An interim extraoral prosthesis used for the rehabilitation of a patient treated for osteoradionecrosis of the mandible: A clinical report

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In patients with tumors of the head and neck, ionizing radiation delivered in dosages that will kill cancer cells induces unavoidable changes in normal tissue. Bone cells and vascularity may be irreversibly injured, leaving devitalized bone susceptible to the development of osteoradionecrosis. This clinical report describes the fabrication of an acrylic/rubber prosthesis retained by an orthodontic headgear. The prosthesis was used to improve the mastication, speech, and saliva control of a patient treated for osteoradionecrosis of the mandible. (J Prosthet Dent 2001;86:130-4.)

In patients with tumors of the head and neck, ionizing radiation delivered in dosages that will kill cancer cells induces unavoidable changes in normal tissue. The degree of these changes is related to a variety of host factors as well as to the radiation fields, dosage, energy, total time of delivery, and number of fractions given.[1] Bone cells and vascularity may be irreversibly injured with the destruction of osteocytes, absence of osteoblasts, lack of new osteoid, and fibrosis of the blood vessels. This devitalized bone is highly susceptible to infection and has a limited capacity for repair. If initiated, the necrotic process may readily extend throughout the compromised bone, leading to the development of osteoradionecrosis (ORN).[1,2]

Clinically, ORN can be defined as an exposure of necrotic, irradiated bone through a wound in the overlying soft tissues that does not heal after 3 to 6 months. The diagnosis is made when there is pain, loss of substance of mucosa, fracture of the bone, trismus, infection, and radiographic evidence of necrotic bone.[3] The mandible is far more likely to be affected than the maxilla,[4] mainly because of its compact structure and its predominant blood supply through end arteries.[5] ORN is usually a late complication of radiotherapy, with an average appearance delay of 22 months[6] and an unpredictable increase and persistence of risk with time, even up to 20% after 10 years.[1,3] Daly et al[7] found 41% of the cases to be spontaneous, 28% caused by extractions before irradiation, 17% after jaw surgery for disease in an irradiated area, 7% caused by irritation from a prosthesis in an irradiated area, and the remainder caused by trauma or extractions after radiation. When the mandible has been partially lost as a result of ORN, the functions of respiration, deglutition, and speech are frequently severely compromised.[2]

This clinical report describes the fabrication of an interim extraoral prosthesis used to improve the speech, mastication, and saliva control of a patient treated for ORN of the mandible.

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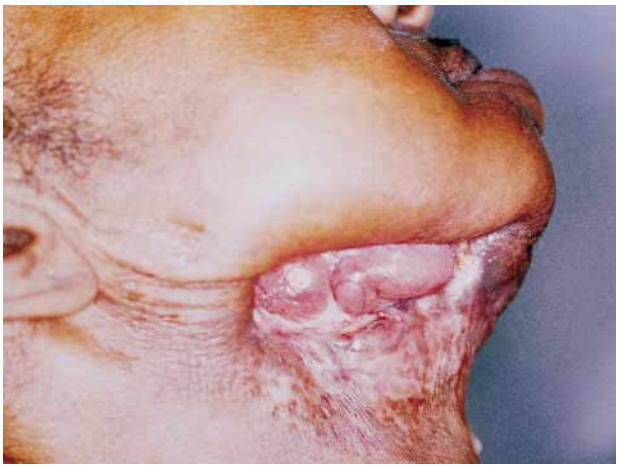

Fig. 1. Mandibular defect revealing patient's tongue.

CLINICAL REPORT

A 57-year-old woman presented with a large eroded ulcer on the undersurface of the right side of her mandible; the ulcer extended from the angle to the midline (Fig. 1). The lesion was full thickness and revealed the inside of her mouth and tongue. She reported a history of a slow-growing salivary gland tumor in the floor of her mouth; the tumor had begun in 1993 but was not surgically resected until 1996, by which time it had invaded the mandibular bone. Resective surgery was followed by a course of radiation therapy. Neutrons were used because there was still macroscopic evidence of tumor after the surgery, and the lesion was slow growing.

The surgical site healed uneventfully and remained stable and asymptomatic for 2 years. It then developed a spontaneous area of ulceration that did not heal after repeated attempts at conservative management with irrigation, debridement, and organism-specific antibiotics. Radiographic examination revealed the presence of a necrotic sequestrum of bone and helped confirm the clinical diagnosis of ORN. The necrotic tissue was resect-

Fig. 2. Panelipse showing poor periodontal condition of mandibular teeth.

ed back to viable tissue margins, the defect was packed with ribbon gauze impregnated with Whitehead's varnish, and a nasogastric tube was inserted to maintain the patient's nutrition while healing took place. The pack was removed after 1 week, and the wound was inspected and gently irrigated. New packs were placed over the subsequent weeks until the bone was covered by granulation tissue. Because no immediate reconstructive surgery was planned for fear of inducing further ORN, the patient requested a prosthesis to help her eat, drink, and control drooling saliva in the interim. Although her speech was affected by the defect, it was still intelligible and not of much concern to her.

On examination, the defect had healed well, but the margins were still sensitive and friable. Surgery had resulted in the tongue becoming tethered down to the floor of the mouth in many areas. The few teeth remaining in the patient's mandible had a Class III mobility with extensive periodontal involvement (Fig. 2). These could not be extracted for fear of causing more damage and reinitiating the necrotic process. In addition, the patient had severe trismus as a result of radiation-induced fibrosis of the muscles of the temporomandibular joint, which made access to the inside of her mouth difficult. This extensive defect presented the patient with many problems. She found it difficult to maintain food and fluids in her mouth while eating and drinking. This was made worse by the fact that part of her tongue had been resected during her original cancer surgery. There was constant drooling of saliva from the base of her mandible, and she had to wrap a large bandage over her head to control this. In addition, the defect allowed her tongue to drop out of her mouth, which was uncomfortable as well as cosmetically deforming (Fig. 3).

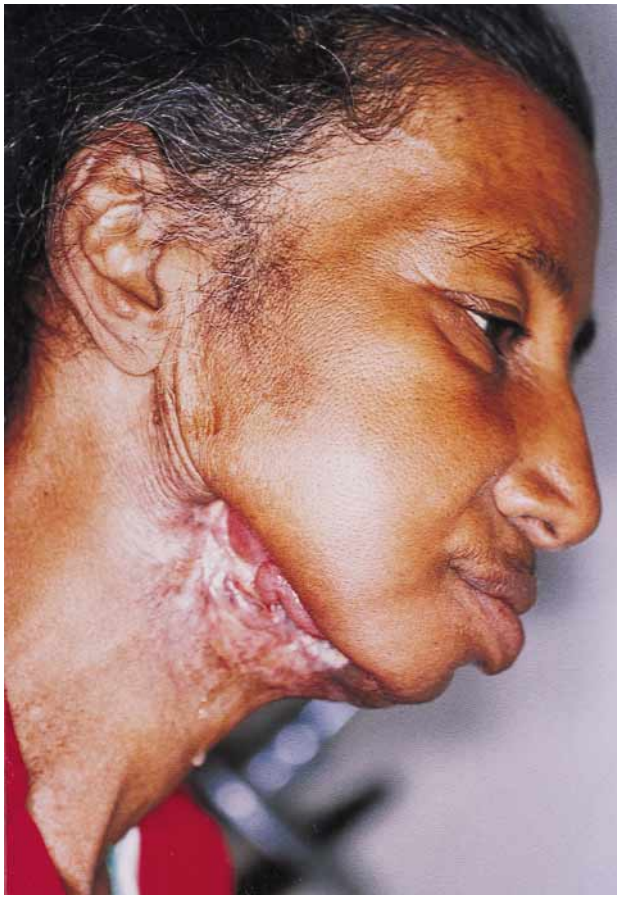

Fig. 3. Saliva drooling from defect.

Treatment plan

An interim prosthesis was needed until surgical grafting and reconstruction could be attempted. This appliance needed to support the patient's tongue inside her mouth; prevent food and fluids from dropping out while she ate and drank; reduce saliva leakage; reduce the drying of her mouth; prevent wound contamination and secondary infections; reduce the foul smell; be retentive, stable, and comfortable once in position; and be esthetically acceptable. Retention for such a prosthesis was a problem. The defect was very

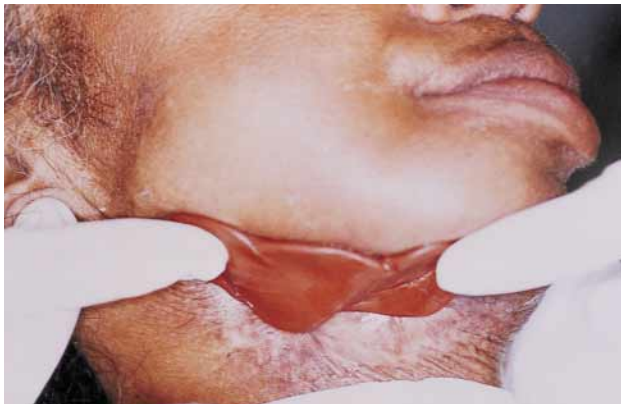

Fig. 4. Compound impression molded over defect.

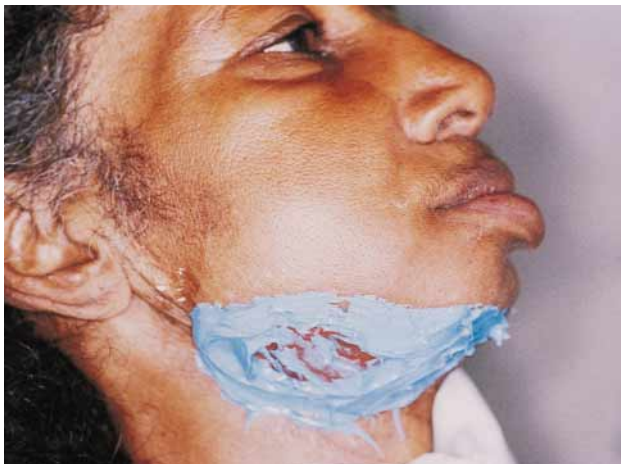

Fig. 5. Recording of functional impression.

large with few useable tissue undercuts around the rim, and the tissues in this area were atrophic, tender, and not healthy enough to sustain any mechanical stress placed on them. The teeth offered no means of retention because they were loose and periodontally compromised; moreover, the trismus would have made it impossible to gain access to take an impression of them. The surrounding facial skin was constantly moist because of the drooling saliva, which eliminated the option of using medical adhesives, and these tissues were mobile, which would have further weakened the adhesive bond.

A prosthesis made out of a combination of hard acrylic resin and a flexible rubber material (Molloplast-B heat-cured soft denture liner, Molloplast Regeneri GMbH and Co, Karlsruhel, Germany) was planned. It was retained by means of orthodontic headgear. The acrylic backing provided stability and housed retentive hooks, whereas the flexible Molloplast-B fitting surface formed a seal with the facial tissues and allowed for a small amount of tissue movement without becoming dislodged. Molloplast-B has a lower wettability than acrylic resin and thus allows saliva to stick to its surface better.

Treatment sequence

An impression was taken with the patient sitting upright because her facial tissues changed shape when she moved her head or lay on her side. Impression compound was used because it is stiff and moldable, does not droop as a result of gravity, and is not distorted by the moisture of saliva. The compound was molded to the patient's jaw to capture the basic shape of the defect (Fig. 4) and was then removed, chilled, and modified to be used as a special tray for the definitive impression. It was reduced by 2 to 3 mm on the tissue-fitting surface to allow space for a thin layer of a vinyl polysiloxane impression material (Reprosil, Regular body, Dentsply International Inc, L. D. Caulk Division, Milford, Del.). This was replaced over the defect. While it was setting, the patient was asked to move her head from side to side, open and close her mouth, sip water, swallow, and talk in an attempt to create a functional impression (Fig. 5).

The impression was removed and a stone model poured. A wax-up of the prosthesis was fabricated and tried on the patient to verify the fit. The cast was altered by reducing the stone 1 mm around the periphery. This reduction ensured that the final prosthesis fit closely to the underlying tissues. Custom-made clasps were positioned in the wax before flasking. A 2-mm–thick layer of dental laboratory putty (Coltène Lab-putty, Coltène/Whaledent Inc, Mahwah, N.J.) was packed into the model on the tissue-fitting surface in the areas where the Molloplast-B was to be placed. Acrylic resin was mixed at chairside with extrinsic colors, and veining was added to match the patient's skin tone. The resin was packed into the other half of the flask, which was closed and clamped while the acrylic polymerized. The flask was then opened, the laboratory putty removed, and Molloplast-B was packed into the resulting space. The flask once again was closed and clamped for 8 hours while the Molloplast-B polymerized (Fig. 6).

At the delivery appointment, the final prosthesis was evaluated and appeared to conform to the defect well. An orthodontic headgear was adjusted to fit snugly around the patient's head. One band was permanently secured around one of the clasps; the other band had a hook attached that allowed the patient to place and remove the prosthesis herself (Fig. 7). When fitting the headgear, it was important to ensure that the pull was firm enough to keep the prosthesis in close contact with the defect to control the drooling saliva and support the patient's tongue effectively. However, it was equally as important to make sure that the tension did not cause tissue pressure, which

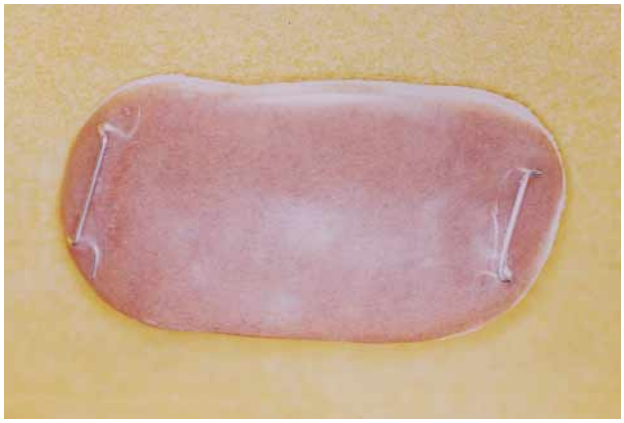

Fig. 6. Prosthesis with acrylic resin housing hooks and Molloplast-B fitting surface.

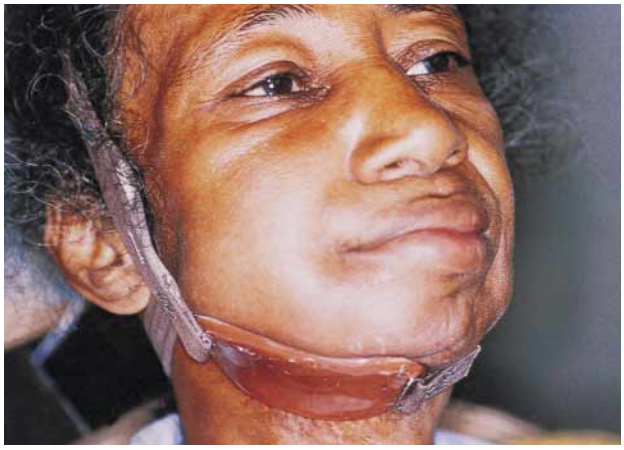

Fig. 7. Headgear securing prosthesis in position.

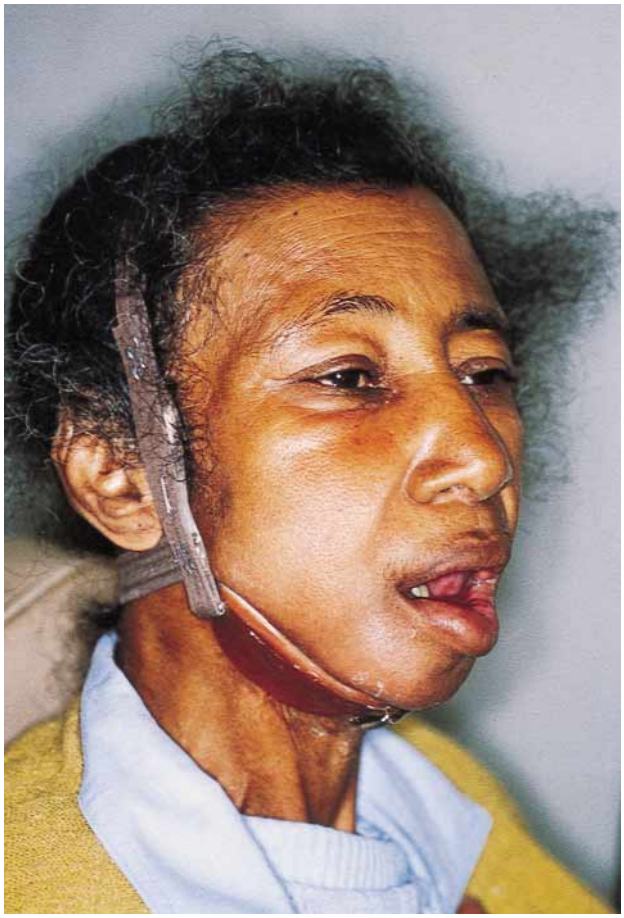

Fig. 8. Close adaptation of prosthesis during function.

can lead to further ulceration and radionecrosis as well as restrict head movement, speech, and mastication. Fortunately, the trismus permitted little facial movement; thus, dislodging forces due to eating and speaking were minimal. The patient reported that she felt comfortable with the prosthesis in position and was able to talk, eat, swallow, and open and close her mouth (Fig. 8), and move her head without discomfort or dislodging the appliance. A small amount of saliva still escaped from around the edges, but she was able to control this leakage and disguise her prosthesis by wearing a thin scarf around her neck.

DISCUSSION

Biologic actions of radiation therapy are dependent on the level of tissue oxygenation. Anoxic tissues may be up to 3 times more resistant to radiation than they would be under full oxygenation. Heavy particles like neutrons have high kinetic energy, which allows them to penetrate cells and cause death by direct action. The oxygen effect is not as pronounced for neutrons as it is for photons; consequently, the former may be more effective in treating large hypoxic tumors.[8] Thus, neutron therapy often is used for slow-growing tumors where oxygenation to the tissues is poor. This therapy is used especially in tumors of minor and major salivary glands and in situations in which there is macroscopic tumor left after surgery. Unfortunately, the high incidence of radionecrosis seen after neutron therapy occurs because it is nonspecific and destroys tumor cells and normal tissue with equal vigilance.

After wound debridement for ORN, it is advisable to pack the cavity with gauze during healing until the margins are seen to be granulating. The cavity should not be impregnated with antibiotics, as this can lead to a bacterial overgrowth and a foul-smelling pack. Whitehead's varnish, an ether solution of benzoin, iodoform, borax, and balsam of Tolu, is recommended; it is well tolerated by bone and soft tissues, and it waterproofs the gauze and inhibits bacterial growth.[4]

Prophylactic extraction of diseased teeth in the radiation field has been considered a means of reducing long-term incidence of bone necrosis.[8] However, some

authors[9,10] argue that this increases the risk of bone infections and that only completely unsalvageable teeth should be extracted before radiotherapy to ensure that there is a time interval of at least 15 days between extraction and commencement of treatment.[11] Whenever possible, an attempt is made to retain teeth to support tooth-borne appliances for the tentatively planned rehabilitation of these patients.[1] Tooth preservation is possible with the use of stringent oral hygiene measures and topical fluoride application.[6] However, criteria for removing teeth include extensive caries, periodontal disease, lack of opposing teeth, partial or incomplete eruption, periapical disease, and mobile teeth.[12] Unmotivated patients who continue to use tobacco and alcohol and patients with poor oral hygiene measures should also have all doubtful teeth removed before or as soon as possible after the therapeutic radiation in the case of difficult extractions or where rapid tumor growth requires immediate commencement of radiation.[13]

SUMMARY

Clinicians who treat patients with head and neck cancer should strive to reduce posttherapeutic morbidity. However, when complications such as ORN arise, they need to be addressed appropriately. Although surgical intervention can halt the disease process, prosthodontic rehabilitation often is needed to restore mastication, speech, respiration, and esthetics. This may be a temporary solution where further surgery is planned or may become the definitive treatment in patients for whom there is no surgical option available. Ultimately, the goals of all therapy are to maximize cure, to optimize function and cosmetic results, and to minimize morbidity.

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