

## OSTEONECROSIS LITERATURE

### **Retrospective audit of the use of the Marx Protocol for prophylactic hyperbaric oxygen therapy in managing patients requiring dental extractions following radiotherapy to the head and neck.**

N Z Dent J. 2009 Jun;105(2):47-50.

*Kaur J, Hay KD, Macdonald H, Rich AM.*

**OBJECTIVE:** The study's primary objective was to review (for the years 2003 to 2006) the outcomes of using prophylactic hyperbaric oxygen therapy (HBOT) to prevent osteoradionecrosis (ORN) in a group of patients previously exposed to radiotherapy of the head and neck. A secondary objective was to evaluate any HBOT-associated vision changes. **DESIGN:** The study was a retrospective audit of the clinical outcomes of HBOT for the prevention of ORN following dental extractions in previously irradiated jaws. **METHODS:** Information was obtained from dental records held at Green Lane Clinical Centre (Auckland) and Oxygen Therapies Ltd (Quay Park Health, Auckland). Data included patient age, gender, site of tumour, radiation dose, time lapse between radiotherapy and tooth/teeth extracted, extraction procedures and the HBOT protocol used. Follow-up data were obtained through a telephone interview using a standardised questionnaire. **RESULTS:** Of the 29 treated patients, 26 (90%) were available for follow-up. Of these, one failed to heal after dental extractions following the use of prophylactic HBOT, and only nine (34%) developed temporary vision changes. **CONCLUSION:** The outcome of this audit suggests that it is appropriate to use prophylactic HBOT in association with dental extractions in patients who have previously had radiotherapy to the head and neck. Acute vision changes following the 30th HBOT were transient.

### **Dental extractions and radiotherapy in head and neck oncology: review of the literature.**

Oral Dis. 2008 Jan;14(1):40-4

*Koga DH, Salvajoli JV, Alves FA.*

Management of irradiated patients with cancer in the head and neck region represents a challenge for multidisciplinary teams. Radiotherapy promotes cellular and vascular decrease that results in a low response rate in the healing. Consequently, surgical procedures in irradiated tissues present high rates of complication. Osteoradionecrosis (ORN) is the most severe sequelae caused by radiotherapy. It is associated with previous extractions especially those carried out post-irradiation. The management of this side effect is difficult and can result in bone or soft tissue loss, affecting the quality of life. The literature regarding dental extractions performed before and after head and neck radiotherapy was evaluated, focusing on indications, criteria, surgical techniques and adjunctive therapies such as antibiotics and hyperbaric oxygen. Osteoradionecrosis can be minimized by oral evaluation and care prior to irradiation and healing time which allows tissue repair until the commencement of radiotherapy. In dental extractions realized after irradiation, minimal trauma, alveolectomy, primary alveolar closure and adjunctive therapies are recommended. Patients must be evaluated before radiation therapy and at that time all unrestorable teeth and/or teeth with periodontal problems must be extracted to reduce the post-radiotherapy exodontias that contribute to ORN. Once dental extractions become unavoidable after irradiation, additional care is needed.



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### **Oxygen and wound healing**

Bull Acad Natl Med. 2005 May;189(5):853-64; discussion 864-5

*Wattel F, Mathieu D.*

It has long been recognized that normal healing is dependent on the oxygen gradient in the wound. Hypoxia can slow or arrest the healing process and augments the risk of infection. While hypoxia triggers neoangiogenesis, normal tissue oxygen pressures are mandatory for migration of repair cells (macrophages, fibroblasts), production of collagen precursors and, thus, for wound repair with good mechanical properties. Recent studies have identified the underlying molecular mechanisms of wound repair. In clinical practice, hyperbaric oxygen therapy is to treat problem wounds like diabetic foot lesions, arterial ulcers, and radionecrosis. Direct or indirect measurement of oxygen tissue pressure can help to select patients and to monitor treatment outcome.

### **Hyperbaric oxygen therapy and mandibular osteoradionecrosis: a retrospective study and analysis of treatment outcomes.**

J Can Dent Assoc. 2001 Jul-Aug;67(7):384

*David LA, Sándor GK, Evans AW, Brown DH.*

**BACKGROUND:** Hyperbaric oxygen (HBO) therapy is recognized as an adjunctive treatment for osteoradionecrosis (ORN). It may also be used prophylactically in patients who require dental extractions and are at high risk for developing ORN. This article reviews the treatment outcomes of patients treated with HBO therapy at the Toronto General Hospital from 1985 to 1997. **MATERIALS AND METHODS:** A total of 297 charts of patients treated with HBO were reviewed. Criteria assessed included age of patient, gender, original diagnosis, radiation dose, time between radiation treatment and onset of ORN, presence or absence of fracture, orocutaneous fistula, pain, history of a precipitating event triggering ORN, medical status, HBO therapy (total oxygen time, number of dives), method of treatment of ORN and follow-up period. Minimum patient follow-up time for inclusion in the study was 6 months. **RESULTS:** Adequate information to meet the inclusion criteria was obtained for 75 patients. Group A (51 patients) had been treated for overt ORN with HBO alone, HBO with sequestrectomy, or HBO with sequestrectomy and reconstruction. Group B (24 patients at risk for developing ORN) had been treated with HBO prophylactically for dental extractions. In group A, only 3 patients (5.9%) failed to show improvement. In group B, only one patient (4.2%) had complications during healing. **CONCLUSIONS:** Encouraging results were achieved when HBO was used in the 2 groups described above. This paper supports existing literature on the potential benefit of HBO as a prophylactic agent and adjunctive treatment of ORN.

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### **Adjunctive hyperbaric oxygen in irradiated patients requiring dental extractions: outcomes and complications.**

J Oral Maxillofac Surg. 2001 May;59(5):518-22; discussion 523-4

*Chavez JA, Adkinson CD.*

**PURPOSE:** This study assessed complications of hyperbaric oxygen (HBO) therapy, potential predictors of poor outcome, and treatment outcomes in irradiated patients undergoing dental extractions. **PATIENTS AND METHODS:** This was a prospective, descriptive study of 40 consecutive patients treated with HBO before and after dental extractions in an irradiated field. All patients had radiation caries; none had osteoradionecrosis (ORN). All were prescribed a protocol of 20 pre-extraction and 10 postextraction HBO treatments at 2.4 ATA for 90 minutes. Potential risk factors for poor healing and risk factors for complications were identified. All complications were recorded. Extraction site healing was evaluated at the conclusion of HBO therapy, at 1 month, and 1 year later. **RESULTS:** There were no serious complications. There was no correlation between preidentified risk factors and poor healing. At 1 year, 98.5% of all extraction sites were healed. Patients who did not heal were an average of 8 years since radiation, compared with 3.3 years for those who healed ( $P < .001$ ). **CONCLUSION:** Use of HBO is associated with a very low incidence of ORN at 1-year follow-up. However, the time since radiation has a positive correlation with risk for ORN.

### **Management of refractory osteoradionecrosis of the jaws with surgery and adjunctive hyperbaric oxygen therapy.**

Int J Oral Maxillofac Surg. 2000 Dec;29(6):430-4

*Curi MM, Dib LL, Kowalski LP.*

This retrospective study aimed to determine the effectiveness of surgery and hyperbaric oxygen (HBO) treatment in the management of refractory osteoradionecrosis (ORN) of the jaws. Of the 18 patients who had undergone this treatment, 14 patients had complete healing, 3 patients had improved and one patient did not show any improvement. Of the 14 patients who had complete healing, only 4 still had a discontinuity defect of the mandible but they declined additional reconstructive surgery. In conclusion, surgery/HBO therapy showed satisfactory results in the management of refractory ORN of the jaws.

### **Hyperbaric oxygen in the therapeutic management of osteoradionecrosis of the facial bones.**

Int J Oral Maxillofac Surg. 2000 Dec;29(6):435-8

*Vudiniabola S, Pirone C, Williamson J, Goss AN.*

This paper reviews all 17 cases of facial bone osteoradionecrosis (ORN) which were treated in Adelaide, South Australia, in a nine-year period (1987-1996). This was 1.2% of all cases of head and neck cancer treated with radiotherapy (RT). Fourteen cases received treatment following the Marx principles of staging and the protocols of hyperbaric oxygen plus or minus surgery. The three exclusions were two patients who died of recurrent cancer before treatment was complete and one who declined treatment. The eleven cases of mandibular ORN occurred within a few years of the initial RT treatment. All except one occurred after surgical trauma, with dental extractions being the factor in nine cases. All responded to HBO, with or without surgery depending on stage. The three cases of temporal bone ORN were all of late spontaneous onset. All were stage I and all responded to HBO alone. This study shows that the incidence of ORN in Adelaide is low, probably through use of conservative doses of RT and good preventative protocols. The treatment with HBO plus or minus surgery was effective.

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### **Hyperbaric oxygen in the prevention of osteoradionecrosis of the jaws.**

Aust Dent J. 1999 Dec;44(4):243-7

*Vudiniabola S, Pirone C, Williamson J, Goss AN.*

Patients who have had their jaws irradiated as part of management of head and neck malignancy are at risk of osteoradionecrosis (ORN) following tooth extraction. Thirty-seven patients with a history of irradiation to the jaws were managed during a four year period. Twenty-nine patients received hyperbaric oxygen therapy (HBO) consisting of 20 treatments before surgery and ten treatments after. Only one (4 per cent) developed ORN. Seven patients who did not have HBO and one who did (15 per cent) developed ORN. The need for prophylactic treatment with HBO is discussed. It is recommended that prophylactic HBO is used prior to surgery for irradiated facial bones.

### **A review of the Marx protocols: prevention and management of osteoradionecrosis by combining surgery and hyperbaric oxygen therapy.**

SADJ. 1998 Oct;53(10):469-71.

*Cronje FJ.*

The 30/10 protocol is employed in the treatment of established osteoradionecrosis. No surgery should be attempted before the first 30 HBO treatments have provided sufficient angiogenesis to support surgical wounding. After 30 treatments surgical management can be staged according to the extent of improvement achieved after HBO and the size of sequestrum or area of osteolysis. If the ORN extends to the inferior border of the mandible or if it manifests as an orocutaneous fistula or pathological fracture, discontinuity resection of the necrotic bone and soft tissue will be required to resolve the disease. Unless HBO and surgery are combined in the management of ORN, the results are not long lasting or satisfactory. Even though resection of stage three ORN seems unduly aggressive, it has stood the test of time. By using the Marx protocols in the treatment of ORN, more than 95 per cent of patients can be successfully cured of their disease with predictable, functional and aesthetically acceptable outcomes.

### **Postradiation osteonecrosis of the mandible: a long-term follow-up study.**

Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1997 Jun;83(6):657-62

*Epstein J, van der Meij E, McKenzie M, Wong F, Lepawsky M, Stevenson-Moore P.*

OBJECTIVES: The objective of this study was to assess the long-term progress of 26 patients who experienced postradiation osteonecrosis of the jaw between 1975 and 1989. STUDY DESIGN: Of 26 patients who had been previously managed with hyperbaric oxygen therapy as a part of their treatment for postradiation osteonecrosis of the jaw, 20 were evaluated to determine their current status of the condition: resolved, chronic persisting (unresolved), or active progressive (symptomatic). RESULTS: Two of 20 patients experienced recurrences of the condition. In one of these patients, surgical treatment was identified as the stimulus of postradiation osteonecrosis. In the other patient, the recurrence appeared to be related to periodontal disease activity. In 60% (12 of 20) of the patients, the condition remained resolved, improvement in clinical staging occurred in 10% (2 of 20) (from symptomatic to unresolved or resolved), and 20% (5 of 20) of the patients continued to demonstrate chronic persisting postradiation osteonecrosis at the end of the long-term follow-up period. CONCLUSION: This study supports the contention that postradiation osteonecrosis can occur at any time after radiation therapy, and that patients remain at risk up to 231 months after treatment of the cancer and probably indefinitely after radiation therapy. Our findings also suggest that risk of second episodes of the condition after management of an initial episode is low. In addition, our follow-up study revealed that chronic nonprogressive postradiation osteonecrosis can remain stable without extensive intervention including combined hyperbaric oxygen therapy and surgery.



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### **Use of hyperbaric oxygen in postradiation head and neck surgery.**

NCI Monogr. 1990;(9):151-7.

*Myers RA, Marx RE.*

Data are presented to indicate the value of hyperbaric oxygen in all stages of treatment of patients with irradiation complications following head and neck surgery. Hyperbaric oxygen stimulates angiogenesis, with increased neovascularization and optimization of cellular levels of oxygen for osteoblast and fibroblast proliferation, collagen formation, and support of ingrowing blood vessels. The hypoxic, acellular matrix in the postirradiated field is changed to a hypercellular, hyperoxic/normoxic situation. Oxygen is used as an adjunct to appropriate surgery. By using the two modalities together, the salvage rate for osteoradionecrosis and its complications of orocutaneous fistula, pathological fractures, and severe bone losses can be increased dramatically. It may also be used prophylactically in patients with periodontal disease or teeth requiring extraction in a previously irradiated area. Finally, the use of oxygen helps support tissue flaps and grafts placed into previously irradiated areas. Economically, there is considerable cost savings in the use of hyperbaric oxygen therapy with appropriate surgery. From the patient's point of view, pain relief is achieved, function is returned, and prognosis improves in a relatively short time.