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Delivery date: 2016-10-10 07:56:09

Delivery priority: NORMAL

Delivery way: www / DRM

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Remarks concerning delivery:

Data concerning document:

Signature: Z 3936a / Magazin

Author:

Title: International journal of radiation oncology, biology, physics

Year: 1992

Volume / Issue: 24 / 2

Pages: 359-67

Author of article: Jansma, J; Vissink, A; Bouma, J; Vermey,

Title of article: A survey of prevention and treatment regimens for oral sequelae resulting from head and neck cancer

ISSN: 0360-3016

ISBN:

CODEN:

Your comment concerning the order:

1602263 Geurts-Jaeger, N.E.

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Unter Anerkennung der Benutzungsbedingungen wird bestellt:

Verfasser: Jansma, J; Vissink, A; Bouma, J; Vermey,
(Aufsatz)

Titel: A survey of prevention and treatment regimens
(Aufsatz) for oral sequelae resulting from head and neck
radioth

Seiten: 359-67

Titel (Monographie/ Zeitschrift)

International journal of radiation oncology, biology,
physics
Elsevier
New York, NY u.a.

0360-3016

Lieferung erwünscht bis:
2016-10-12 15:50:04

Standort:
Z 3936a / Magazin

Band/Heft:
24 / 2

Jahr:
1992

Lieferform:
KOPIE

Lieferart:
FTP

SUBITO-2016100700952

Bemerkung: ACHTUNG: Dokumente mit elektron. Lieferweg via FTP-Aktiv an subito ausliefern!

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● Special Feature

A SURVEY OF PREVENTION AND TREATMENT REGIMENS FOR ORAL SEQUELAE RESULTING FROM HEAD AND NECK RADIOTHERAPY USED IN DUTCH RADIOTHERAPY INSTITUTES

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Radiation treatment plays an important role in the management of head and neck cancer. Unfortunately several radiation-induced side effects may occur including mucositis, hyposalivation, radiation caries, trismus and osteoradionecrosis. It is generally accepted that most side effects can be prevented or reduced in severity. The purpose of this investigation was to make a survey of the prevention and treatment regimens for oral sequelae resulting from head and neck radiotherapy applied in all radiotherapy institutes in the Netherlands, and to evaluate the differences in these regimens. In all Dutch centers ($n = 20$) in which irradiation of head and neck cancer patients is performed, members of the staff responsible for prevention and treatment of oral side effects were interviewed. Questions referred to composition of the dental team, screening and care pre-irradiation, care during irradiation, and care post-irradiation. There appeared to be a great diversity in the preventive approach of the head and neck cancer patient in Dutch radiotherapy institutes. The most comprehensive counseling was performed by those centers in which a dental team was active, particularly when an oral hygienist was a member of such a team. The diversity is among others based on lack of well-defined guidelines in many centers, the spread of a relatively small patient group over a rather large number of centers, absence of a dental team in some centers, absence of an oral hygienist in some dental teams, and the observation that a rather large number of patients were not referred, or not timely referred to the dental team. There seems to be a need for the development of a general protocol for the prevention of oral complications applicable in all centers.

Head and neck cancer, Radiotherapy, Oral sequelae, Preventive regimens.

INTRODUCTION

The incidence of malignant head and neck tumors (skin cancer excluded) in the Netherlands is about 23/100,000 inhabitants, that is about 3500 new cases per year (39). Radiation treatment plays an important role in the management of head and neck cancer. According to Rothwell (32), approximately 50% of new cases of invasive head and neck cancer will need external beam radiotherapy as a primary treatment, as an adjunct to surgery or chemotherapy or as palliation. The amount of radiation needed for curative treatment is based on location and type of malignancy, and whether or not radiotherapy will be used alone or as a pre- or post-surgical aid. Most patients who have head and neck carcinomas receive between 50 and 70 Gy as a curative dose, which is usually

given over a 5–7 week period, once a day, five days a week, with a daily tumor dose of about 2 Gy. Because of the location of the primary tumor and regional lymph nodes, the oral cavity, salivary glands, and jaws are in the field of radiation in most head and neck cancer patients, resulting in irradiation-induced changes in these tissues.

The major side effects of radiotherapy in the head and neck region are mucositis, hyposalivation, radiation caries, and osteoradionecrosis (ORN). Mucositis is a transient complication, but it is an integral part of the radiation therapy in terms of morbidity. Mucositis causes local discomfort and pain as well as difficulties in drinking, eating, swallowing, and speech. As a consequence nutritional problems can arise and, in severe cases, nasogastric tube feeding may become necessary (9, 35). Severe mucositis may even necessitate a break in the course of radiation

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Acknowledgement—The authors would like to thank the staff

of all Dutch radiotherapy institutes and the members of their dental teams for spontaneous cooperation in this survey.

Accepted for publication 17 March 1992.

treatment and can thus become a dose-limiting factor (20, 32).

Hyposalivation leads to distressing, long-lasting, often irreversible complaints, such as oral dryness, hampered oral functioning, nocturnal oral discomfort, burning mouth, impeded social activities, and high susceptibility to oral infections and dental caries (16, 40).

The effects of irradiation on the jaws lead to a lifelong risk for the development of ORN (12, 22, 23).

It is generally accepted that most oral complications of head and neck irradiation can be prevented or reduced in severity (29). Prevention regimens are mainly based on clinical experience. The result is a great diversity in procedures (3, 4, 20, 21, 31, 32, 43). This may account for the diversity in the preventive approach in daily practice.

The purpose of the present investigation was to survey the prevention and treatment regimens used in all radiotherapy institutes in the Netherlands, and to identify the differences in these regimens.

METHODS AND MATERIALS

Dutch radiotherapy institutes

All centers in which irradiation for head and neck cancer is performed ($n = 20$) were included in the study. According to the patient numbers reported by these centers, a total of about 2200 patients was treated with radiotherapy to the head and neck region in 1989. This number includes patients treated for laryngeal carcinoma and patients treated for (Non) Hodgkin lymphoma in the head and neck region. Patients with skin cancer are excluded. The participating institutes are listed in Table 1.

Survey

All centers were visited in the period June–October 1990 and at least two members of the staff responsible for the prevention and treatment of oral side effects of head and neck irradiation were interviewed, that is radiotherapist and/or dental team (oral and maxillofacial surgeon, center dentist, oral hygienist). In centers without a dental team or dentist, only the radiotherapist was interviewed. All interviews were performed by the same interviewer (J.J.) using a list of open-ended questions. The answers were scored by the interviewer according to predefined response categories. New categories were added when the response did not match the predefined ones, so that the interviewer did not influence the response. In the result section “ n ” always refers to the number of centers in which the interviewees positively responded to a certain item. Questions referred to:

1. Composition of the team responsible for the prevention and treatment of radiation-related oral side effects;
2. Screening and care pre-irradiation: moment of first contact of the patient with the team, dental assessment

Table 1. Dutch radiotherapy institutes in which head and neck radiotherapy is performed

Academisch Medisch Centrum, Amsterdam
Academisch Ziekenhuis Rotterdam Dijkzigt, Rotterdam
Academisch Ziekenhuis Groningen, Groningen
Academisch Ziekenhuis Leiden, Leiden
Academisch Ziekenhuis Nijmegen St Radboud, Nijmegen
Academisch Ziekenhuis Utrecht, Utrecht
Academisch Ziekenhuis Vrije Universiteit, Amsterdam
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Radiotherapeutisch Instituut Friesland, Leeuwarden
Radiotherapeutisch Instituut Limburg, Heerlen
Radiotherapeutisch Instituut Stedendriehoek en Omstreken, Deventer
Rode Kruis Ziekenhuis, 's-Gravenhage†
St. Sophia Ziekenhuis, Zwolle
Westeinde Ziekenhuis, 's-Gravenhage†
Ziekenhuis Leyenburg, 's-Gravenhage

* Including patients of Radiotherapeutisch Instituut Zeeland, Vlissingen.

† These institutes use the same radiotherapeutic unit but were evaluated separately because of different preventive programs.

and screening on focal infection, extraction protocol, instruction for oral hygiene and fluoride usage;

3. Care during irradiation: oral hygiene and mucositis protocol, fluoride protocol, denture wearing;
4. Care post-irradiation: oral hygiene and fluoride protocol, denture wearing, extraction protocol, treatment of hyposalivation, follow-up.

RESULTS

Composition of the dental team

In the majority of centers at least one oral and maxillofacial surgeon ($n = 14$) or one oral hygienist ($n = 16$) were part of the team, occasionally supplemented by a center dentist ($n = 8$) (Table 2). A team consisting of an oral and maxillofacial surgeon, an oral hygienist, and a center dentist was present in only five centers. In three centers the pre-irradiation screening and pre- and post-irradiation care of the patients was left to their family dentist because of the absence of a dental team. In all centers a radiotherapist screened the patients on the development of oral side effects, particularly mucositis, at least once a week during radiation treatment.

Screening and care pre-irradiation

In seven centers, at least 50% of the patients whose oral cavity and/or salivary glands were included in the field of radiation were not screened prior to radiotherapy by such a team (Table 3). If screening was performed this was

Table 2. Composition of dental teams in 20 Dutch radiotherapy institutes

Team	
Oral and maxillofacial surgeon, center dentist and oral hygienist	5/20*
Oral and maxillofacial surgeon and oral hygienist	8/20
Oral and maxillofacial surgeon	1/20
Center dentist and oral hygienist	3/20
No dental team	3/20

Note: In several centers more than one oral and maxillofacial surgeon, center dentist and/or oral hygienist were part of the team.

* 5 out of 20 centers.

always done prior to the onset of radiotherapy. In about half the cases even more than 2 weeks before irradiation.

The routine pre-irradiation dental assessments and instructions are presented in Table 4. In centers with a dental team ($n = 17$), a panoramic x-ray was always made for screening on focal infection in dentulous patients. Two of these centers took no radiographs in edentulous patients. No information was obtained if patients were referred to their family dentist. Baseline data on composition of oral flora ($n = 0$) and mouth opening ($n = 0$) were not collected. In two centers the salivary flow rate was measured. Professional tooth cleansing was performed only in centers with an oral hygienist.

Periodontal disease was occasionally treated with root-planing and curettage instead of extraction ($n = 11$), particularly when an oral hygienist was a member of the team ($n = 10$). If extraction or surgical removal of teeth or root tips was indicated, a minimum interval of 0–1, 1–2 or 2–4 weeks between extraction and the onset of radiotherapy was considered necessary in one, nine, and ten centers, respectively. Wound healing was routinely checked in 12 centers before irradiation was started.

In the majority of the centers dentulous patients were instructed on toothbrushing ($n = 16$) and interdental cleansing ($n = 15$). In edentulous patients oral hygiene

Table 4. General overview of the routine dental assessments and instructions in dentulous and edentulous patients prior to radiation treatment in 20 Dutch radiotherapy institutes

	Dentulous patients	Edentulous patients
Oral assessments		
Plaquescore	4/20*	—
Bleeding index/record of pocket depths	13/20	—
Vitality testing	4/20	—
Restoration of carious teeth	16/20	—
Panoramic x-ray	17/20	15/20
Checking fit of dentures	—	14/20
Inspection oral mucosa	—	14/20
Surveillance culture of oral flora	0/20	0/20
Measurement of mouth opening	0/20	0/20
Assessment of salivary flow rate	2/20	2/20
Prophylactic care		
Professional tooth cleansing	16/20	—
Rootplaning and curettage	11/20	—
Oral hygiene instructions:		
Toothbrushing	16/20	—
Interdental cleansing	15/20	—
Use of disclosing agents	1/20	—
Cleansing of mucosal surfaces	—	10/20
Denture hygiene	—	12/20
Massage of oral mucosa	—	7/20
Discouraging denture wearing during radiation	—	7/20
Instruction of fluoride usage	18/20	—
Consult with dietitian	11/20	11/20

* 4 out of 20 centers.

and denture hygiene were instructed only in ten and twelve centers, respectively.

Routine fluoride usage, other than by brushing with fluoridated toothpaste, was instructed in 18 centers. In two of the centers fluoride was prescribed by the radiotherapist. The fluoride preparations used are listed in Table 5. Self-application of the fluoride gel was prescribed in 11 centers, while in another four centers the gel was applied by an oral hygienist. Custommade carriers ($n = 12$) and commercially available carriers ($n = 3$) for the application of fluoride gel were used. Fluoride-containing mouthwashes were used in three centers.

The routine frequency of fluoride application differed between the various centers. Daily application was prescribed in all centers in which fluoride-containing mouthwashes were used routinely ($n = 3$) and in nine centers in case of gels, while in the other centers in which gels were used, the application frequency was twice ($n = 2$) or once ($n = 4$) a week.

Care during irradiation

An overview of the routine oral care in the different centers during radiotherapy is presented in Table 6. From the onset of radiotherapy, the majority of centers ($n = 15$)

Table 3. Fraction of patients per center, whose oral cavity and/or salivary glands were included in the field of radiation, that was referred to a dental team prior to radiotherapy

Fraction referred	Dentulous patients	Edentulous patients
All patients (100%)	9/20*	7/20
75–100% of the patients	4/20	4/20
50–75% of the patients	3/20	2/20
< 50% of the patients	1/20	4/20
Only family dentist	3/20	0/20
No screening for foci	0/20	3/20

Note: Data reflect the opinion of the radiotherapist and dental team.

* 9 out of 20 centers.

Table 5. Evaluation of fluoride usage in 20 Dutch radiotherapy institutes

Preparations	Routinely	On indication*	Total
Neutral NaF gel, 1%	6/20 [†]	1/20 ^a	7/20
Acidulated NaF gel, 1%	4/20	2/20 ^b	6/20
Aminfluoride gel, 0.4%	5/20	2/20 ^b	7/20
Neutral NaF mouthwash, 0.05%	3/20	1/20 ^c 1/20 ^d	5/20
Only fluoride containing toothpaste	1/20		1/20
Unknown [‡]	1/20		1/20

* On indication: ^ain case of inability to rinse, ^bcommercial availability, ^celderly, ^dinitial lesions.

[†] 6 out of 20 centers.

[‡] In one center it was unknown whether or not fluoride was routinely prescribed.

prescribed daily frequent rinsing of the oral cavity as baseline care. The most commonly used oral rinses were camomile ($n = 11$) and saline ($n = 5$). In only four centers frequent spraying of the oral cavity with saline was routinely performed by an oral hygienist. Pharmacological prevention of mucositis with PTA lozenges (polymyxine E, tobramycine, amphotericine B) was performed in two centers.

If the oral cavity was included in the field of radiation, in seven centers the wearing of partial and full dentures was discouraged from the onset of radiotherapy to prevent mucosal irritation and bacterial overgrowth. In all other centers, denture wearing was no longer allowed if patients had complaints due to mucositis. In three centers dentulous patients with large metal restorations were instructed to wear their custommade fluoride carriers during irradiation to reduce scattering. In five centers the only care during radiotherapy consisted of weekly check-ups.

When mucositis had developed, most centers increased the frequency of oral rinsing and added extra rinsing agents and, in all centers, the wearing of dentures was prohibited (Table 6). Camomile ($n = 14$), saline ($n = 6$) and salt-soda ($n = 3$) were frequently prescribed. Chlorhexidine solutions were added for oral rinsing ($n = 6$) and for professional spraying ($n = 2$). Frequent spraying with hydrogen peroxide and water was started in one center, and four centers continued spraying with saline. Viscous lidocaine or sucralfate was prescribed for pain relief in three centers. For pharmacological treatment of mucositis, four centers used PTA lozenges and another four centers prescribed nystatine. The starting of mucositis therapy was based on patients' complaints (discomfort, pain) ($n = 12$), on the occurrence of mucosal erythema ($n = 2$) or pseudomembranes ($n = 6$). Culturing of the oral flora during the course of radiotherapy was performed in cases of mucositis in two centers. When oral candidiasis was suspected the oral flora was cultured in half the centers

($n = 10$). Thirteen centers stated that, in exceptional cases, severe mucositis necessitated a break in the course of radiotherapy.

The frequency of checking the oral condition during radiotherapy by a member of the dental team differed between centers. A distinction between dentulous and edentulous patients was also made. In three centers with a dental team, the dentulous patients were seen at least once per two to three weeks, while in most centers they had check-ups once a week ($n = 8$), twice a week ($n = 4$), or even every day ($n = 1$). The highest frequencies were reported in centers with an oral hygienist. In four centers dentulous patients were seen only by a radiotherapist. In 11 centers edentulous patients were not seen by a dental team during radiotherapy. In the other centers check-ups were performed daily ($n = 1$), weekly ($n = 5$) or once per two to three weeks ($n = 3$). When patients were hospitalized during radiotherapy, which seemed to occur rarely, the check-up frequency for dentulous patients was increased to several times a week in eight centers. Check-up schedules were not changed for edentulous patients in these cases.

Table 6. General overview of the oral care during radiotherapy in 20 Dutch radiotherapy institutes

	Routine	In case mucositis
Rinsing of the oral cavity with [†]		
Water	1/20*	1/20
Camomile	11/20	14/20
Saline	5/20	6/20
Salt-soda	2/20	3/20
Emser salt	1/20	1/20
Old brown ale	1/20	1/20
Blueberry juice	1/20	1/20
Chlorhexidine	0/20	6/20
Lidocaine	0/20	1/20
Sucralfate	0/20	2/20
Nystatine	0/20	4/20
No rinsing prescribed	5/20	0/20
Professional spraying of the oral cavity with:		
Saline	4/20	4/20
Chlorhexidine 0.1%	0/20	2/20
Hydrogenperoxide in water	0/20	1/20
No professional spraying	16/20	13/20
Professional tooth cleansing	6/20	6/20
Fluoride application	18/20	18/20
Discouraging of denture wearing	7/20	20/20
PTA lozenges (polymyxine E, tobramycine, amphotericine B)	2/20	4/20
Weekly inspection of the oral mucosa	20/20	20/20

Note: In case of mucositis, some centers increased the rinsing/spraying frequency and/or are added new agents.

* 1 out of 20 centers.

[†] In some centers more than one rinse was used.

Care post-irradiation

In 18 centers patients were allowed to wear dentures immediately after the full course of radiotherapy had been completed and/or mucositis had resolved. In two centers the wearing of dentures was prohibited during a period of two or three months post-irradiation.

The fluoride application frequency was decreased in 17 centers. Instructions for this decrease were based on a general rule in ten centers (Table 7), in the other centers the instructions were patient dependent. Reduction of application frequency was started immediately after irradiation ($n = 9$), after three months ($n = 5$), after one to two years ($n = 2$), or was strictly patient dependent ($n = 1$). In two centers the frequency of fluoride application was not reduced post-irradiation. The fluoride usage and reduction could not be evaluated in one of the centers in which patients were referred to their family dentist.

In most centers ($n = 12$) fluoride usage was reduced to a minimal standard application frequency. This frequency differed between the various centers, and ranged from twice a week ($n = 1$), once per week ($n = 1$), once per two weeks ($n = 2$), once per month ($n = 2$), once per three months ($n = 1$) to one time per six months ($n = 4$). Five other centers gradually reduced the fluoride applications to zero, and in one center the reduction was strictly patient dependent.

The fluoride protocols in most centers were based on literature ($n = 10$), clinical experience ($n = 8$), and own

research ($n = 1$), and/or had been adopted from other centers ($n = 11$) or predecessors ($n = 4$). The main factors on which fluoride reduction was based, were severity of oral dryness according to the clinician ($n = 11$) or patient ($n = 15$), level of oral hygiene ($n = 14$), and dental status (initial lesions, cavities) ($n = 13$). Measurement of salivary flow rate ($n = 1$) and information on radiation dosage ($n = 1$) and field ($n = 1$) were rarely mentioned as important factors.

Salivary gland function after radiotherapy was determined only by clinical inspection of the oral cavity in 18 centers. In one center the response to citric acid stimulation was measured, and in another center the actual salivary flow rate was measured prior to and 6 and 12 months after radiotherapy. Treatment for hyposalivation and related oral phenomena was not started until patients complained about oral dryness. Home remedies such as old brown ale and cold tea were advised in 13 centers. Gustatory and tactile stimulation with, for example, vitamin C tablets or chewing gum was instructed by half the centers ($n = 10$). Systemic sialogogues like pilocarpine were occasionally prescribed in two centers. The use of artificial saliva was advised in 18 centers. This was a carboxymethylcellulose (CMC)-based saliva substitute ($n = 9$), a mucin-containing one ($n = 3$), or both types without preference ($n = 8$).

Post-irradiation protocols for removal of teeth from irradiated jaw segments are presented in Table 8. In twelve centers extractions were deferred to at least 6 months after

Table 7. Reported schedules for fluoride usage during and after radiotherapy in 10 Dutch radiotherapy institutes*

Type of fluoride	Fluoride usage during and after radiotherapy	
	During	After
Neutral NaF gel, 1%	Weekly	Weeks 1, 3, 8, 15, 24; subsequently once per 3 months during the first 2 years; thereafter twice per year
	Daily	The first year once per 2 days; thereafter once per week or once per month
	Weekly	< 40 Gy: once per month during the first year; thereafter once per 6 months > 40 Gy: 0–3 months once per week; 3–12 months once per month; thereafter once per 3 or 6 months
	Daily†	> 40 Gy: 0–3 months twice per week; 3–6 months once per 2 weeks; subsequently every 3 months
Acidulated NaF gel, 1%	Daily	Daily during the first 2 years; thereafter stepwise reduction with 50% every 6 months until minimal frequency of once per month
	Daily	0–3 months once or twice per week; thereafter gradually reduction to once per 6 months
Aminfluoride gel, 0.4%	Daily	Immediately after irradiation once per week; discontinuing fluoride usage if patients experience recovery of salivary gland function
	Weekly†	< 40 Gy: 0–3 months once per 2–4 weeks; subsequently once per 3 months
	Weekly	0–6 months once per month; thereafter discontinuing fluoride usage
Neutral NaF mouthwash, 0.05%	Twice/week	0–6 months once per week; thereafter once per 2 weeks
	Daily	Reduction to zero in 7 weeks starting from the moment the patient experiences recovery of salivary gland function

* In the other ten centers reduction of fluoride usage was strictly patient dependent.

† In this center the fluoride preparation of choice was based on the expected total radiation dose (< 40 and > 40 Gy).

Table 8. Post-irradiation protocol for removal of teeth from irradiated jaw segments in 20 Dutch radiotherapy institutes

Protocol	
Independent of the time after irradiation	6/20*
Only in exceptional cases	2/20
Not within the first year post-irradiation	7/20
Not within the first six months post-irradiation†	4/20
Not within the first six months post-irradiation‡	1/20

Note: Unless stated otherwise removal is performed under high dose antibiotic coverage.

* 6 out of 20 centers.

† In two centers primary closure of wounds is performed routinely.

‡ No antibiotics prescribed.

irradiation. Extractions were performed under high dose antibiotic coverage in 19 centers. Only two centers stated that they always performed primary wound closure after extraction. Eleven centers stated that the dental team spontaneously received information about radiation dosages and fields of more than fifty percent of their patients after completion of radiotherapy.

The total length of the period during which dentulous patients are regularly screened by the dental team is presented in Table 9. In the early post-irradiation period (0–6 months), the frequency of checking the oral condition by the dental team differed between the centers. Also a difference between dentulous and edentulous patients was made. Dentulous patients had check-ups every month during this period in 11 centers, while there was no post-irradiation recall for them in six centers. In the other three centers, the check-up frequency was once per three ($n = 2$) or 6 months ($n = 1$) during this period. In most centers these check-ups with dentulous patients were performed by an oral hygienist ($n = 15$) and/or an oral and maxillofacial surgeon ($n = 10$). For edentulous patients, 13 centers arranged no check-ups with the dental team. In three centers the oral condition of the edentulous patients was screened only once or twice by an oral hygienist in the early post-irradiation period. In four centers the oral condition of the dentulous and edentulous patients was screened by an oral and maxillofacial surgeon who participated in the oncologic follow-up.

DISCUSSION

A great diversity in the prevention and treatment of oral sequelae resulting from head and neck radiotherapy in Dutch radiotherapy institutes is shown. There is no consensus on mucositis prevention, its treatment, and the prophylaxis of radiation caries. Furthermore, there is great diversity in the frequency of check-ups and in the length of the follow-up by the dental teams. The most comprehensive counseling of the head and neck cancer patient was observed in those centers in which an oral hygienist participated in the dental team. Because the approach of

the survey was such that the effects of the various regimens in the patient situation were not studied, only conclusions by comparison with the literature can be drawn.

Screening and care pre-irradiation

Clinical experience has indicated that foci such as impacted teeth and root tips, periapical infection, and especially periodontal infection frequently precede ORN (23, 26, 27). Therefore, pre-irradiation evaluation of the periodontal status with special attention to furcation involvement is extremely important (3, 4, 5, 21, 38). Nevertheless, from our survey it appears that many dentulous and edentulous patients to be treated with radiotherapy in the head and neck region are not screened on dental foci. This may be a result of absence of a dental team in some centers, lack of personnel in many teams, and underestimation of sequelae such as caries and periodontal disease that may precede ORN by radiotherapists.

Adequate time for treatment, fabrication of fluoride carriers, and wound healing after pre-irradiation extractions and other surgical procedures must be allowed to maximize the impact of screening (33). Notwithstanding the fact that the interval between tooth removal and onset of radiotherapy should be at least two (21, 37) to three (23) weeks and the presence of waiting lists for radiotherapy in some centers, a period of less than two weeks was still regarded by ten centers. Short periods were often connected with a late referral of patients to the dental team. In these cases the start of radiotherapy should be postponed if extractions are indicated.

Radiation caries prevention can almost completely be achieved by the daily application of fluoride in conjunction with a strict oral hygiene regimen (10, 17, 18, 42). For reasons of commercial availability, nine Dutch centers prescribed an acidulated fluoride gel. Although these gels have a higher effectivity than neutral preparations (15), they may cause significant mucosal irritation with burning

Table 9. Length of the period during which dentulous patients are regularly screened by the dental team post-irradiation in 20 Dutch radiotherapy institutes

Period	Dental team	Oncologic follow up*
0–3 months	3/20†	1/20
3–6 months	2/20	2/20
6–12 months	3/20	0/20
1–2 years	2/20	1/20
2–3 years	0/20	0/20
3–5 years	2/20	0/20
> 5 years	2/20	2/20
No follow-up by dental team or oral and maxillofacial surgeon	6/20	

* Oral and maxillofacial surgeon participates in oncologic follow up which is continued after follow-up by dental team has been completed.

† 3 out of 20 centers.

pain, erythema, and even ulceration in irradiated patients (4, 21). Because the success of a preventive regimen depends on the level of patient compliance, neutral fluoride preparations are mostly preferred (18, 29, 32).

Care during irradiation

It appears that there is no consensus on wearing dentures. No studies on denture wearing during the course of radiotherapy have been reported. The information provided is mainly empiric and based on clinical experience. To prevent irritation of the irradiated oral mucosa, some authors advise not to wear dentures during the radiation treatment (2, 8, 34). Others recommend meticulous denture hygiene and removal of the appliance at least at night (11, 20, 32). Thirteen centers allowed denture wearing as long as patients did not suffer from mucositis. In these centers denture wearing was not considered to be a causative or aggravating factor of mucositis or it was allowed on social grounds.

Daily frequent oral rinses as routine oral care are advocated for reduction of the incidence and severity of mucositis. The primary goal of oral rinsing seems to be mechanical cleansing of the oral cavity and wetting of mucosal surfaces (24). The major cleansing agents reported are saline and sodium (bi)carbonate solutions (7, 31). Despite these recommendations, mouthrinses were not prescribed before the first signs of mucositis occurred or the patients complained in five centers. Camomile was the most frequently prescribed rinsing agent in Dutch centers, but the scientific grounds are missing.

Seven centers added chlorhexidine to rinsing or spraying when mucositis was observed, but in recent studies it was shown that chlorhexidine has no benefit for mucositis prevention in these patients (14, 36). The only rationale to apply chlorhexidine is to reduce plaque accumulation (13) which assists oral hygiene once toothbrushing has become too painful due to irradiation.

Care post-irradiation

To prevent radiation caries and periodontal disease oral hygiene has to maintain at a high level, as instructed prior to radiotherapy, and fluoride usage has to be continued as long as hyposalivation exists, that is in many cases lifelong (10, 17). Some authors mention the possibility of reducing fluoride application frequency guided by factors such as the level of oral hygiene and the salivary flow rate, but no schedules for reduction have been reported (4, 25, 43). Reduction of fluoride usage is, however, general practice in Dutch centers. The rapid reduction of fluoride application frequency, especially in combination with the relatively short follow-up performed by most dental teams, seems to bear a considerable risk, and is inconsistent with publications on the irreversibility of salivary gland damage (19, 41). When reducing fluoride usage while salivary flow has insufficiently recovered, caries prevention becomes totally dependent on the level of patient compliance with

the prescribed oral hygiene measures. It seems reasonable to assume that the risk of compliance failure increases with time after radiotherapy. Short follow-up periods will deprive the dental team of its possibility to evaluate the effect of rapid fluoride reduction and to encourage patients to adhere to the strict oral hygiene program. Thus the role of the patients' family dentist after radiotherapy is very important.

Controversy exists regarding the non-wearing period of dentures after radiotherapy. Dependent on radiation dosage and field, trauma to the thin, atrophic, and relatively avascular irradiated mucosa may result in soft-tissue necrosis and ORN (1, 28). Waiting periods of 1 month (6), 6 to 8 months (1, 28), and 1 to 2 years (30) before placement of dentures have been advocated. Because a relation between ORN and denture wearing was not considered to be significant, patients were allowed to wear dentures immediately after radiotherapy in most centers.

In this survey it is shown that there is diversity in the preventive and treatment approach of oral sequelae in head and neck cancer patients in Dutch radiotherapy institutes. In our opinion this diversity is among others based on: lack of well defined guidelines in many centers, spread of a relatively small patient group over a rather large number of centers, absence of a dental team in some centers, absence of an oral hygienist in some dental teams, and the observation that a rather large part of the patients was not referred or not timely referred to the dental team.

To reach consensus in the preventive approach to head and neck cancer patients in the Netherlands, it seems necessary that all centers have a dental team at their disposal, which in our opinion should ideally consist of an oral and maxillofacial surgeon, an oral hygienist, and a center dentist. This team should always be involved at the time of initial cancer diagnosis, so that dental treatment can be included as an integral part of the overall treatment regimen. We are aware of the fact that the presence and composition of a dental team is not only dictated by clinical interest but also by priorities, politics, and financial aspects. During the various interviews, it was felt that in several centers the problem of prevention in head and neck radiotherapy has gained more attention and interest over the last few years.

It seems necessary to perform further research to develop a general preventive protocol that is applicable in all centers. Such a protocol is of utmost importance to optimally prevent oral sequelae of head and neck radiotherapy thereby increasing the patients' quality of life and to convince radiotherapists and surgical oncologists of the importance to refer all dentulous and edentulous patients at risk to the dental team.

The role of a family dentist both prior to and during the radiation treatment period is questionable because of the complexity of oral screening and oral care, the possible complications during radiotherapy, and the fact that most family dentists will only be confronted rarely with this

type of patients. In our opinion, the family dentist's role is limited to the post-irradiation phase in uncomplicated cases. When instructed properly, the family dentist can have an important task in controlling radiation caries and preventing periodontal disease, and thus in minimizing the risk of ORN.

Similar survey studies from other countries are not available, but it may be assumed that analogous to the

situation in the Netherlands prevention is still not optimal in many other countries. Because of implementation of new irradiation schedules in head and neck cancer therapy (more early effects in case of hyperfractionation and accelerated treatment) and the increasing number of aged dentulous patients, adequate preventive and treatment protocols for head and neck cancer patients are a matter of increasing significance.

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