PHYSICIAN REFERRAL GUIDE

CANADA HYPERBARICS

Hyperbaric Oxygen for Radiation Damage Affecting Bone (Osteoradionecrosis)

A referral guide for emergency and referring physicians in Canada.

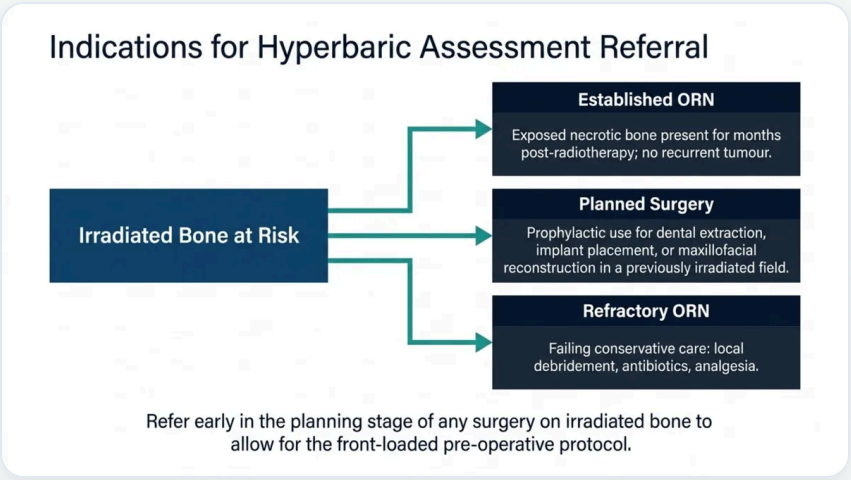
Condition: **Radiation Damage Affecting Bone (Osteoradionecrosis)** Open-access studies: **25**
Updated **June 2026** Reviewed **quarterly**

For referring and emergency physicians in Canada. Radiation damage affecting bone, most commonly mandibular osteoradionecrosis (ORN) after head and neck radiotherapy, is one of the 14 conditions Health Canada recognises for hyperbaric oxygen therapy (HBOT), and it is managed as an elective adjunct at Canadian hospital-based hyperbaric programmes, covered by provincial health insurance. Unlike acute hyperbaric indications, referral here is planned rather than urgent and is usually coordinated around dental or maxillofacial surgery. This guide summarises when to refer, how to assess the patient before referral, what the evidence supports, the Canadian referral pathway, and contraindications. It closes with the complete list of open-access research published since 2020, each linked to its free full text.

IN THIS GUIDE

When to refer

Refer for elective hyperbaric assessment when a patient with a history of head and neck (or other regional) radiotherapy has, or is at risk of, irradiated bone that will not heal:



FIGURE

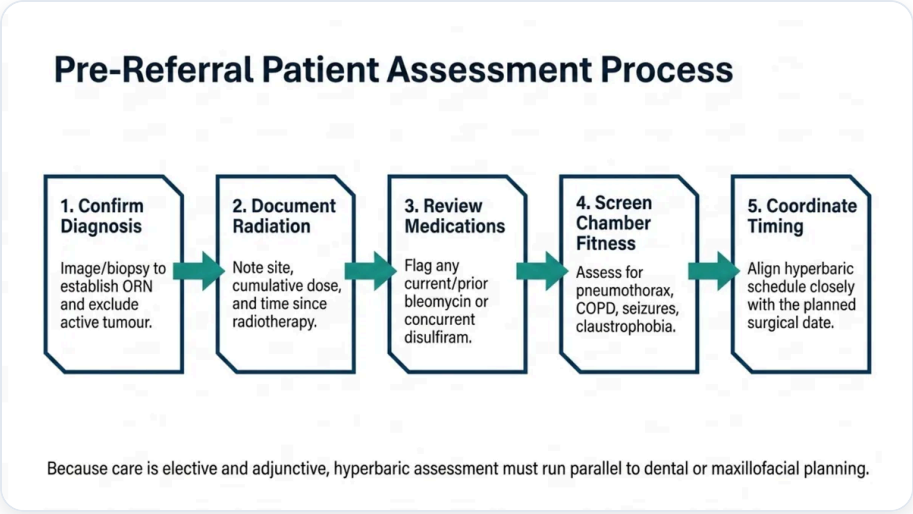
When to refer. Three situations warrant elective hyperbaric assessment in a patient with prior head and neck radiotherapy: established osteoradionecrosis with exposed, non-healing bone and no evidence of recurrent tumour; planned surgery in a previously irradiated field, where hyperbaric oxygen is used prophylactically around dental extraction, implant placement, or reconstruction; and refractory osteoradionecrosis that has failed debridement, antibiotics, and analgesia. Refer early in the planning of any surgery on irradiated bone, because the protocol front-loads treatment before the operation, and confirm with the oncology team that there is no active recurrence in the field first.

- **Established osteoradionecrosis**, typically exposed, non-healing necrotic bone present for months after radiotherapy with no evidence of recurrent tumour, particularly mandibular ORN. ORN is an uncommon but serious complication of curative-intent head and neck radiation; reported rates vary widely with radiation technique and dose, and modern intensity-modulated radiotherapy has reduced its frequency. It usually presents months to years after treatment.
- **Planned surgery in a previously irradiated field**, such as dental extraction, dental implant placement, or maxillofacial reconstruction in the radiation port, where HBOT is used prophylactically around the procedure (the Marx protocol, below).
- **Refractory ORN failing conservative care**, where local debridement, antibiotics, and analgesia have not controlled the disease and resection or reconstruction is being considered.

Refer early in the planning of any surgery on irradiated bone rather than after a wound has already broken down, because the protocol front-loads a course of treatment before the operation. Confirm with the treating oncology team that there is no active recurrent malignancy in the radiation field before referral.

Assessing the patient before referral

Because this is elective adjunctive care, the referring clinician or dental or maxillofacial team should arrange the following before or alongside hyperbaric assessment:



FIGURE

The pre-referral assessment in five steps. Confirm the diagnosis with imaging and, where indicated, biopsy to establish osteoradionecrosis and exclude active or recurrent tumour in the field. Document the radiation history, including treated site, cumulative dose where available, and the interval since radiotherapy. Review the medication history for current or prior bleomycin, which affects pulmonary safety in the chamber, and for concurrent disulfiram. Screen for chamber fitness, and coordinate timing closely with the dental or maxillofacial team, since care is elective and adjunctive and the hyperbaric assessment must run parallel to surgical planning.

- **Confirm the diagnosis and exclude recurrence.** Imaging and, where indicated, biopsy should establish ORN and rule out recurrent or persistent tumour in the field, since active malignancy in the treatment area is a relative contraindication.
- **Document the radiation history**: site, total dose where available, and time since radiotherapy, as ORN risk rises with higher cumulative mandibular dose.
- **Review the cancer-treatment medication history**, in particular any current or prior **bleomycin** exposure, which affects pulmonary safety in the chamber and may require pulmonary-function review, and any concurrent **disulfiram**.
- **Screen for chamber fitness**: untreated pneumothorax, severe chronic obstructive pulmonary disease with bullous lung disease, uncontrolled seizure disorder, recent middle-ear or sinus surgery, claustrophobia, and cardiac status, so the programme can assess suitability.

- **Coordinate timing with the planned procedure**, since the regimen delivers a defined number of sessions before surgery and a further course afterward.

What the evidence supports

The foundational work is the **Marx histology and clinical series (J Oral Maxillofac Surg, 1983)**, which described irradiated bone as characterised by tissue that is hypoxic, hypovascular, and hypocellular, and reported that staged HBOT before and after surgical intervention improved healing of irradiated jaws. This work defined the still-used prophylactic regimen.

The Evidence Landscape: Rationale vs. Randomised Trials

Foundational Rationale	Trial Realities
- Based on Marx (1983) histology and clinical series. - Strong mechanistic proof of angiogenesis. - Defined the widely used prophylactic staged regimens.	- Based on Cochrane (Lin & Bennett 2023), DAHANCA-21, and HOPON. - Shows modest pain/dehiscence improvement in established ORN (low certainty). - Prophylactic benefit for extractions/implants remains uncertain.

The trial evidence is mixed; strongest support exists for established ORN, while prophylactic **surgical benefit is debated** in modern RCTs.

FIGURE

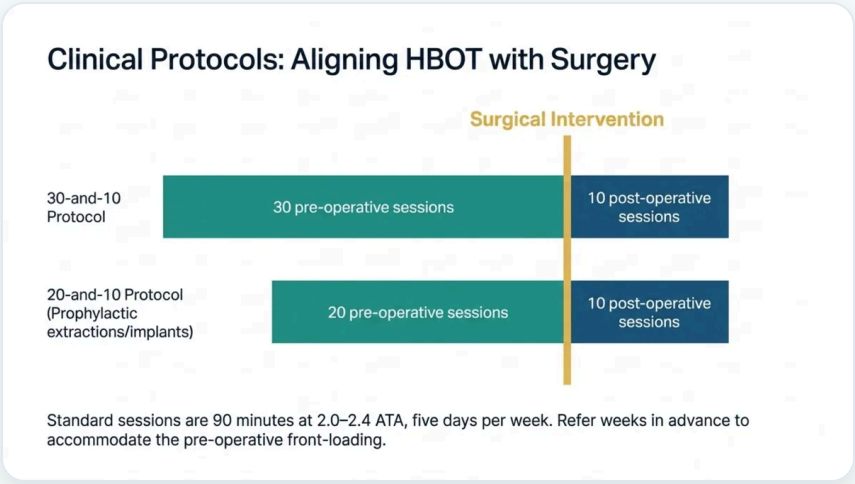
What the evidence supports, presented honestly. The rationale rests on Marx's 1983 histology, which described irradiated bone as hypoxic, hypovascular, and hypocellular and showed staged hyperbaric oxygen improving healing of irradiated jaws, together with a well-described angiogenic mechanism. The randomised evidence is more mixed: a Cochrane review (Lin and Bennett 2023) found hyperbaric oxygen may improve some outcomes in established osteoradionecrosis at low certainty, while the DAHANCA-21 and HOPON trials did not show a significant prophylactic benefit. Hyperbaric oxygen is therefore best framed as an adjunct to surgical and dental management, with the strongest support in established osteoradionecrosis and the prophylactic benefit uncertain.

The mechanistic rationale is well described. Radiotherapy causes progressive endothelial damage and obliteration of small vessels, leaving bone chronically hypoxic and less able to heal or to mount a normal response to injury. HBOT raises tissue oxygen tension enough to stimulate **angiogenesis**, an effect attributed to sustained oxygen gradients and elevation of pro-angiogenic signals including vascular endothelial growth factor (VEGF) and stromal cell-derived factor-1 (SDF-1), with recruitment of bone-marrow-derived endothelial progenitor cells. Over a course of treatment, Marx's histology described capillary density in irradiated tissue increasing substantially toward normal, with new vessels still present on biopsy years later. HBOT also supports collagen synthesis and oxygen-dependent neutrophil function. On this model the angiogenic effect is intended to be durable rather than a temporary rise in oxygen during a single session, though the supporting human data are largely observational.

The trial evidence is mixed and should be presented honestly. A **Cochrane systematic review (Bennett et al. 2016, updated as Lin and Bennett 2023)** pooling randomised trials concluded that HBOT may improve some outcomes in established osteoradionecrosis, including reduced wound dehiscence after head and neck soft-tissue surgery and modest pain improvement, but that the certainty of the evidence is low and trial quality is variable. Two randomised controlled trials specifically questioned prophylactic and established-ORN benefit: **DAHANCA-21** (combined with NWHHT2009-1) did not show a statistically significant advantage of HBOT for surgically managed established mandibular ORN, and the **HOPON trial** did not demonstrate a significant reduction in ORN when HBOT was added before dental extraction or implant surgery in irradiated patients. HBOT is therefore best framed as an **adjunct** to surgical and dental management of irradiated bone, not as a standalone cure, with the strongest support in established ORN and the prophylactic benefit uncertain.

◈ Clinical translation

HBOT for irradiated bone is delivered as a planned course rather than a single treatment. The standard prophylactic regimen described by Marx is **30 sessions before planned surgery and 10 sessions afterward** (the "30-and-10" protocol); a shorter **"20-and-10"** course (20 pre-operative and 10 post-operative sessions) is used around prophylactic dental extractions or implant placement in an irradiated jaw. Sessions are typically **90 minutes at 2.0 to 2.4 ATA, five days per week**. Because the pre-operative course takes several weeks, refer at the planning stage so the hyperbaric schedule and the surgical date can be aligned. HBOT supplements debridement, antibiotics, and reconstruction; it does not replace them, and the decision to proceed should be made jointly with the maxillofacial or oncology team. Background on the indication is available on the delayed radiation injury condition page.

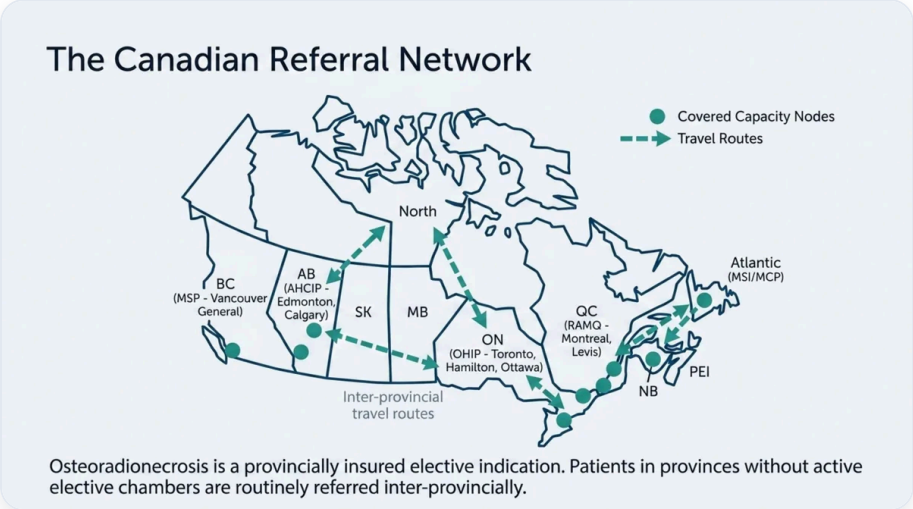


FIGURE

Clinical translation: hyperbaric oxygen for irradiated bone is a planned, staged course aligned with surgery, not a single treatment. The standard regimen described by Marx is 30 sessions before planned surgery and 10 afterward, the 30-and-10 protocol, while a shorter 20-and-10 course is used around prophylactic dental extractions or implants in an irradiated jaw. Sessions run about 90 minutes at 2.0 to 2.4 ATA, five days per week. Because the pre-operative course takes several weeks, refer at the planning stage so the hyperbaric schedule and the surgical date can be aligned, and remember that hyperbaric oxygen supplements debridement, antibiotics, and reconstruction rather than replacing them.

The Canadian referral pathway

Osteoradionecrosis is an accepted elective indication at Canadian hospital-based hyperbaric programmes and is covered by provincial health insurance. Referral is usually made by the treating dental, maxillofacial, or oncology service in coordination with the regional hyperbaric unit. Because care is elective, the route is a standard specialist referral to the nearest programme rather than an emergency transfer line.



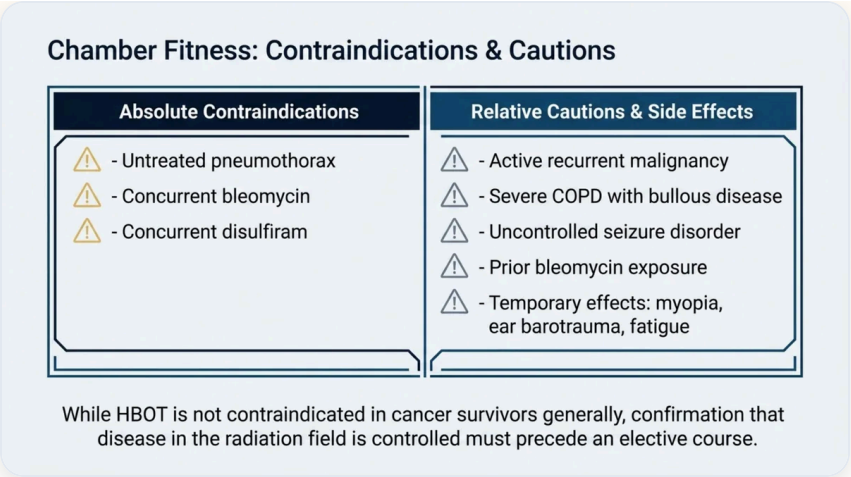
FIGURE

The Canadian referral pathway. Osteoradionecrosis is an accepted elective indication covered by provincial health insurance, with hospital-based programmes in Ontario (the Toronto, Hamilton, and Ottawa hospitals), British Columbia (Vancouver General), Alberta (Edmonton and Calgary), Quebec (the Montreal and Levis programmes), and Atlantic Canada (Nova Scotia and Newfoundland and Labrador). Because care is elective, referral is a standard specialist route from the dental, maxillofacial, or oncology service to the nearest unit rather than an emergency transfer. Patients in provinces with limited or no in-province capacity, including Saskatchewan, where the sole chamber closed in 2021, and Manitoba, New Brunswick, PEI, and the territories, are routinely referred inter-provincially, most often to Edmonton or the Ontario programmes.

- **Ontario (OHIP):** Toronto General Hospital (UHN), Hamilton General Hospital, and The Ottawa Hospital programmes accept elective referrals for irradiated-bone HBOT.
- **British Columbia (MSP):** Vancouver General Hospital, the hospital chamber for the province.
- **Alberta (AHCIP):** Misericordia Community Hospital (Edmonton) or Foothills Medical Centre and the Arthur J.E. Child Comprehensive Cancer Centre (Calgary).
- **Quebec (RAMQ):** Hopital du Sacre-Coeur de Montreal and Hotel-Dieu de Levis.
- **Atlantic Canada:** hospital hyperbaric programmes are available in Nova Scotia (MSI) and Newfoundland and Labrador (MCP).
- **Provinces and territories with limited or no in-province elective capacity** (Manitoba, New Brunswick, PEI, Yukon, NWT, Nunavut, and Saskatchewan, where the sole chamber closed in 2021 and has since operated only on a reduced schedule): patients are often referred inter-provincially to the nearest accepting programme, most often Edmonton or the Ontario programmes. For elective courses, travel and accommodation are usually the patient's responsibility unless medical-travel assistance applies.

Contraindications and cautions

The only absolute contraindication relevant to chamber entry is an **untreated pneumothorax**, which must be drained before treatment. **Concurrent bleomycin** and **concurrent disulfiram** are also treated as absolute contraindications to elective HBOT. Relative contraindications and cautions include prior bleomycin exposure (with pulmonary-function review), **active recurrent malignancy in the radiation field**, severe COPD with bullous lung disease, uncontrolled seizure disorder, recent middle-ear or sinus surgery, claustrophobia (often manageable in a monoplace chamber), uncontrolled hypertension, and significant cardiac disease requiring assessment. There is no good clinical evidence that HBOT promotes cancer growth or recurrence, and the Undersea and Hyperbaric Medical Society position is that HBOT is not contraindicated in cancer survivors; nonetheless, confirmation that disease in the field is controlled should precede an elective course. Common, self-limiting effects include temporary myopia that usually resolves within weeks of stopping treatment, ear barotrauma managed with pressure-equalisation techniques, and mild fatigue; serious events such as oxygen-toxicity seizures are uncommon at standard treatment pressures.



FIGURE

Contraindications and cautions, screened at referral. The absolute contraindications relevant to chamber entry are an untreated pneumothorax, which must be drained first, concurrent bleomycin, and concurrent disulfiram. Relative cautions to weigh with the hyperbaric team include active or recurrent malignancy in the radiation field, severe COPD with bullous lung disease, an uncontrolled seizure disorder, and prior bleomycin exposure with pulmonary-function review. There is no good evidence that hyperbaric oxygen promotes cancer recurrence, and the Undersea and Hyperbaric Medical Society position is that it is not contraindicated in cancer survivors; even so, confirmation that disease in the field is controlled should precede an elective course. Common, self-limiting effects include temporary myopia, ear barotrauma, and mild fatigue.

How to use the research list below

The list contains every osteoradionecrosis and radiation-bone-injury study in the Canada Hyperbarics database that was published in 2020 or later **and** has a freely available full-text version, each linked directly to that full text. Paywalled and abstract-only studies are excluded, and retracted studies are removed. This is a reference list, not a set of summaries. Counts and the open-access set refresh each quarter.

Open-access research, 2020 to present

25 studies with a free full-text version, grouped by year, newest first. Each title links to the full text. Retracted and paywalled studies are excluded; the set refreshes quarterly.

2026

1. Vos D et al.. Transoral Minimal Access Mandibular Reconstruction Using Fibula Free Flap in Osteoradionecrosis. *Laryngoscope*.
2. Dejonckheere CS et al.. Hyperbaric oxygen therapy for chronic radiotherapy-related adverse effects: A clinically focused review. *CA: a cancer journal for clinicians*.

2025

1. Fritz MA et al.. Managing Mandibular Osteoradionecrosis. *Otolaryngology--head and neck surgery : official journal of American Academy of Otolaryngology-Head and Neck Surgery*.
2. Wu P et al.. Periorbital emphysema after a dry hyperbaric chamber exposure. *Diving Hyperb Med*.
3. Rao A et al.. Comparison of Effectiveness of Conservative and Surgical Management of Osteoradionecrosis: A Clinical Study. *Journal of pharmacy & bioallied sciences*.
4. Rishi KS et al.. A review of interaction of radiotherapy and implants in head and neck cancer - implications and strategies to improve outcomes. *Reports of practical oncology and radiotherapy : journal of Greatpoland Cancer Center in Poznan and Polish Society of Radiation Oncology*.
5. Shah S et al.. Presentation and Optimal Management of Anterior and Central Skull Base Osteoradionecrosis: Systematic Review and Meta-Analysis. *Laryngoscope*.
6. El Hadji S et al.. Hyperbaric oxygen therapy for late radiation tissue toxicity injury after head and neck cancer: a systematic review of the literature. *Radiat Oncol*.
7. Ringenbach S et al.. A Comprehensive Review of the PENTOCLO Protocol and Its Applications in the Head and Neck. *Ear, nose, & throat journal*.

2024

1. Quah B et al.. Efficacy of adjunctive modalities during tooth extraction for the prevention of osteoradionecrosis: A systematic review and meta-analysis. *Oral diseases*.
2. Kusumoto J et al.. Effect of Statins on Patients With Osteoradionecrosis of the Jaw. *Journal of oral and maxillofacial surgery : official journal of the American Association of Oral and Maxillofacial Surgeons*.
3. Schroter GT et al.. Osteoradionecrosis treatment in head and neck cancer patients: An overview of systematic reviews. *Special care in dentistry : official publication of the American Association of Hospital Dentists, the Academy of Dentistry for the Handicapped, and the American Society for Geriatric Dentistry*.
4. Mezri S et al.. Factors influencing osteoradionecrosis progression during hyperbaric oxygen therapy: A case study. *F1000Res*.

2023

1. Li Y et al.. Review of the Pathogenesis, Diagnosis, and Management of Osteoradionecrosis of the Femoral Head. *Medical science monitor : international medical journal of experimental and clinical research*.
2. Dang B et al.. The role of hyperbaric oxygen in osteoradionecrosis-a prophylactic insight. *Australian dental journal*.
3. Corrao G et al.. Oral Surgery and Osteoradionecrosis in Patients Undergoing Head and Neck Radiation Therapy: An Update of the Current Literature. *Biomedicines*.
4. Sreenath SB et al.. Free Tissue Transfer for Skull Base Osteoradionecrosis: A Novel Approach in the Endoscopic Era. *The Laryngoscope*.
5. Mughal A et al.. Mesenchymal stem cell therapy for treatment of osteoradionecrosis of mandible in head and neck surgery patients - A way forward into the future with promising clinical Outcomes. *J Pak Med Assoc*.
6. Huang N et al.. The Progress in Reconstruction of Mandibular Defect Caused by Osteoradionecrosis. *Journal of oncology*.

2022

1. Kim L et al.. Noninvasive Systemic Modalities for Prevention of Head and Neck Radiation-Associated Soft Tissue Injury: A Narrative Review. *J Reconstr Microsurg*.
2. Sapienza LG et al.. Three-dimensional (3D) anatomic location, extension, and timing of severe osteoradionecrosis of the mandible. *Reports of practical oncology and radiotherapy : journal of Greatpoland Cancer Center in Poznan and Polish Society of Radiation Oncology*.
3. Raj R et al.. Advances and Controversies in the Management of Osteoradionecrosis After Head and Neck Cancer Treatment: A Narrative Review. *Journal of maxillofacial and oral surgery*.

2021

1. Alfouzan A. Radiation therapy in head and neck cancer. *Saudi Med J*.
2. Dutheil F et al.. Predictive factors for mandibular osteoradionecrosis after irradiation of head and neck cancers. *Cancer Radiother*.

2020

1. Jin C et al.. Lumbar vertebral osteoradionecrosis: a rare case report with 10-year follow-up and brief literature review. *BMC musculoskeletal disorders*.
