The Current Status of The Irradiated Patient Regarding Dental Implant Treatment: A Review of The Literature

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Abstract

Oral implantology is a process that improves the patient's aesthetic and functional rehabilitation while also increasing their comfort. The local and overall conditions for osseointegration success, as well as the psychological environment and technological possibilities, are all considered before placing a dental implant. Clinical and x-ray workups are important elements of a patient's dental implant evaluation, and developments in CT equipment and software have improved implant surgical success. In patients who have had head and neck radiotherapy, implant therapy can be more difficult than in healthy patients. Radiation has some effects on the oral cavity that can jeopardize the osseointegration process. To promote osseointegration and prevent implant failure, hyperbaric oxygen treatment is utilized as adjuvant therapy. Finally, certain soft-tissue and bone-related problems may occur after surgery. As a result, the irradiated patient's follow-up following implant prosthetic rehabilitation is critical for long-term success. This work aims to determine the feasibility of implant placement in irradiated patients, the survival rate of its success, and the major risks of failure.

Keywords: Dental Implant • Osseointegration • Hyperbaric oxygen treatment • Implantology

Introduction

The use of Osseo Integrated Implants (OI) in cancer patients was once thought to be contraindicated by previous radiotherapy [1]. Nonetheless, it has been tried in some nations with variable success rates. There is a lot of debate in the literature on the result of OI in cancer patients [2, 3]. Implant failures or other problems appear to be more likely following previous irradiation, according to certain studies. There is no consensus on when the best time is to rehabilitate cancer patients with OI implants, how irradiation doses impact implant survival, whether irradiation after implant placement is possible, whether chemotherapy affects OI, or whether HBO (Hyper- Baric Oxygen Therapy) is required [4].

Literature Review

Osseointegration in irradiated patients

Selection of patient

Patients with edentulous mandibles: When assessing the feasibility of placing a mandibular implant in a patient who has undergone radiation therapy, the clinician should consider several factors, including the risk of osteoradionecrosis, short and long-term implant success rates, the patient's potential lifespan, the do-ability of treatment with hyperbaric oxygen therapy, and the patient's potential benefit. The radiation received by the insertion locations determines the risk of osteoradionecrosis. Furthermore, concurrent chemotherapy amplifies tissue effects and should be considered. When doses are mentioned in this discussion, the levels cited refer to dosages delivered by standard fractionation (200 cGy fractions), five fractions per week [5, 6].

The doctor should apply formulas that take into consideration the dose per fraction, the number of fractions, the total dose, and the length of time the treatment is provided when considering implant therapy for a patient treated with hyper-fractionation or fast fractionation [7]. Doses below 5500 cGy or their equivalent imply a low risk of osteoradionecrosis at the implantation sites unless the patient is treated with hyperbaric oxygen therapy. However, doses above 6500 cGy or their equivalent imply a high risk of osteoradionecrosis at the implantation sites, unless the patient is treated with hyperbaric oxygen therapy [8]. Most patients with an edentulous mandible, according to these guidelines, are strong candidates for implant treatment and will benefit greatly from it, especially if the patient has had surgery that compromises the bearing surfaces of the prosthesis or adversely affects the prosthesis. The patient's capacity to use his or her mouth and cheeks to manipulate the prosthesis. In most cases, the symphysis would have been out of scope or the dose administered to that location would have been less than 5,500 cGy if the patient had been treated with traditional radiation [7].

The only exception is malignancies of the mouth's interior floor. The dose administered to the symphysis in these individuals usually matches the tumor dose and almost invariably surpasses 6500 cGy or it's equivalent. The symphyseal region will almost always be irradiated if the patient is treated with intensity modulated radiation treatment, regardless of the tumor site, however, doses to possible implantation sites are often less than 5500 cGy. Hot spots with doses greater than 6500 cGy are common, however, the volume of these local areas exposed to high doses of radiation is usually fairly modest [7]. The tumor's prognosis is crucial in determining whether or not implant therapy will be successful. The majority of recurrences happen within the first year. Before considering implant placement, the authors wait till the end of this period [9].

Patients with edentulous maxillary: Patients with edentulous jawbones: Implant-supported obturator prosthesis help all edentulous patients with maxillectomy or palatectomy abnormalities, and the authors urge their use even though success rates are lower in irradiated areas. Osteoradionecrosis is a rare complication. The volume and quality of bone at the implant location, as well as the radiation dose, affect the success rate. When implantation sites are subjected to doses larger than 5,000 cGy, the initial anchoring of the implant is very important, because it is extremely improbable that any considerable amount of bone will deposit on the implant's surface. As a result, long-term anchoring is more likely to be mechanical than biological [9]. Some implant failures in the irradiated jaw are caused by difficulties obtaining initial anchoring during surgery, whereas others develop after loading. As a result, the physician must consider the altered biomechanics imposed by a compromised implant anchor while constructing the implant connection bar and selecting the attachments utilized for retention. Implant connection bars should be implant aided rather than implant-supported, according to the authors [8].

The tissue bar's main aim should be retention. The defect and residual area of the prosthesis should be employed to provide the complete prosthesis-obturator prosthesis with the appropriate support and stability. Because implant connecting bars have a high failure rate, the entire prosthesis should be designed to be quickly adjusted and continue to function in the event of implant failure [9].

The relationship between implant surgery and radiation: It is becoming increasingly clear that high-dose irradiation bones do not regenerate over time. This is due to the fact that irradiation bone becomes more fibrotic and less vascular, while surviving mesenchymal stem cells become few or non-existent.

According to Granstrom (2005), failure rates rise as time passes after radiation therapy [4]. Colella et al. (2007) showed no significant difference in the survival rates of implants implanted before or after radiation in a

systematic review. Implants inserted after radiation therapy had a failure rate of 3.2%, compared to 5.4% for implants placed before radiation therapy. In fields irradiated at less than 4500 cGy, no implant was lost [10].

Barber et al. (2011) conducted another systematic review that looked at the benefits and drawbacks of dental implant insertion before and after cancer [11]. Implant treatment before malignancy has been proven in the literature to shorten restoration time, but it may limit surgical alternatives if implants are inserted perioperatively. Implant placement after cancer treatment gives additional planning time and avoids radiation therapy's unfavorable biological effects [11].

Irradiation of already-in-place implants: Because backscattering occurs when titanium implants are irradiated, tissues on the radiation source side of implants receive a larger dosage than other tissues in the irradiation field [12]. In the 1 mm area from the implant's surface, the dose is raised by approximately 11% to 15% [13]. Increasing the dose locally can cause ulceration of these tissues, as well as exposure of the underlying bone and bone loss around the implants [5, 13].

Noble metal alloys are frequently utilized to construct tissue bars and implant repairs, therefore backscattering caused by these metals is a cause for worry. These restorations can go below the gum line and connect to the implant directly. The dosage increase due to backscattering can be as high as 80% in these circumstances [6, 14].

Clinicians are debating whether osseointegrated implants should be removed in patients about to be irradiated for head and neck malignancies due to backscattering and the growing number of patients having implants at the time of tumor diagnosis. Most qualified doctors advise against surgical removal before irradiation because of the considerable trauma caused by the trepanation process required to remove an osseointegrated bone-bound implant.

Granstrom et al. investigated these issues in a study of 11 individuals who needed to have 33 titanium implants irradiated. The doses ranged between 5,000 cGy and 6,600 cGy [12]. Granstrom et al. suggested that all abutments and superstructures be removed before to irradiation and that the skin and/or mucosa be closed over the implants based on their findings [12]. They indicated that after the healing process is complete, radiation therapy could commence. The authors used the Granstrom technique to treat patients with intraoral prosthesis on implants, surgically burying the implants beneath the mucosa before irradiation. The main closure, on the other hand, might be difficult to perform, and the suture line is typically tense. Dehiscence at the incision site is common, exposing the implants and their cover screws. As a result, before starting radiation therapy, the University of California, Los Angeles School of Dentistry removes the restoration and attaches titanium healing abutments to the implants. In most situations, the abutments and/or the prosthetic superstructure can be replaced when the treatment is completed. However, in the case of the mandible, a number of things must be considered, including the dose received by the implant sites, the type of prosthesis, and the patient's wishes. The danger of peri-implant tissue infections in the mandible, which can develop to osteoradionecrosis, should be taken into consideration [9, 15].

Preparation of the irradiated patient for implant placement

Multiple current clinical studies in oropharyngeal cancer are evaluating various techniques for each therapy modality, with the goal of enhancing the therapeutic ratio of treatment, decreasing toxicity, and maintaining high rates of cancer control. Reducing the volume of electively treated tissue, lowering the recommended radiation dose or using new emerging technology in radiation delivery, and prophylactic treatments are all ways to reduce toxicity. Hyperbaric oxygen is one of the preventative treatments available to reduce the risk of osteoradionecrosis. This has been suggested as a way to raise the oxygen tension in irradiation bone, which helps with capillary angiogenesis and bone production [16, 17].

Recent research suggests that oxygen in hyperbaric circumstances acts in concert with growth factors to promote bone turnover and may even act as a growth factor in its own right. By enhancing bone turnover and vascular supply to irradiated bone, hyperbaric oxygen has been proven to operate as an osseointegration activator [18, 19].

Hyperbaric oxygen improves the healing capability of irradiated tissue by increasing hair growth and osteogenesis, which raises the oxygen gradient between blood and tissue. The treatment comprises of 90 minutes of inhaling 100% oxygen under pressure, 20 sessions before surgery and 10 sessions after surgery [20].

Granstrom et al. found that using this treatment enhances implant survival rates. However, its effectiveness in the treatment of osteoradionecrosis has been questioned, in part because to a randomized, placebo-controlled clinical trial conducted by Annane et al. (2016) and other publications indicating that these therapies are ineffective [16, 21].

The success of the osseointegration

In irradiated patients, the use of osseointegrated implants is a reliable way of cosmetic and dental rehabilitation. Although radiation therapy and treatment increase the chances of implant failure, overall implant survival rates remain at 85%. Given the high prevalence of smoking in this patient population, more study is needed to shed light on the role of smoking in the failure of bone-integrated implants [11].

The faillure of the osseointegration

Colella et al. (2007) found that implants placed before radiotherapy and those implanted after radiotherapy had similar failure rates of 3.2% and 5.4%, respectively, in a systematic study. The implant failure rate in the maxilla was much higher (17.5%) than in the mandible (4.4%); all implant failures occurred within three years of irradiation, with the majority occurring every 1 month to 12 months. When the radiation dose was less than 45 Gy, no implant failure was documented [10].

In a systematic analysis, Ihde et al. (2009) found that implants placed in irradiated bone had a failure rate two to three times higher than implants placed in unirradiated bone. Higher doses (more than 50 Gy) have a higher failure rate. Implants inserted at different intervals, either before or after radiation therapy, had no significant difference in failure rate, allowing a clinical recommendation to be made. However, implants put in the jaw were at least twice as likely to fail, and survival statistics could not be used to select a certain implant [21].

Conclusion

Because of the increased likelihood of failure, implantology in the irradiated patient is a serious problem. As a result, success requires a close-knit dental team that communicates and collaborates well in order to preserve bone and soft tissue. Thus, implant surgery in irradiated bone is viable if a stringent protocol is followed, and the technique's progress is aided by a high success rate and improved quality of life. In addition to the use of hyperbaric oxygen therapy, sufficient time following radiotherapy is required to confirm the cancer's cure and excellent prognosis.

For a better patient care and a higher success rate of implant treatment in an irradiated patient:

1. Discuss the expectations for maintenance and revision with the patient before starting treatment. Ascertain that the patient is aware of the biological and technological risks involved with implant rehabilitation, the significance of home and professional maintenance, and his or her financial responsibility for future maintenance costs.
2. Develop a tailored maintenance plan for the patient, focusing on disease prevention through plaque management, and monitor the plan for effectiveness and compliance on a regular basis.
3. Recognize the clinical and radiological signs and symptoms of peri-implant mucositis or peri-implantitis as quickly as possible and intervene or refer the patient to a specialist colleague for further treatment.
4. Re-evaluate the occlusion on implant restorations on a regular basis, especially if the dentition has changed.

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