GENERAL ARTICLE

Avoiding Osteoradionecrosis - The Dental Surgeon's Nightmare

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Summary

Osteoradionecrosis is a severe debilitating complication; it may occur from radiotherapy to the bones. It is a dental surgeon's nightmare as it may be long standing and difficult to manage. Osteoradionecrosis is characterised by hypoxia, hypocellularity and hypovascularity of the affected tissue. This paper reviews osteoradionecrosis in relation to dental treatment.

Key Words: Osteoradionecrosis, Complication, Management

Introduction

Radiation is one of the modalities of treatment for cancer of the head and neck. In Malaysia, it is used extensively to treat nasopharyngeal carcinoma and as an adjunct treatment or to cure oral carcinoma. This mode of treatment is not without side effects, and among the most dreadful adverse reactions include xerostomia and loss of taste and smell. As a consequence of xerostomia, dental surgeons always find that it is difficult to maintain patients' dental hygiene status, resulting in radiation-induced caries needing extensive conservative treatment and occasionally exodontia. One of the complications of exodontia is osteoradionecrosis (ORN).

Osteoradionecrosis is a non-healing, non-septic lesion of bone in which bone volume and density cannot be maintained by the hypocellular, hypovascular and hypoxic tissue [1]. In other words the tissue cannot adequately meet its metabolic demands. There is a reduction in the osteocyte population and the vascularity of the bone. Such changes make the bone vulnerable to trauma and infection and impair its capacity to re-model and repair.

Effect of radiotherapy in general

Radiation therapy to oral tissue produces a three-fold problem[1]. First, the small blood vessels undergo endothelial death, hyalinisation, and ultimately, thrombosis[1]. Second, the fibrosis occurs in the periosteum and overlying mucosa and third, the radiation causes destruction of osteocytes, osteoblasts, and fibroblasts[1].

Dental precipitating factors

Post-radiation extractions, pre-existing

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periodontal disease and occasionally, pre-radiation extractions that are poorly planned may result in ORN of the jawbones[2].

Ill fitting dentures causing trauma to the oral mucosa and underlying bone may also be part of the cause. Consequently, the patient's dental status as well as the tumour site and radiation will determine susceptibility to ORN. Although the introduction of mega-voltage radiotherapy has lead to a fall in the incidence of necrosis of the mandible (5% of long-term survivors), its consequences are extremely serious for the patient and difficult to manage for the dental surgeons[3].

Similarly, minor oral surgery can increase the risk of bone necrosis by compromising circulation to the overlying mucosa and periosteum. Tooth extractions disrupt relatively large blood vessels entering the bone from the periodontal ligament space, leaving adjacent bone relying on collateral circulation from smaller vessels that are more prone to be affected by radiation[4].

Other precipitating factors

The effects of radiation depend on the dose of the radiation, the age of the patient, the time interval between treatments of the tissue being irradiated and the susceptibility of the individual patient[5,6]. The mandible and the maxilla are particularly prone to these effects because of their high mineral content, with the associated increase in backscatter irradiation. The mandible is more vulnerable because of its denser structure and poorer blood supply.

A study by Morrish et al (1981) found that the total dosage of radiation received by the patient seemed to be a critical factor, with no reported cases using less than 6500 RADS (6500cGy) and a significant increase noted above 7500 RADS (7500cGy)[7]. It was concluded that 85% dentulous and 50% edentulous patients developed ORN[7]. Patients who were edentulous at the time of cancer diagnosis were at low risk for ORN, whereas dentate patients showed an increased risk[7,8]. The greater incidence of dentate patients was associated with extractions occurring after radiotherapy. Dentate patients with pre-radiotherapy extraction or no extraction after radiotherapy have the possibility of developing ORN similar to that of the edentulous patients[7]. The mandible was more at risk for ORN as compared to the maxilla, presumably due to the less vascular nature of the mandible.

Articles published since 1970 showed an incidence of ORN which ranged from 5 to 22%[9]. The use of megavoltage radiation such as the cobalt-60 and the linear accelerator may result in a lower incidence since this type of radiation is supposed to spare the bone.

The risk of developing necrosis is greatest in the first six months following treatment. However, the risk of developing ORN persists for years after radiation therapy since the reduction in healing capacity may be permanent[10,11,12].

Management

Management of ORN involves prevention and the treatment proper. Obviously the dental surgeons will wish to avoid this potential complication where possible. Therefore, pre-radiation dental assessment is very important. In order to maximise the patient's quality of life and minimise the possible dental complications, the team involved in the patient care can use one of the suggested guidelines for oral care (as below).

Prevention

Guidelines proposed by Regezi et al (1976) and Donoff (1997):[13,14]

A) Pre-radiation protocol
B) Intra-radiation protocol
C) Post-radiation protocol

A) Pre-radiation Protocol

A thorough clinical and radiographic examination is recommended for patient scheduled for radiotherapy. Teeth with poor prognosis should be removed.

Oral hygiene regimen should be started as soon as possible. This includes:

1) Teeth brushing with soft brush with the frequency of four times daily
2) Warm saline (NaCl and $NaHCO_3$) mouth wash daily especially after brushing
3) Fluoride treatment either 0.4 % stannous fluoride gel, 1% sodium fluoride or 1% acidulated fluorophosphate gel in a custom tray for 15 minutes twice daily.

B) Intra-radiation Protocol

This includes:

1) Weekly prophylaxis with fluoridated polishing paste
2) Analgesics, dietary supplements, antifungal and antibiotics prescription.

C) Post-radiation Protocol

1) Patients who have completed radiotherapy should not wear dentures for at least a year to maximise tissue healing.
2) Fluoride treatment and oral hygiene care should be continued. Artificial saliva may have to be prescribed.

Pre-Radiotherapy Dental Extractions

The interval period between extraction and radiotherapy is extremely crucial. Marx and Johnson (1987) recommended an interval of three weeks before commencing radiotherapy[6].

Their justification is based on experimental studies that shows osteoid takes three weeks to form. Others are satisfied with only two weeks interval in order not to delay the radiation therapy[15,16]. The highest occurrence of ORN was observed in patients who had dental extraction just before or just after radiotherapy[9].

Post Radiotherapy Dental Extractions

Despite of modern method in radiotherapy, there is little difference between the rate of ORN associated with pre-radiation dental extractions which carries about 4.4% and post-radiation extraction which is 5.8%[17]. ORN is most frequently reported to occur following removal of a mandibular molar located directly in the treatment field.

There have been many controversial issues on dental extraction in the irradiated jaws. Extractions should be limited to one or two teeth at a time and techniques should be as atraumatic and aseptic as possible. Flaps should be raised conservatively to minimize displacement of mucoperiosteum. Sharp projections of bone require re-contouring or minor alveolplasty followed by primary closure.

Factors that should be considered when planning dental surgery for patients completing radiation treatment are as follows:

- dose of radiation received and area of mucosa irradiated
- Location of the tumour
- Number of extractions to be performed
- anticipated difficulty of extraction
- required medication (antibiotics)
- suturing technique to be used
- previous major surgery performed
- time span between radiation and dental surgery e.g. six months after radiotherapy

Although a study by Makkonen et al (1987) did not reveal a single case of ORN associated with 94 teeth extracted after radiotherapy, the authors agreed with the generally held concept that elective tooth extraction after full cancericidal doses of more than 6,500 cGys should be avoided if at all possible, and that restorative or endodontic treatment in such cases is probably preferred[18].

If a tooth needs to be removed at this stage, extraction should be as atraumatic as possible and limited to one to two teeth at a time. Prophylactic antibiotics for such extractions are as follows:

a) Pen G 1,000,000 units IV 15 minutes before procedure followed by Penicillin V 500 mg

orally, four times a day for 10 days, beginning one hour after the parenteral dose.

b) For Penicillin allergic patients: Erythromycin 1 gm 1 hour prior to surgery followed by 500 mg orally four times a day for 10 days.

Conclusion

In order to improve the patient's quality of life post radiotherapy, the oncologist should work hand in hand with the patient's dental surgeon in order to minimise the development of ORN. Teeth with doubtful prognosis should be extracted at least 2-3 weeks prior to radiotherapy. Elective tooth extraction after full cancericidal doses of 6,500 cGys or more should be avoided if possible, and restorative or endodontic treatment in such cases is preferred. Denture can be worn, but attention must be given to ensure that the oral mucosa is not traumatised by it.

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