Osteoradionecrosis (ORN) of the Jaw

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Case Report
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Osteoradionecrosis (ORN) of the Jaw

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Abstract

TA, a 67-year-old male with nasopharyngeal squamous cell carcinoma (NPC) was initially treated with radical chemo-radiotherapy for his malignanacy. Two years later, dental extractions were performed by a community dentist, following which the tooth sockets were reported to be healing poorly. TA developed osteoradionecrosis (ORN) of the jaw and was managed ultimately with a sub-total mandibular resection and fibula free flap reconstruction. This article uses the case above to explore the aetiology, presentation and management of ORN. Furthermore the principles of surgical management using free tissue transfer and mandibular reconstruction are also discussed.

Case Report

TA, a 67-year-old male presented in March 2007 to a teaching hospital with right sided hearing problems, facial numbness and sensory disturbance in the right trigeminal nerve distribution. The patient had a lifelong history of smoking twenty cigarettes per day.

On examination, a right sided neck swelling was noted. Histological findings showed a poorly differentiated squamous cell carcinoma of the nasopharynx, arising from the posterior wall and eroding the skull base. Right side lymph node involvement was confirmed. Tumour staging was reported as T4 N2 M0 Stage IV cancer. Radical chemo-radiotherapy was administered with neoadjuvant Cisplatin and 5-Flourouracil. In addition he received radiotherapy at a dose of 66Gy over 33 sessions. In March 2009, extractions of the molar teeth were performed by the patient's community dentist. The subsequent sockets failed to heal and in September 2009 an Orthopantomogram (OPT) showed osteoradionecrosis (ORN) of the posterior mandible at both sites of tooth extraction (**Figure 1**). This was managed with local debridement and Augmentin was prescribed for symptomatic relief. Secondary infection was treated with Metronidazole and Clindamycin.

An OPT in November 2010 showed a loss in continuity of the inferior cortex of the mandible, as well as a moth-eaten, radiolucency in the alveolar region bilaterally where the mandibular bone has failed to heal (**Figure 2**).

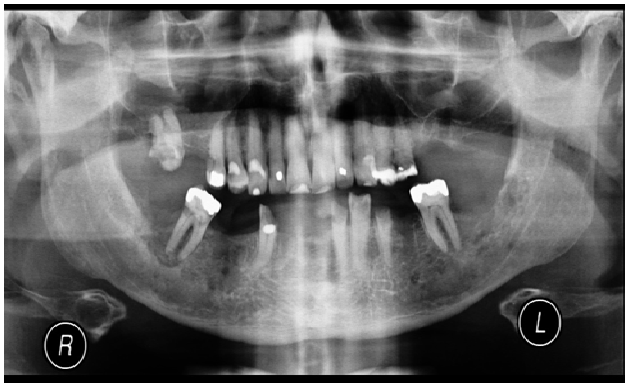

Figure 1: An OPT taken in September 2009

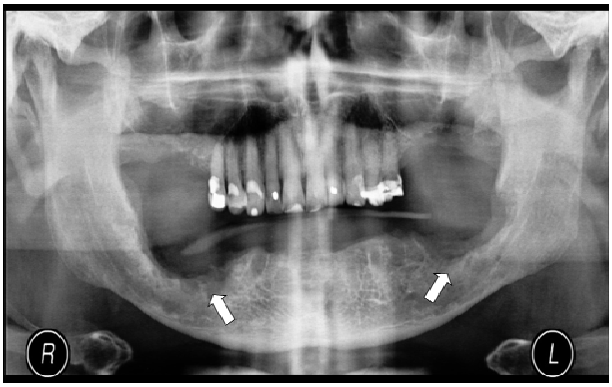

Figure 2: An OPT in 2010 showing advancement of the ORN

In March 2011, surgical management was agreed upon, namely a sub-total mandibular resection with reconstruction using a fibula free flap.

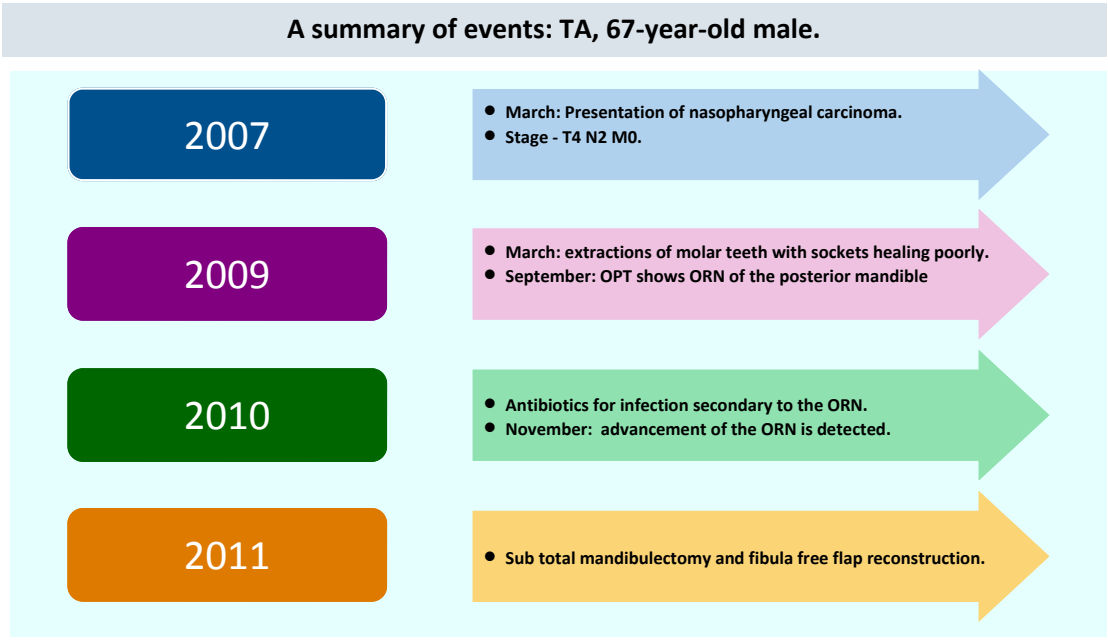

Figure 3: Summary of events in case report

Osteoradionecrosis (ORN)

"ORN is defined as exposed bone tissue that has had previous irradiation and which fails to heal over a period of 3 months in the absence of a residual or recurrent tumour [1]."

ORN usually occurs in patients who have been exposed to more than 60 Gy of radiation. The overall incidence of the disease is hard to determine due to the absence of a formal reporting system, but certain studies have found a reduced incidence of ORN over the past three decades. An approximate value of a 3% incidence has been collated from pooled studies[2].

Pathology

The pathological processes behind ORN have been an issue of dispute for some time. There are three proposals explaining the pathology of ORN. **Figure 4** highlights the principles of the theory of 'Three H's' proposed by Marx.

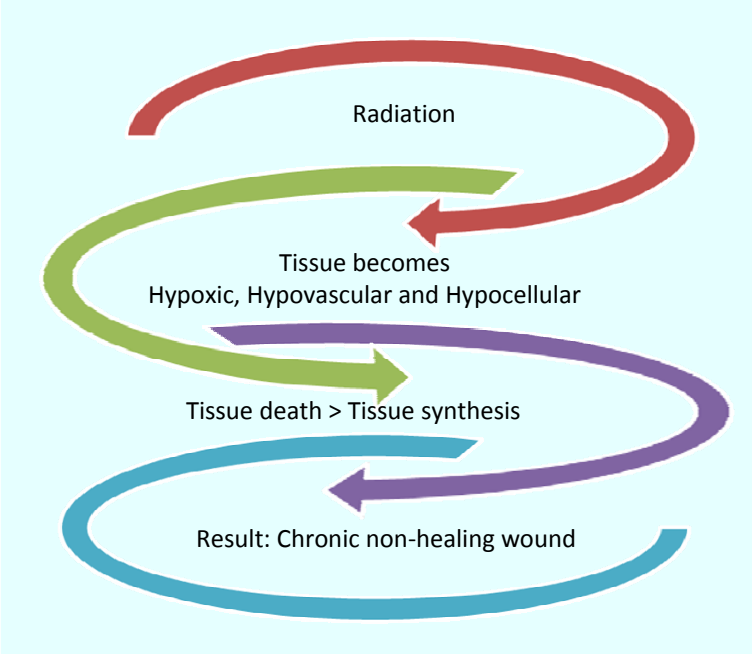

Figure 4*. Marxs' theory of 'Three H's'*

Previous to the 'Three H theory', the pathology was understood as a triad of radiation, trauma (tooth extraction in 88% of cases) and subsequent infection of the devitalised bone. ORN was likened to a disease similar to osteomyelitis secondary to irradiation. Marx disputed this heavily suggesting that infection is superficial and secondary.

Recent work challenges the principle of 'Three H's' and introduces a concept surrounding a radiation induced mechanism of fibro-atrophic tissue formation. The cascade of events proposed by this theory is outlined in **Figure 5**[4].

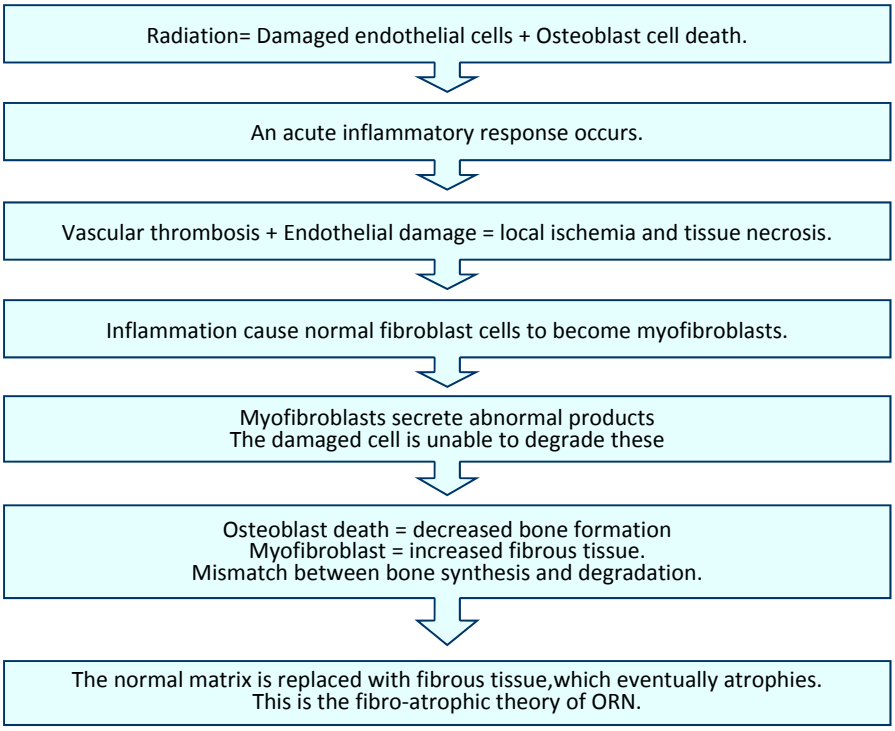

Figure 5: The fibro-atrophic cascade involved in ORN.

Risk Factors and Presentation of ORN

There are several risk factors for developing ORN as well as a number of protective agents. These are explored in **Figure 6**.

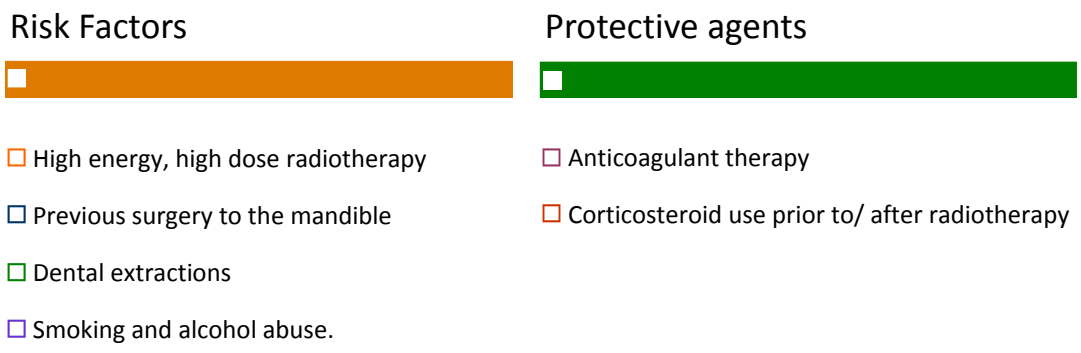

Figure 6: Risk factors and protective factors in ORN

ORN is an extremely disabling disease, not only because it causes pain and swelling in the jaw, but it has the potential to erode through bone and cause fistulation to the mucosa and skin. **Figure 7** outlines the presentation of ORN.

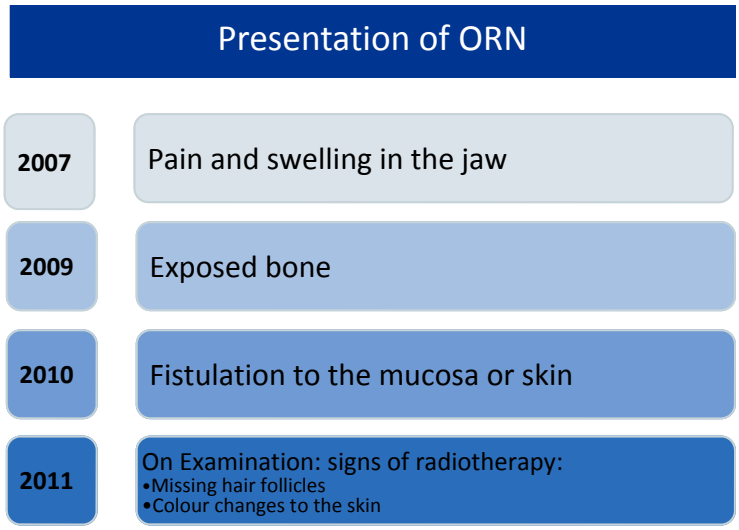

Figure 7: Presenting features of ORN

Diagnosis

Diagnosis is primarily from history and examination. One criterion states:

"The presence of persistent exposed bone after 6 months of conservative management is diagnostic[4]."

Diagnosis is aided by an Orthopantomogram(OPT)) to observe the different densities of bone and soft tissue. Histology can also be used to show necrosis of the bone.

Radiological Features of ORN on OPT

- Moth-eaten appearance
- Radiolucent alveolar region
- Poorly defined osseous destruction

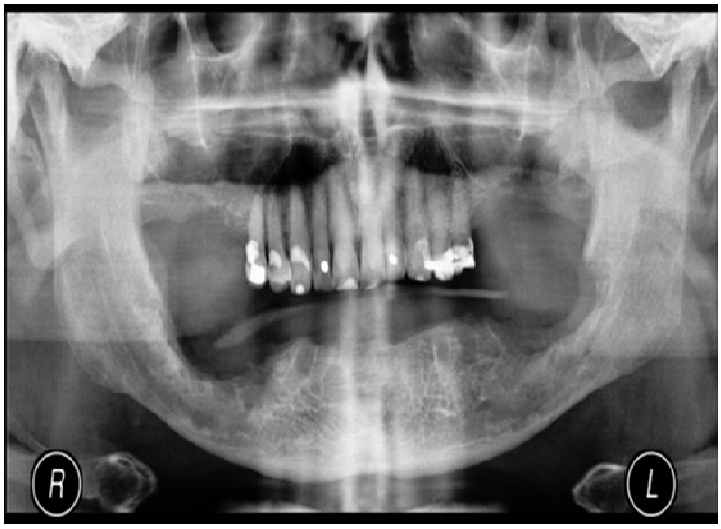

Figure 8: Radiological signs of ORN of the jaw

Management

There are a number of treatment options available for ORN depending on the severity of the disease and individual patient factors.

Prevention

- Preventative extractions of decayed teeth before radiotherapy[6].
- Lifestyle advice- Avoid alcohol and tobacco
- Good dental hygiene.

Medical

1. Pentoxifylline (PTX) 1200mg/day for 6 months- works by counteracting tumour necrosis factor alpha (TNF- α).
2. Alpha-tocopherol- an active form of vitamin E which removes free radicals generated during oxidative stress.
3. Antibiotic therapy-this is not evidence based, but has been found to be helpful.

Surgical

This involves reconstructive techniques such as reconstructive plates, regional flaps and free tissue transfer. Free flaps are the treatment of choice. They enable functional ability to be restored with the best cosmetic result. Donor sites include fibular, radial, iliac crest and scapula. Angiography is used to investigate collateral blood supply at the donor site.

Fibula Free Tissue Transfer for Mandibular Reconstruction

"A free flap is a mass of tissue that is transferred from its donor site to a recipient site, which can be some distance away."

Free flaps can be used to reconstruct large areas and the mass of tissue transferred can include skin, muscle, fat, bone and nerve. The structures that need reconstructing in a mandibular reconstruction are the mandibular bone, the intra-oral lining, underlying soft tissue, lower lip and in some cases the tongue.

The fibula free flap is the treatment of choice. It provides a high quality and quantity of bone and vasculature with a flap survival rate reaching 95%[7]. The lower third of the face is used for many activities, eating, speech and deglutition. The face is paramount in the social context. Thus it is fundamental that a good aesthetic result is achieved along with good levels of function.

Harvesting the Fibula Free Flap and Mandibular Reconstruction

The diagram below illustrates the principles of reconstructing the mandible.

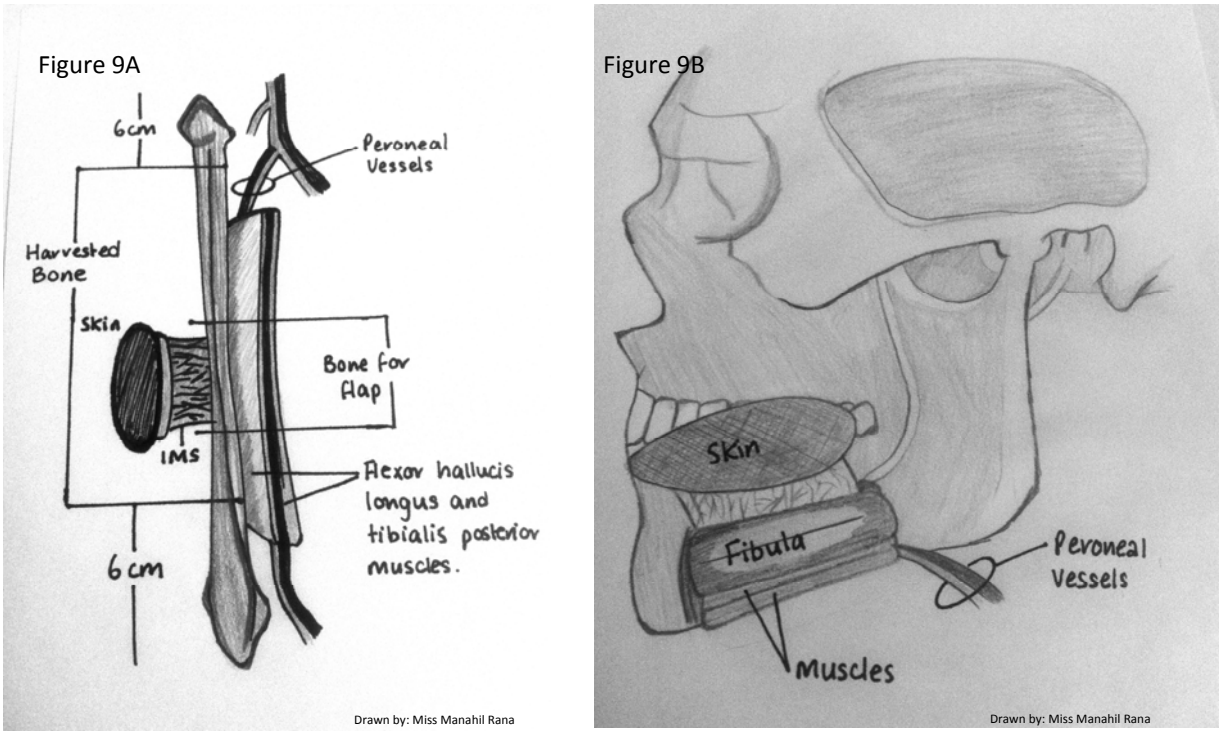

Figure 9: Principles of fibula free flap and mandibular reconstruction.

Conclusion

ORN is a significant complication of radiation therapy to the head and neck. The mandible is a region most at risk, due to its anatomical position which leaves it exposed and also a consequence of the high amount of cortical bone. The pathophysiology of ORN is still evolving and there are a number of theories regarding the molecular changes that occur in the disease process. This case highlights a patient who had undergone previous radiotherapy and went on to develop ORN following tooth extractions. Prevention of ORN can be facilitated by lifestyle changes and adequate dental hygiene.

ORN has a profound impact on quality of life; it can be treated using a number of methods. Pharmacological interventions play a role in counteracting free radical formation occurring in the diseased bone. Antibiotics are useful for symptomatic control and to manage secondary infections. However, in advanced disease, surgical intervention such as a free flap is often required to restore form and function to the jaw.

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