Chemotherapy in breast cancer patients has been shown to cause mucosal lesions, affect salivary function leading to a macrobial shift to cariogenic and fungal flora, and cause taste change that may persist for more than six months. Decreased phosphate and secretary IgA food molecules to reach taste receptors and to develop a bolus for deglutition. Dietary shifts are seen in HNC patients following treatment, with increased consumption of high-carbohydrate foods of moist or pureed consistency. Saliva is necessary to maintain dental integrity by providing calcium and phosphate, maintaining pH, and effecting oral flora.

Several approaches have been examined to reduce hyposalivation in cancer patients. Amifostine (WR-2721) is a free radical scavenger approved to prevent hyposalivation in patients undergoing radiation therapy for HNC. A recent meta-analysis demonstrated that amifostine resulted in a decrease in acute and late hyposalivation. Salivary flow after IMRT, where the major glands have been discussed; however, the use of advanced radiation technology, such as intensity-modulated radiation therapy (IMRT) to spare salivary tissue, has become standard in HNC radiation therapy, limiting the consideration for this surgical approach. Measurements of salivary flow after IMRT, where the major glands are spared high-dose exposure confirm less severe hyposalivation and improved quality of life.

Sialagogues, such as pilocarpine, cevimeline, and benztropine, may improve hyposalivation in patients with residual salivary gland function. IMRT with salivary gland sparing may allow stimulation of residual gland function with sialogogues. Products for mouth washing (salivary substitutes) should be considered for palliation when salivary production cannot be stimulated. Despite these products, patients often require an alternative for eating and car- rying water for frequent mouth washing. There has been no assessment of saliva aspiration and related functions, and while mucositis such as xerostomia and xerostomia can be considered for patients with thickened secretions, their effective-ness is not well documented.

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orders may also follow oncologic surgery, which may damage the lingual branch of the glossopharyngeal nerve or the chorda tympani.

IMRT may spare salivary glands and thus reduce the impact of radiation therapy on taste. However, low-dose irradiation to peripheral areas of the oral cavity may impact taste. Radioprotectors, such as amifostine, may have utility in protecting taste by protection of tissue or indirectly by maintenance of salivary flow.18 Dietary counseling/modification, addition of seasoning to food, avoidance of unpleasant foods, and food rotation are recommended. Local infection and hypo- salivation should be managed if possible. Zinc supplementation may affect taste dysfunction.19,20

Postradiation Fibrosis
Radiation therapy and surgery may lead to limited oral opening, limited mobility of the tongue, and trismus that may affect oral function. Trismus may be defined as a maximum jaw opening of <35 mm, and severe trismus as a maximum jaw opening of <23 mm; it is reported in up to 45 percent of HNC patients. Radiation therapy can result in atrophy or hypoplasia of the muscles of mastication and retraction of the soft tissue envelope.21,56 Although IMRT has been shown to have lower incidence of trismus following radiation therapy, this is not consistent in recent studies. Prevention of trismus may be achieved by modifying radiation therapy fields and by introducing active jaw range-of-motion exercises during radiation therapy. Pentoxifylline, which affects fibrogenic cytokine production, has been shown to improve established trismus21b but has not been studied for prevention. Established trismus may show limited response to jaw exercising. Botulinum toxin has also been assessed for the management of trismus, although its benefits are not clearly documented.

Infection
Local oral infections and increased risk of systemic infection from an oral source may occur in cancer patients. Reactivation of latent organisms and exacerbation of chronic focal infections, including dental and periodontal infections, may occur. Cancer therapy may lead to decrease in oral microflora that can lead to infection. Chemotherapy can compromise oral mucosal immune defense mechanisms and reduce antimicrobial functions of saliva, which may lead to exacerbation of pre-existing sites of chronic infection or pre-dispose the patient to new infection and increase the risk of systemic infection. Latent herpes simplex virus infections exacerbate when host immune defenses are compromised due to malignant disease or the chemotherapeutic regimens. Management may include prophylaxis for severe positive patients who will become myelo-suppressed, or early recognition and use of antivirals.

Taste Alterations
Taste is related to sensory mechanisms, including taste, texture, temperature, and smell, that are perceived when placing food or other agents in the mouth. Taste is composed of five basic qualities: sweet, bitter, salty, sour, and umami. Umami is the taste sensation associated with pleasure or desirable flavor, and loss of umami has been suggested to have the strongest correlation with impact on quality of life.35 Taste is mediated by epithelial receptors, is impacted by hyposalivation, and may be affected by microbial factors and retention of food in the mouth. Additionally, it is affected by oral hygiene, dental and periodontal disease, mucosal inflammation, and infection.

Reduced or abnormal taste occurs in up to 70 percent of HNC patients during and following radiation therapy with or without chemotherapy.22 Recovery of taste is variable, in some studies improving in two to six months following cancer therapy, although taste change may continue indefinitely. The impact of taste change includes reduced interest in food, leading to reduced caloric and nutrient intake. Similar findings are noted in stem cell transplantation, with more severe symptoms in myeloablative transplantation compared to reduced intensity conditioning. Temporary change in taste occurs due to solid-tumor chemotherapy, such as that received by breast cancer patients. Chemotherapeutic agents may be secreted salivary, resulting in taste change during the drug is cleared; however, taste change may continue due to direct damage to taste receptors. Tissue necrosis, oral bleeding, and posturgical wounds may contribute to taste change, halsaltosis, and altered smell. Taste disorders may also follow oncologic surgery, which may damage the lingual branch of the glossopharyngeal nerve or the chorda tympani.

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Hemorrhage
Thrombocytopenia may occur in patients on high-dose chemotherapeutic regimens or due to disease involving the bone marrow. Oral hemorrhage can occur when platelet counts are below 25,000/mm3, is more likely in patients with gingivitis or periodontal disease, and may occur in ulcerative oral mucositis.

Neurotoxicity
Some chemotherapeutic agents are neurotoxic (e.g., vinclozolin, platinum agents, and taxanes) and may lead to orofacial dysphagia and pain that can be confused with pulpitis. Dental pain causes significant physical and emotional trauma, including orofacial neuropathy. Patients may develop dental hypersensitivity following cancer therapy that may be due to dental demineralization and possibly neuropathy. Patients may experience symptomatic relief with topical fluoride foods and/or desensitizing toothpaste. Topical fluoride exposure may be impacted by anxiety, depression, and sleep disturbances associated with cancer or cancer therapy.

Temporomandibular Disorders
Orofacial pain in cancer patients may include TMDs. Posturgical complications, including mandibular discontinuity defects, posttreatment fibrosis, and clenching and bruxism, may be increased, resulting in orofacial pain. These patients may benefit from oral health appliances, physical therapy—such as massage, physiotherapy, and/or muscle relaxants—and management of mood change and sleep dysfunction.

Compromised Nutrition
Compromised nutrition may occur due to nausea, emesis, and altered oral function. Oral function may be affected by hyposalivation, taste change, xerosthony, 24 Journal of the Massachusetts Dental Society Vol. 59/No. 3 Fall 2010
geal mucositis, orofacial movement and pain, and altered or limited mastication and deglutition due to posttreatment fibrosis. The most severe changes on diet intake may result in macro- and micro-nutrient deficiencies. All factors associated with oral function and oral intake should be addressed in management.

Compromised Wound Healing

High-dose chemotherapy, radiation therapy, orofacial movement, or compromised nutritional status may compromise tissue healing due to local and systemic effects that can affect patients who have undergone dental procedures. In addition to cancer therapy, comorbid conditions (e.g., diabetes mellitus, myositis, anemia, tobacco use, and nutritional compromise) may affect wound healing. These factors influence the treatment chosen following cancer therapy.

Guidelines for dental extractions in oncology are primarily based on expert opinion. General recommendations are:

- Expert and minimally traumatic extraction to avoid pain, bleeding, or infection
- Extraction within 3 days of treatment
- Antimicrobial prophylaxis
- Avoidance of surgery, if possible
- Platelet support if patient count is <40,000/mm³

Halitosis

Halitosis in cancer patients can be caused by tissue necrosis, hyposalivation, mouth breathing, poor oral hygiene, and viral infections, and oral bleeding. Treatment is directed at diagnosis and treatment of the cause(s) when possible.

Soft Tissue and Osteonecrosis

Risk for osteonecrosis of the jaws is seen in patients following head and neck radiotherapy, and in patients provided bisphosphonates for oncologic purposes and possibly antiangiogenic medica-
tions. Dental necrosis and bone exposure can be asymptomatic or minimally symptomatic and, therefore, not recognized until progressive and symptomat-
tic, resulting in limited recognition and underdiagnosis. Comorbid risk factors include diabetes, immunosuppressive therapy and immunosuppression, local trauma, and tobacco use. Prevention is the primary goal, and pretreatment dential management and preventive care to reduce local tissue irritation and dental disease following treatment are critical.

In radiation-associated osteonecro-
sis, management may include antico-
agulants, hyperbaric oxygen, sequestec-
tomy, and surgery with vascularized free flaps from in advanced cancers. Other adjuvant approaches, including the use of pentoxifylline and vitamin E, are in study. In bisphosphonate-associated osteonecrosis, HNC patients and stem cell transplant patients may be at risk for development of oral necrosis and to posttreatment myeloporo-
pliferative disorders, which present in the head and neck and in the oral cavity, and have been linked to smoking status.

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References

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