located outside the oral cavity or oropharynx, resulting in a lower radiation dose to the jaws, which might be accompanied by a lower incidence of ORN. Both studies [25,27] did not report how many patients received post-operative or primary IMRT, which may have influenced the outcomes on ORN since it is a known risk factor [7]. A complete lack of ORN was reported by Ben-David et al. [26]. They suggested that the reduction in the ORN rates could be attributed to more conformal dose distributions and to better prophylactic care and ongoing dental care.

Our oral care protocol did not change in the years between the retrospective and prospective study, although it was more strictly executed prospectively, with only 1 patient that was not treated according to protocol compared to 15 patients in the retrospective study [2]. Those 15 patients received pre-radiotherapy initial periodontal therapy for teeth with pockets ≥6mm, instead of tooth extraction, and they were particularly at risk of developing ORN. The improved implementation of the dental screening protocol may have decreased our ORN prevalence, as suggested by others [26], and this might explain the weaker relationship between periodontal disease and ORN found in the present study compared to the retrospective study [2]. Nevertheless, periodontal disease is still the only factor that we found to be associated with bone healing problems.

Periodontal treatment might have a short-term (6 months) positive effect on periodontal breakdown [21], but the present study, with a median of 24 months of follow-up, showed that progression of periodontal pocket depth was frequently observed after IMRT (24%). This percentage is even higher than the 18% reported in the retrospective study [2].

In our study on oral microflora [29], we found an almost immediate effect after the elimination of oral foci of infection, with a decrease of periodontal pathogens. However, rather high percentages of periodontal pathogens were still present in our HNC patients 1 year after IMRT and may have caused the observed progression of pocket depth.

Conclusion

This study showed that patients with periodontal disease before IMRT/CHIMRT are prone to develop bone healing problems during post-radiotherapy follow-up. The protocol was considered equally effective for those treated with IMRT/CHIMRT as compared to patients treated with conventional radiotherapy. Post-radiotherapy oral and dental morbidity seen in IMRT/CHIMRT patients is comparable to that seen in patients treated with conventional radiotherapy.
References


