The Contribution of Dental Implants to Functional Artificial Restoration After Treatment of Oral Cancer

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Abstract. Background/Aim: The aim of this study was to evaluate dental implants with regard to artificial restoration of oral function and quality of life in patients with oral cancer. Patients and Methods: We examined 134 implants in 41 patients who had undergone jawbone resection as treatment for oral cancer. The patients were aged 44-89 (mean=61.5) years, and the male to female ratio was 27:14. Results: The 5-year implant success rate was 91.0%. Of the 12 unsuccessful implants, four were embedded on bone grafts with skin flaps, four were embedded on skin flaps using muscle, and four were embedded after peripheral resection. Of the 41 patients, 11 received radiation, but exposure to radiation was not associated with implant loss. The level of satisfaction on the visual analog scale before development of oral cancer was set at 100 mm. Satisfaction fell to 47.0 mm after primary treatment, but recovered to 82.6 mm after implant therapy. Conclusion: Patient satisfaction after implant therapy was high, and the implants resulted in improved quality of life. A high proportion of cases involving use of skin flaps resulted in implant loss. Constructing an immobile mucous membrane by replacement of a skin flap with a skin graft may facilitate self-maintenance of implants.

Various complications can develop after resection of oral cancer, particularly if resection of the jawbone is performed. If resection is performed in the dentulous areas, teeth are often lost. Furthermore, inconveniences such as inability to insert artificial teeth are common, even after resection of the edentulous jaws. Thus, resection of the jawbone often leads to difficulties involving not only mastication, but also pronunciation and swallowing; where these complications are substantial, the patient’s quality of life (QOL) invariably declines (1).

Recent advances in oral implant therapy have made occlusion reconstruction possible even for patients with oral cancer. In cases of mild deficiency, the implant can be directly embedded and a superstructure can be created. Furthermore, occlusion can be restored in cases of transection by embedding the implant into a reconstructed bone derived from the patient’s own ilium or fibula. Importantly, treatment of oral cancer extends beyond therapy of the cancer itself. The current challenge is to develop different modes of rehabilitation that collectively may facilitate the recovery of occlusal functions to the extent that these functions approach preoperative levels.

In this study, we examined 134 implants in 41 patients with oral cancer. Associations between implant location, radiation exposure, and prognosis were investigated, and patient satisfaction was evaluated using a visual analog scale (VAS).

Patients and Methods

The study included 41 patients who had undergone jawbone resection due to oral cancer. The patients were aged from 44 to 89 years (mean=61.5 years), and the male:female ratio was 20:11. Of the 41 patients, 14 had 42 implants in the maxilla and 27 had 92 implants in the mandible. A total of 11 patients underwent radiotherapy. There were various deficiency morphologies, including 27 cases of mandibular peripheral resection, segmentectomy, and 14 cases of maxillary resection.

Firstly, we determined the success rate of the 134 implants. The implants had been fitted in numerous different contexts, including bone grafts (12 cases), skin flaps (14 cases), and areas exposed to radiation (seven cases). Next, the patients were asked to rate their level of satisfaction with respect to mastication and swallowing before the onset of their oral cancer, after treatment for it but prior to implant therapy, and after their implant therapy, using a VAS whereby 0 mm represented total dissatisfaction and 100 mm as satisfied as prior to surgery.
Results

The 5-year implant success rate was 91.0% (122/134). The success rate in the maxilla was 88.1% (37/42), and in the mandible it was 92.4% (85/92) because of the loss of total 12 implants. Of these 12 lost implants, four were embedded into the bone grafts (fibula) with skin flaps, four were embedded into the skin flaps using muscles such as the pectoralis major, and four were embedded after peripheral resection. Eight of the 12 lost implants involved embedding into skin flaps.

Of the 41 patients, 11 were exposed to radiation, with the largest dose being 40 Gy. However, no statistically significant relationship was observed between exposure to radiation and loss of implants.

The VAS self-evaluation survey determined the levels of satisfaction with respect to mastication and swallowing before development of oral cancer, after treatment for oral cancer but prior to implant therapy, and after implant therapy. The level of satisfaction before occurrence of oral cancer was set at 100 mm; it fell to mean of 37.0 mm after primary treatment, but recovered substantially after implant therapy, to a mean of 82.6 mm.

Discussion

The 5-year implant success rate in this survey was 91.0%; this value is comparable to those mentioned in previous reports, and thus constitutes an acceptable result (2, 3). The male:female ratio of 27:14 was in accordance with the general tendency of a higher incidence of oral cancer in men than in women. While the rate of implant loss was slightly higher in a small minority of the cases involving the maxilla, there were no significant differences. Generally, the rate of loss of implants of the maxilla is higher, this may because of the low bone density compared with mandible.

Results from a previous study suggest that compared to practitioner-removable superstructures, overdentures are easier to maintain, and are thus associated with more favorable prognoses (4). However, our results were better than those of that study, with regard to maxillary, and mandibular implants. Implant therapy using fibula with skin flap evidently greatly increases patient QOL (5). However, the problem of reversal of the implant:crown ratio due to the thickness of the soft tissue and the thinness of the bone remains. Studies reporting this problem have been published [see (6)], and those of implants in thin fibula flap were also observed in our study. A major limitation of skin flaps is that only relatively short implants are possible. In practice, the skin flap should be replaced with an alternative that makes plaque control easier, such as a skin graft. However, patients are often exhausted due to previous treatments and obtaining their consent for skin flap replacement can be difficult. Controlling plaque formation for implants embedded through skin flaps is extremely difficult, as is evident in the patient whose photographs are depicted in Figure 1. This patient was performing daily self-care; however, controlling formation of plaque in that area was difficult. After removing the upper structure of the implant for maintenance, a large amount of plaque was found attached to the area near the platform. The prognosis of this patient could potentially have been enhanced by measures facilitating easier daily self-care, such as persuading the patient to have the skin flap replaced with a skin graft, or making a 2-tooth bridge, even though the initial recommendation was for three implants.

A previous study on radiation therapy showed only a very slight difference in the 5-year survival rates between the cases without radiation therapy and those exposed to radiation doses of 50-70 Gy (7). However, some of the cases reported in that study developed radiation osteomyelitis, with a tragic prognosis. Another study reported that hyperbaric oxygen therapy should be administered to prevent radiation osteomyelitis in patients exposed to radiation (8). On the other hand, a different report concluded that exposure to radiation up to 50 Gy is of little danger (9). Compared to the radiation dose used in that report, the radiation doses used in this study, that were 40 Gy at most, were considered insubstantial. Our study suggests that exposure to up to 40 Gy of radiation does not adversely affect the outcome of implant therapy. The outcome of implant therapy can be improved by addressing associated problems such as those related to the cleaning of practitioner-fixed type implants (10). Notably, where implants are not properly maintained, they will have to be removed, as was the case for the second patient described in this report.

Patient-removable overdentures have proven useful, particularly in elderly patients (11), and such overdentures were used by several patients included in this study. Once a removable overdenture is embedded, daily maintenance is easy, and the prosthetic apparatus can be kept clean. However, overdentures do entail a potential problem: in cases involving peripheral resection, the supporting device is usually embedded underneath the mucous membrane, due to the slackness of this membrane. Undergoing a small incision in the mucous membrane under local anesthesia, to re-expose the supporting device, is inconvenient for most patients. In our Department, we use computer-aided design and computer-aided manufacturing to construct a custom-designed bar that can be fitted along the alveolar ridge that is used for support in cases of peripheral resection. This alteration of the supporting device further improves patient satisfaction.

In this study, changes in the mastication force or mastication efficiency of the prosthetic area were not examined because many cases involved residual teeth, and the differences in the morphological deficits were minor. Consequently, VAS was used for evaluation. While the VAS scores did not return to the
levels reported before the onset of oral cancer (assigned an arbitrary base-value of 100 mm), the fact that these scores recovered to a mean of 82.6 mm, after dropping from 100 mm to approximately less than 30 mm, should be considered very significant. The results of this study may contribute to improving the QOL in patients with oral cancer.

In the future, more patients are likely to be prescribed bisphosphonate drugs. Practitioners of different disciplines, such as oral surgeons and plastic surgeons, have published different opinions on the potential risks and benefits of these drugs, and disputes have occurred in various contexts (12, 13). With regard to implant therapy, the procedures requiring the conservative use of bisphosphonates are likely to increase, not only in cases of jaw prosthetics, as were investigated in this study, but also in other medical fields involving prosthetic implants (14-16). However, practitioners must bear in mind the importance of achieving occlusion recovery for patients with jawbone damage after treatment for bisphosphonate-associated osteonecrosis of the jaw (17). After all, implants are foreign bodies, and problems other than those associated with bisphosphonate use are likely to be encountered. Oral surgeons should aim to solve these problems collaboratively, in order to achieve optimal occlusion recovery outcomes.

The treatment of oral cancer extends beyond successful treatment of the cancer itself. One of the primary subsequent aims is to restore occlusal functions to an extent that they approach preoperative levels. Based on our data, we conclude that implant treatment may improve the QOL in postoperative oral cancer patients.

Conflicts of Interest

None of the Authors has any financial conflict of interest to disclose in relation to the content of this article.

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