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## Oral complications in the head and neck radiation patient

### Introduction and scope of the problem

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Published online: 12 September 2001  
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Presented as an invited lecture at the symposium "Supportive Care in Cancer", Copenhagen, Denmark, 14–16 June 2001

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**Abstract** Head and neck cancer arises in the upper aerodigestive tract, most commonly in the oral cavity, pharynx, and larynx. The anatomy and physiology of this region are uniquely complex, and the function and appearance are critical to patients' self-image and quality of life. Head and neck cancer is related to tobacco and alcohol exposure, and is hence found more frequently in males in lower socio-economic classes. These patients therefore tend to be less health conscious and to have less social support than most other groups of cancer patients. Most head and neck cancer patients are treated with high-dose radiotherapy to large irradiation fields encompassing sensitive structures, including the oral cavity and surrounding structures. Significant side effects occur in both the acute and the chronic

phase, and dealing with these is a complex issue. Increasing intensity of treatment has improved survival but has also increased treatment side effects. A dedicated multidisciplinary team of oncologist, head and neck surgeon, dentist, nurse, dietician, physical therapist, social worker and in some instances plastic surgeon, prosthodontist, and psychologist is needed to provide the optimal supportive care for these patients. New developments in radiotherapy techniques are expected to lead to even higher cure rates and fewer side effects in patients with head and neck cancer.

**Keywords** Acute effects · Head and neck cancer · Late effects · Oral complications · Radiotherapy · Supportive care

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### Introduction

Head and neck cancer is the term used for a group of cancers arising in the upper aerodigestive tract. The most common ones are cancers of the oral cavity, pharynx and larynx, but head and neck cancer also includes cancer of the ear, nose, paranasal sinuses, lip and salivary glands. Thyroid cancer is also included in the group, but this tumour is quite distinct from the others and will not be dealt with in the present presentation.

The anatomy and physiology of the head and neck region are uniquely complex, and the basic functions of seeing, speaking, swallowing, hearing, and smelling depend on these complex structures working together.

Moreover, much of a person's physical appearance is based on the form and presentation of facial structures. The function and appearance of the head and neck are thus critical to one's self-image and quality of life. Preservation of form and function are key elements in the overall management of head and neck cancer patients. Nevertheless, physical, social, and psychological well-being is greatly affected by the potential disfigurement and dysfunction resulting from the disease and its treatment. Hence, this group of patients needs particular attention to supportive care before, during, and after treatment.

By far the most common histological tumour type in the head and neck region is squamous cell carcinoma,

comprising over 90% of cancers of the oral cavity, pharynx and larynx [8]. Tobacco and alcohol exposure are the major determinants and account for an estimated three-quarters of all oral and pharyngeal cancers [1]. Since the abuse of tobacco and alcohol is related to male gender and lower socio-economic status, head and neck cancer is found more frequently in males in lower socio-economic classes [9]. Hence, head and neck cancer patients tend to be less health conscious and less compliant with health care advice such as advice on avoidance of substance abuse and on good nutritional habits, and to have less social support than most other groups of cancer patients. These are important facts which make the supportive care of these patients all the more challenging and necessary.

Worldwide, head and neck cancers account for 15% of incident male cancers, or approximately 600,000 cases annually in men, and approximately 270,000 in women [18]. Increasing incidence and mortality rates are reported.

Head and neck cancers generally spread locally and regionally to lymph nodes in the neck. The incidence of neck node metastases varies with the site of the primary tumour, but in general more than 50% of head and neck cancer patients have neck node metastases at diagnosis, either clinically or subclinically [14]. In contrast, distant metastases are relatively rare and occur late in the disease; the incidence of these at diagnosis is only about 10% [12]. Hence, many patients can be cured by loco-regional treatment with radiotherapy and/or surgery, and over 50% of all patients are cured by these modalities. The treatment is increasingly supplemented by chemotherapy given concomitantly with the radiotherapy.

Most patients with head and neck cancer are treated with high-dose radiotherapy to large irradiation fields that encompass parts or the whole of the oral cavity, maxilla, mandible, and major salivary glands. High-dose radiotherapy to these sensitive structures is associated with significant side effects manifesting themselves in the oral cavity. Side effects occur both in the acute phase, during a course of irradiation and in the immediate postirradiation weeks, and in the chronic phase many months and years after treatment. Dealing with these problems is a very complex issue with no easy solutions. Hence, a multidisciplinary team of oncologist, head and neck surgeon, dentist, nurse, dietician, physical therapist, social worker and in some instances plastic surgeon, prosthodontist, and psychologist is needed to provide the best supportive care for these patients.

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### Acute oral complications

The severity of the acute oral complications depends on how much of the oral cavity and adjacent structures are included in the high-dose radiation area. They may range

from mild discomfort if only minor parts of the mouth are irradiated to serious debilitating symptoms if large parts of the oral cavity are included.

Mucositis is a general term that describes a state of mucosal irritation. In radiation therapy patients the mucositis is initiated by direct cellular damage from the ionizing radiation. The mucous membranes of the oral cavity respond early during a course of radiotherapy. Mucosal erythema develops within the 1st week. About 2 weeks into the course of radiotherapy the reddened mucous membrane develops small white or slightly yellow patches. These patches represent caking of dead surface epithelium, fibrin, and neutrophils. In many patients, the patches of mucositis become confluent by the 3rd week of irradiation, and the process persists for 3–6 weeks after therapy is completed [19].

Infection of the damaged oral mucosa is common. There is a dramatic increase in the incidence of oral colonization with *Candida albicans*, which can cause mucosal infection that is often confused with radiation-induced mucositis. Frequently, the two conditions coexist, and treatment of the candidiasis may alleviate symptoms to some extent. Bacterial and viral infections of the damaged mucosa can also cause significant discomfort.

Pain is inevitably caused by the damaged mucosa, and most patients will need strong analgesics during a course of radiotherapy. The pain is exacerbated with every attempt to eat or drink.

Loss of taste, although not permanent, is a disabling symptom that may last from several weeks to several months after radiation therapy. In most patients the function of taste returns to a near-normal level, although some patients continue to complain of a metallic taste in the mouth [21].

Eating problems are almost inevitable as a result of the combined effects of the aforementioned acute oral complications, and patients undergoing treatment for head and neck cancer are therefore prone to the development of malnutrition. Moreover, patients with head and neck cancer often present with nutritional deficits before treatment [6]. Nutritional deficiencies may be due to dietary indiscretions coexistent with a history of alcohol and tobacco abuse. In addition, the presence of a tumour in the upper digestive tract makes mastication and swallowing difficult and painful. Hence, weight loss is almost universal in patients being irradiated for head and neck cancer [20]. Malnutrition is a major problem. It has a significant impact on survival and performance status and limits the patient's ability to withstand the side effects of treatment and therefore to tolerate the treatment itself [13, 22].

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### Chronic oral complications

Chronic oral complications occur months and years after treatment. In contrast to acute complications, chronic ra-

radiation damage is generally irreversible, leading to permanent debilitation and decreased quality of life.

Xerostomia, or dry mouth, is caused by radiation-induced damage to major salivary glands. It occurs very early in the course of radiotherapy and is usually reported as being irreversible with doses above 50 Gy [3, 15]. Both the quantity and the quality of saliva are altered. The serous component of salivary flow is affected most often, resulting in the production of saliva with a thick consistency, and the salivary protein content and buffering capacity are altered [19]. Xerostomia is often the major complaint of patients cured of head and neck cancer by radiotherapy. Patients with severe xerostomia may never be able to resume work in a job in which direct communication is necessary, and they may never be able to return to normal feeding habits.

Dental caries increases dramatically as a consequence of xerostomia. The normal oral microflora shifts markedly to a highly cariogenic microbial population [2]. The teeth are affected regardless of whether they are inside or outside of the radiation field. Unless stringent measures are taken to protect the teeth, dental caries begins to develop as early as 3–6 months after treatment and progresses to complete destruction of all the teeth over a period of 3–5 years [5, 24].

Fibrosis of submucosal and soft tissues occurs in many patients after radiation therapy. It manifests as mucosal pallor, thinning, and loss of pliability. It is usually asymptomatic. However, ulceration and necrosis may occur and can result in bone exposure, particularly in the mandible, thus increasing the risk of osteonecrosis.

Trismus, or limited opening of the mouth, may occur due to fibrosis of the muscles of mastication (temporalis, masseter, and pterygoid muscles), whereas the mandibular joint itself is relatively resistant to injury from irradiation. Severe trismus may interfere with eating and proper dental care.

Alteration of taste is reported as a long-term side effect of radiotherapy to the oral cavity in 20% of patients. Subjective recovery of preirradiation taste is usually complete by 2–4 months after treatment [4]. On rare occasions, patients report little or no improvement for many months or years after treatment. At least part of this subjective loss of taste is due to xerostomia.

Eating problems may continue in the chronic phase after radiotherapy because of the chronic side effects mentioned above. Many head and neck cancer patients never regain their pre-morbid body weight.

Osteoradionecrosis is a relatively uncommon chronic complication after irradiation of bone, usually with doses over 60 Gy. It is related to hypocellularity, hypovascularity, and ischaemia of tissues rather than to infection [11]. Bone tolerates high doses of radiation without serious problems as long as the tissues overlying the bone remain intact and the bone is not subjected to trauma. In 95% of cases, bone necroses are associated with soft tis-

sue necrosis and bone exposure, occurring either spontaneously or after trauma, usually dental extraction [23]. Differences in blood supply and anatomical structure between the mandible and maxilla may explain the overwhelming predilection for the mandible, particularly the premolar, molar, and retromolar regions [23]. The risk is increased if the primary tumour site is close to bone and in patients who continue to smoke and drink after irradiation. Osteoradionecrosis is often painful and debilitating and can result in eventual loss of significant parts of the mandible. Except for recurrent malignancy it is one of the worst scenarios in head and neck cancer.

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## Future developments

Most of the oral complications of radiotherapy for head and neck cancer are directly related to the total volume irradiated and the total dose of irradiation. Intensification of radiotherapy in head and neck cancer has led to significant improvements in tumour control and survival in these patients [16, 17]. With increasing intensity of treatment and improved survival we see more chronic side effects of radiotherapy than before.

Exciting new developments in bioimaging, molecular biology, and radiotherapy planning and delivery are going to revolutionize the way radiotherapy is delivered in the next 5–10 years. Modern radiotherapy techniques using advanced computer technology and high-precision equipment are enabling us, for the first time in the history of radiotherapy, to put the radiation dose almost precisely where we want it in the body. These techniques, three-dimensional conformal radiotherapy and the even more advanced technique of intensity-modulated radiotherapy, are now being implemented in the treatment of head and neck cancer [10]. By using image-guided treatment planning and computer-controlled treatment delivery, it is now possible to shape the high-dose volume to fit the tumour volume and avoid the critical normal tissues, e.g. the major salivary glands, as much as possible [7]. These techniques are expected to lead to higher cure rates and fewer side effects in patients with head and neck cancer.

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