Review

Radiotherapy prostheses

Hisashi Taniguchi

Department of Maxillofacial Prosthetics, Maxillofacial Reconstruction and Function, Division of Maxillofacial/Neck Reconstruction, Graduate School, Tokyo Medical and Dental University

The orofacial region performs the essential functions of mastication and speech, as well as that of appearance, which for better or worse evokes an instant and instinctive response in other people. In this region, tissue loss caused by surgical resection of a malignant tumor has a tremendous negative impact on the patient’s quality of life, with deep mental and psychological repercussions. Therefore, from the standpoint of preserving form and function, radiotherapy has a major role to play in the treatment of malignant tumors in the orofacial region. That said, important organs, such as sensory organs, are present in close proximity to each other in this small region. During the irradiation process, therefore, it is important to ensure that the lesion is sufficiently irradiated while simultaneously protecting the surrounding normal tissue. In certain cases of radiotherapy of malignant tumors of the orofacial region, the use of radiotherapy prostheses can help to satisfy a basic principle of radiotherapy: that of delivering a lethal dose to the tumor while minimizing irradiation to normal tissue. In recent years, medical and dental experts have taken a team approach to creating and employing a variety of radiotherapy prostheses, working towards improving the treatment record for malignant tumors as well as reducing complications in surrounding normal tissue. As a result, patients treated with radiotherapy prostheses are now able to receive post-radiotherapy prostodontic treatment in a dramatically safer and more rapid manner. It is clear that radiotherapy prostheses contribute significantly to the improvement of these patients’ quality of life.

Key words: spacer, shield, carrier, protector, mold, post-radiotherapy prostodontic treatment

Introduction

Treatment of malignant tumors can involve surgical resection, radiotherapy, chemotherapy, and/or a multidisciplinary approach involving a combination of two or more of these methods. Which method is selected and employed is determined by such conditions as the locus, range, form, and radiosensitivity of the tumor. The orofacial region provides functions essential to basic human life: delicate and diverse motor functions such as mastication, deglutition, and speech; sensory functions including taste and touch; and the esthetic function intimately associated with the face, the gateway to communication with other people. In this region, once tissue is lost through surgical removal, no prostodontic treatment or reconstructive surgery can fully replace it. Radiotherapy has the advantage of being able to preserve form and function, and therefore has great potential as a method for treating malignant tumors of the orofacial region.

Although advances in such techniques as multiple
portai irradiation, interstitial irradiation, wedge filter irradiation, fractionated irradiation, and radiation treatment under hyperbaric oxygen have enabled accurate dose calculation and correct dose distribution, the clinical issue of post-irradiation complications involving the surrounding tissue remains to be resolved. Complications of the orofacial area include mucosal weakening, soft tissue fibrosis, salivary gland disorders, and bone complications; with the onset of osteoradionecrosis, sequestrum removal results in maxillary and/or mandibular loss, and the advantage of radiotherapy is itself nullified\textsuperscript{1,2}. The mandible in particular is known as a prime target for refractory radiation osteopathy by virtue of the ease with which blood supply is compromised, owing to the thick cortical bone and thin mucosa; the onset of osteonecrosis causes the patient to suffer prolonged pain and eating difficulties, making oral management, including post-radiotherapy dental treatment, extremely difficult\textsuperscript{3,4}.

These circumstances have prompted the creation and employment of various radiotherapy prostheses with the dual aim of reducing or preventing complications and improving the effectiveness of irradiation. Early examples from the 1920s and 1930s are radium needle carriers using such materials as vulcanized rubber, wax, and modeling compounds\textsuperscript{5}, while Turre\textsuperscript{6} in 1947 and Golberg\textsuperscript{7} in 1959 reported the use of precursors to modern radiotherapy prostheses that utilized materials such as acrylic resin and lead plates. Reports to date have included a wide range of radiotherapy prostheses with varying names according to the form, construction, function and/or objectives of the device: applicators, stents, molds, positioners, splints, protectors, locators, shields, carriers, templates, spacers, etc.\textsuperscript{8-30} More recently the close collaboration of radiotherapists and maxillofacial prostodontists has resulted in refinements and improvements in an increasing number of clinical cases\textsuperscript{30}, wherein the application of radiotherapy prostheses has reportedly contributed to better treatment results and fewer complications\textsuperscript{31,32}, so that the classification, indications, and methods of fabrication have now been established for radiotherapy prostheses\textsuperscript{33}.

Maxillofacial prostodontists have also, on the request of radiotherapists, taken charge of prosthodontic treatment in patients having undergone curative radiotherapy for oral cancer, including patients treated with or without radiotherapy prostheses. As these patients suffer from varying degrees of the complications described above, and because as long as mucosal and bone complications are latent, osteoradionecrosis can occur regardless of whether or not prosthodontic treatment is performed, caution must be exercised that the prosthodontic treatment does not become the trigger for these conditions\textsuperscript{34,35}. On the other hand, the increasing shift of focus onto the need to improve the patient's quality of life is demanding safer and earlier improvement and/or restoration of oral function\textsuperscript{36}.

Given that the combined use of radiotherapy prostheses can improve treatment results and reduce complications, it is conceivable that radiotherapy prostheses are not only useful for the local control of oral cancer but are also effective for later prosthodontic treatment. In a recent prosthodontic treatment follow-up that we conducted, we found that out of 123 patients whose prosthodontic treatment site included or was adjacent to the irradiation field, 14% (n = 12) of patients in the no radiotherapy prostheses group (n = 84) experienced the onset of osteoradionecrosis, while none of the radiotherapy prostheses patients (n = 39) did.

This paper discusses current use of radiotherapy prostheses with reference to clinical statistics and clinical cases.

**Classification of radiotherapy prostheses**

Santiago\textsuperscript{37} and Rahn and Boucher\textsuperscript{5} have each classified radiotherapy prostheses according to their objectives. A summary would be as follows:

1) Prostheses to displace peripheral normal soft tissues, which are movable, away from the field of irradiation

2) Prostheses to shield normal tissue against irradiation with lead

3) Prostheses to hold radioactive sources at the intended site

4) Prostheses to displace peripheral normal tissues away from radioactive sources

5) Prostheses to deviate the tongue towards the source of radiation

6) Prostheses to hold the intraoral cone in a definite position

The Japanese Academy of Maxillofacial Prosthetics\textsuperscript{38} has three broad categories for radiotherapy prostheses: protectors which correspond to the above-mentioned Category 1; shields which correspond to Category 2; and carriers which correspond to Category 3.

Presumably, the type of radiotherapy prosthesis that is fabricated and employed would differ consider-
ably among treatment facilities, owing to such factors as treatment policy, facilities and equipment, and level of coordination between the radiotherapist and the maxillofacial prosthodontist. At the University Hospital, Tokyo Medical and Dental University, there have been 434 cases of combined radiotherapy prostheses used in the radiotherapy of orofacial area malignant tumors in the 19 years between 1981 and 1999. These radiotherapy prostheses, all of which were fabricated by the maxillofacial prosthodontist upon request by the radiotherapist, can be classified as spacers, shields, carriers, protectors, or molds, which are composed of a carrier combined with a shield, depending on the reason for the request and the treatment objective. One type, the spacer, which corresponds to the above-mentioned Category 4, is for distancing normal tissue adjoining or facing the tumor from the radioactive source.

An itemized breakdown of the 434 cases as well as a year-by-year case count are shown in Fig. 1. In 1988 the case count surged, with more than 80% of the radiotherapy prostheses being spacers; this was because from 1988 onwards our treatment facility made it a general rule to employ spacers in all cases of tongue cancer treated by interstitial irradiation with iridium or radium. Table 1 shows a breakdown by primary tumor site. Spacer application is not limited to tongue cancer, though, and recent years have begun to see its use in cancers of the buccal mucosa and lip. Shields, which up to now have been used in tongue cancer cases, are increasingly being replaced by spacers. Outside the oral cavity, they are also being used for eyelid cancer. Carriers are employed for gingival cancer; and molds are chiefly used for gingival and palatal mucosal cancer. Both applications are for regions whose thin mucosa rule out interstitial irradiation; the type of device used depends on whether the normal tissue is in close proximity to the radioactive source.

![Fig 1. Year-by-year case count of radiotherapy prostheses.](image_url)

### Table 1. Primary tumor site and application of radiotherapy prostheses.

<table>
<thead>
<tr>
<th>Tissue</th>
<th>Spacer</th>
<th>Shield</th>
<th>Carrier</th>
<th>Protector</th>
<th>Mold</th>
<th>Total</th>
</tr>
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<tr>
<td>Tongue</td>
<td>339</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>346 (79.7)</td>
</tr>
<tr>
<td>Gingiva</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>1</td>
<td>21</td>
<td>30 (6.9)</td>
</tr>
<tr>
<td>Palate</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>15</td>
<td></td>
<td>17 (3.9)</td>
</tr>
<tr>
<td>Buccal mucosa</td>
<td>9</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12 (2.8)</td>
</tr>
<tr>
<td>Floor of mouth</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>10 (2.3)</td>
</tr>
<tr>
<td>Lip</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>8 (1.9)</td>
</tr>
<tr>
<td>Eyelid</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10 (2.3)</td>
</tr>
<tr>
<td>Cranial base</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1 (0.2)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>359</td>
<td>22</td>
<td>11</td>
<td>41</td>
<td></td>
<td><strong>434 (100.0)</strong></td>
</tr>
</tbody>
</table>
Requirements for radiotherapy prostheses

Adaptability

In addition to being thick, the periphery of radiotherapy prostheses often extends to regions not covered by conventional dentures. What is more, the area around these regions is composed of movable soft tissue, and the placement of radiotherapy prostheses subjects the mucosa of the residual ridge as well as the surrounding soft tissue to a certain amount of pressure. Injuries to the soft tissue caused by the insertion of poorly adapted radiotherapy prostheses can lead to post-radiotherapy ulceration and osteonecrosis. In carrier cases, where the radioactive source needs to be located a certain distance from the tumor surface based on the dose calculation, poor adaptability can translate into the radioactive source not being placed in the planned location. Hence, the employment of radiotherapy prostheses requires a high degree of adaptability.

Impression taking is critical to ensure sufficient adaptability. Since patients destined to receive radiotherapy prostheses have existing tumors and, in some cases, have already undergone initial irradiation resulting in mucositis, the low-irritation, swift method of taking an alginate impression using an individual tray is the method of choice. Sufficient adjustments must be made at the trial insertion stage, and adaptability confirmed. The use of clear acrylic resin in the fabrication of radiotherapy prostheses allows for efficient confirmation of adaptability.

Retention and stability

Radiotherapy prostheses must remain fixed in a designated location during use and can be classified into two groups according to duration and frequency of use. The first group consists of radiotherapy prostheses that are used for a mere few minutes at a time, but repeatedly, for example, a shield used over the course of approximately one month during treatment with fractionated external irradiation. The other group consists of devices that are worn continuously day and night for the duration of approximately one week, such as spacers used in interstitial irradiation, or carriers or molds used in brachytherapy. In either case, any movement of the radiotherapy prostheses during use can injure soft tissue and/or lead to failure to give the planned dose; sufficient retention and stability are therefore crucial. Care is especially warranted in radiotherapy prostheses that are placed so as to receive a certain amount of pressure from surrounding soft tissue. On the other hand, radiotherapy prostheses that are to be used repeatedly must be designed so that retention is not excessive, as the insertion and removal of these devices will be carried out by the radiotherapist and/or the patient. The technique in some molds has recently been improved to allow for removal of the device at mealtimes. Since this is done by the patient, it is essential to confirm an appropriate degree of retention.

In both dentulous and edentulous cases, the imparting of an appropriate occlusal relationship helps to enhance the retention and stability of radiotherapy prostheses. In edentulous cases where the use of retention devices such as clasps is precluded, devices such as chin caps may be considered.

Structure and shape

Radiotherapy prostheses must be sturdy and structured so as to withstand damage. A structure which allows for speedy shape modification as the need arises is also preferable in case emergencies occur during the course of treatment. The overall shape should be rounded and simple, with care taken to ensure that no portion of the radiotherapy prosthesis protrudes into or injures surrounding soft tissue. In addition, due to the nature of the treatment, the treatment starting date is predetermined and the radiotherapy prostheses must be made within a limited time; therefore, it is important to avoid complicated structures.

Applications of radiotherapy prostheses

Spacers

In Fig. 2A, a patient with cancer on the left side of the tongue was treated by interstitial irradiation with a radium-226 needle and spacer. The patient was a 56 year old male with a histopathological diagnosis of squamous carcinoma. The tumor size was 17 mm anteroposteriorly and 17 mm left to right, with a thickness of 5 - 6 mm. Border molding was done using modeling compound and an individual tray, and an alginate impression was taken so that mesiodistally it spanned from the median to the vicinity of the anterior edge of the mandibular ramus, up and down from the dental cervix or crest of the alveolar ridge to the mylohyoid line, and was adjusted so that the distance between the tumor surface and the opposing mandibular gingiva was approximately 10 mm. By maintaining a distance of approximately 10 mm from the radioactive source, it was possible to attenuate to approximately 50% or less
Fig 2. Application of the spacer for tongue cancer.
(A) cancer on the left side of the tongue
(B) the completed spacer
(C) the spacer inserted into the oral cavity
(D) the schematic drawing
(E) the actual treatment conditions
(F) localized mucositis in the treatment region
(G) no mucositis in the facing gingiva
the dose absorbed by the opposing side gingiva and mandible. Obviously, the use of lead would further improve dose reduction; however, for reasons including lead-caused back scatter making it difficult to make an accurate dose estimation to the tumor, the increased spacer weight and accompanying fatigue and discomfort during use, and complexity of fabrication, the use of shields in interstitial irradiation for tongue cancer has become less common in recent years. To allow for the swelling of the tongue after implantation of the radioactive source, the occlusal part of the prosthesis was adjusted for a 10 mm bite opening at the anterior teeth. Because meals were given via nasogastric tube for the duration of spacer use, there was no need to impart occlusion for mastication purposes; an occlusal index for the upper teeth was established at the occlusal part to stabilize the occlusion. A ball clasp was used as the retention device because of its sufficient retention and ease of adjustment. During trial insertion, degree of retention, excessive tongue deformation, pain, retching reflex, extreme discomfort, and occlusion were checked. The completed spacer is shown in Fig. 2B, while Fig. 2C shows it inserted into the oral cavity. Fig. 2D is a schematic drawing. A 20 mm × 20 mm area was interstitially irradiated with radium-226 needles at a total dose of 70 Gy over 7 days as calculated by the Paterson-Parker system (Fig. 2E). During treatment, the spacer showed good retention and stability, with no pain or abnormalities in the oral mucosa. Fig. 2F and 2G show the state of the oral cavity 14 days after completion of irradiation. Localized mucositis had occurred in the treatment region (Fig. 2F), whereas none had occurred in the facing gingiva (Fig. 2G), indicating that sufficient irradiation in the direction of the tumor, and sufficient protection by the spacer, had been achieved.

In recent years spacers have been used in interstitial irradiation of the buccal mucosa using gold-198 grains, with results similar to those in cases of tongue cancer (Fig. 3A and 3B).

**Shields**

Fig. 4A illustrates a case in which external irradiation with a Betatron was performed with a shield to treat lower lip cancer. The patient was a 52 year old male with a histopathological diagnosis of squamous carcinoma. The tumor was 50 mm from left to right and 18 mm top to bottom, with a thickness of 12 mm. An alginate impression was taken using modeling compound and an individual tray. Sufficient border modeling was carried out of the deepest part of the anterior vestibule, and adjustments were made to allow for encapsulation of a 4 mm thickness of lead. In order to separate the labrum from the irradiation field as much as possible, the occlusal part of the prosthesis was adjusted to allow a bite opening of 10 mm at the anterior teeth, and an occlusal index for the opposite teeth was established to stabilize the occlusion. This shield was heavy and thick, with a border that extended to movable tissue not usually covered by normal dentures, and to allow for detachment, was made in an overlay style whereby the clear matrix of the prosthesis directly covered the residual teeth. The completed shield is shown in Fig. 4B, the shield as inserted into the oral cavity in Fig. 4C, and schematically in Fig. 4D. An 8 MV electron beam was used to irradiate a 40 mm × 80 mm treatment area to give a total dose of 40 Gy in 16 fractions over 30 days (Fig. 4E). No problems occurred regarding retention or stability of the shield during treatment, or in its insertion or removal by the radiotherapist.
Upon completion of irradiation, there was no mucositis in the anterior mandibular gingiva, indicating that a sufficient protective effect had been achieved by the shield.

Shield use is not limited to the oral cavity; it is now also being applied in cases of external irradiation for upper eyelid cancer. In these cases it is recognized as having a sufficient protective effect (Fig. 5A, 5B, and 5C) by preventing complications such as cataracts or blindness.

Carriers

In Fig. 6A, a clinical case is shown whereby cancer of the maxillary gingiva was treated by brachytherapy
Fig 5. Application of the shield for upper eyelid cancer.
(A) cancer of the upper eyelid
(B) the shield in place
(C) the schematic drawing

Fig 6. Application of the carrier for maxillary gingival cancer.
(A) cancer of the maxillary gingiva and the labial mucosa with resultant mucositis by initial irradiation
(B) the completed carrier
(C) the carrier inserted into the oral cavity
(D) the schematic drawing
with gold-198 grains in a carrier. The patient, a 52 year old female, was histopathologically diagnosed with squamous carcinoma. Neoplasm was found on the labial mucosa and the gingiva on both the labial and palatal sides, spanning the area between the left and right side canines. The field for irradiation consisted of the labial mucosa and lip side gingiva. Just two weeks prior to this treatment, the same patient had completed a course of initial irradiation consisting of Linac 6 MeV X-rays at a total dose of 30 Gy in 15 fractions over 21 days, with resultant mucositis in some areas. Accordingly, impression taking, using an individual tray, modeling compound, and alginate impression material, was performed with great care to avoid applying pressure to the tissue surface. As the carrier was to be worn continuously day and night, the border molding was adjusted with great caution so as not to cause pain, and the overlay technique was used for

Fig 7. Application of the carrier for cranial base cancer.
(A) cancer of the cranial base
(B) the completed carrier
(C) the actual placement of gold-198 grains on the cranial base by the carrier
(D) the schematic drawing
retention. There was no need to impart occlusion for mastication purposes, because the carrier was to be removed during meals; an occlusal index for the lower teeth was established to stabilize the occlusion. A cavity for the radioactive source was formed in the location prescribed by the radiotherapist so that the distance between the radioactive source and the tumor surface would be 3 mm. The radiotherapist encapsulated the radioactive source in self-curing resin. The completed carrier is shown in Fig. 6B, while Fig. 6C shows it in place and Fig. 6D shows it diagrammatically. A total dose of 70 Gy over 5 days, as calculated by the Paterson-Parker system, was given. During treatment there was no problem with carrier retention or stability, or with insertion or removal by the patient. No shield was used in this clinical case, since the normal tissue to be protected was not in close proximity to the radioactive source. Adequate irradiation by the carrier was achieved.

Carriers have also performed well outside the oral region, in the treatment of cranial base cancer (Fig. 7A, 7B, 7C, and 7D). Radioactive sources used with carriers include iridium-192 seeds and radium-226 needles in addition to gold-198 grains.

Protectors

Fig. 8A shows a clinical case of protector use with Betatron external irradiation to treat a right side maxillary gingival tumor. The 47 year old male patient was histopathologically diagnosed with malignant melanoma. The tumor was 32 mm mesiodistally and 26 mm up and down, and was found in an area between the right lateral incisor and the right first molar. The completed protector is shown in Fig. 8B, and the same in place in Fig. 8C. Since this protector worked by everting the labrum away from the field, its retention was achieved through an overlay style to prevent detachment, and stability of the device and the occlusion during irradiation were maintained by securely biting. An 8 MV electron beam delivered a total dose of 32 Gy in 4 fractions over 21 days. No problems arose during this period in terms of protector retention, stability, or insertion/removal. No mucositis was found in the labrum that the protector served to evacuate. Adequate irradiation of the neoplasms, and a sufficient protective effect on the part of the protector, were achieved.

Molds

A clinical case involving gold-198 grain brachytherapy for adenoid cystic carcinoma of the palate is
Fig 9. Application of the mold for palate tumor.
(A) adenoid cystic carcinoma of the palate
(B) the completed mold, the shield and carrier were separated
(C) the completed mold, the shield and carrier were joined
(D) the mold in place
(E) the schematic drawing
(F) localized mucositis in the treatment region
(G) no mucositis in the facing tongue
shown in Fig. 9A. The patient was a 64 year old female. The tumor size was 18 mm anteroposterior and 15 mm left to right. To achieve adequate coverage of the irradiation field, the carrier was fabricated by means of alginate impression with an individual tray containing modeling compound. On the oral cavity side of the carrier, a total of 3 shield-retaining grooves were formed at the anterior and posterior areas, an alginate impression taken of the surface, and a 4 mm thick lead plate encapsulated so as to extend by approximately 5 mm beyond the region where the radioactive source was to be imbedded, as prescribed by the radiotherapist, to create the shield. A cavity for the radioactive source was formed at the site prescribed by the radiotherapist so that a 1 mm distance lay between the radioactive source and the tumor surface. Retention of the carrier to the residual teeth was by ball clasp, the carrier and shield were joined by mechanical fitting of the groove sites. The mold was to be removed for mealtimes, so there was no need to impart occlusion for mastication purposes, and an occlusal index for the lower teeth was established on the mold to stabilize the occlusion. The completed mold is shown in Fig. 9B and 9C, the same mold inserted into the oral cavity in Fig. 9D, and its scheme in Fig. 9E. A total dose of 68 Gy over 7 days was given according to the Paterson-Parker system. During the treatment period, no problems arose in terms of mold retention, stability, or insertion/removal. Fig. 9F and 9G show the state of the oral cavity at 14 days after completion of irradiation. There was localized mucositis on the left side of the palate at the irradiated site (Fig. 9F), but no mucositis on the tongue (Fig. 9G). Adequate irradiation by the carrier and sufficient protection by the shield were achieved.

Looking outside the oral region, Fig. 10A and 10B illustrate the use and schema of a single-piece mold for cancer of the vaginal mucosa. In this case, an afterloading technique was employed using an iridium-192 seed assembly.

**Effects of radiotherapy prostheses in prosthetic treatment of irradiated patients**

Patients who have undergone curative radiotherapy for oral cancer are considered to have some degree of latent mucosal and bone complications, and the practice has been to postpone prosthetic treatment as much as possible to avoid triggering osteoradionecrosis. This tendency is particularly pronounced for patients in the no radiotherapy prostheses group, and in many cases forces the patient to endure inconveniences in day to day life. Whether or not to give prosthetic treatment is decided by the radiotherapist, and the maxillofacial prosthodontist commences prosthetic treatment only after the radiotherapist makes the request to do so. While every precaution must be taken to prevent the prosthetic treatment from initiating osteoradionecrosis, the fact is that ordinary prosthetic treatment remains the best approach. The most important points are to have the patient recognize that osteoradionecrosis is a possibility, and to follow up at frequent intervals.

In our treatment facility we give prosthetic treatment to 141 patients who had undergone curative radiotherapy during the 20 years between 1980 and 1999 (Fig. 11). Out of these patients, 49 had had combined radiotherapy prosthesis use during radiotherapy. The prosthetic treatment loci in 123 of the 141 patients either directly included or was adjacent to the

<table>
<thead>
<tr>
<th></th>
<th>Prosthodontic treatment</th>
<th>All cancer patients (n=123)</th>
<th>Tongue cancer patients (n=72)</th>
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<tr>
<td></td>
<td></td>
<td>(O.R.N.)</td>
<td>(O.R.N.)</td>
</tr>
<tr>
<td>With R.P. group</td>
<td>Cr.-Br.</td>
<td>6(0)</td>
<td>6(0)</td>
</tr>
<tr>
<td></td>
<td>P.D.</td>
<td>21(0)</td>
<td>18(0)</td>
</tr>
<tr>
<td></td>
<td>C.D.</td>
<td>12(0)</td>
<td>9(0)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>39(0)</td>
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</tr>
<tr>
<td>Without R.P. group</td>
<td>Cr.-Br.</td>
<td>3(0)</td>
<td>1(0)</td>
</tr>
<tr>
<td></td>
<td>P.D.</td>
<td>43(10)</td>
<td>22(5)</td>
</tr>
<tr>
<td></td>
<td>C.D.</td>
<td>38(2)</td>
<td>16(2)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>84(12)</td>
<td>39(7)</td>
</tr>
</tbody>
</table>

irradiation field, requiring treatment with due consideration for osteoradionecrosis. Of the 123 patients, 14% (n = 12) of the no radiotherapy prosthesis group (n = 84) suffered onset of osteoradionecrosis, compared with no patients in the radiotherapy prosthesis group (n = 39). For tongue cancer patients, there was no major difference between the two groups in terms of specific prosthodontic treatment given, but 18% (n = 7) of the no radiotherapy prosthesis group (n = 39) experienced onset of osteoradionecrosis (Table 2). Additionally, a comparison of the elapse of time from completion of radiotherapy to commencement of prosthodontic treatment for the above 123 patients indicated a mean value of 4 years 11 months for the no radiotherapy prosthesis patients, while in the radiotherapy prosthesis group this value was 1 year 7 months, showing clearly that the latter group had been attended to earlier.

Conclusions

The maxillofacial prosthodontist, participating in radiotherapy through close conferencing with the radiotherapist in the design, fabrication, and application of the radiotherapy prostheses, can personally obtain detailed information on radiotherapy. This in turn gives the maxillofacial prosthodontist a clear picture of what warrants special attention, such as which loci are vulnerable to mucosal ulceration or osteonecrosis, thereby making targeted follow-ups possible (Fig. 12).

It has become clear that radiotherapy prostheses not only improve the treatment results of radiotherapy and reduce complications to the surrounding normal tis-
sue, but also facilitate safer and earlier post-radiotherapy prosthetic treatment, contributing to the improvement and restoration of the patient’s oral function as well as helping to enhance their quality of life. Further efforts are needed to improve and refine these devices, and to extend their range of indications.

References