Dental management of irradiated patient
1# Criteria of preradiation extraction

2# Criteria of postradiation dental care
# Criteria for preradiation extraction:

- Most of patient with oral cancer present with significant dental disease prior to therapy if this left it may precipitate serious infection after therapy.

- The primary purpose of preradiation dental examination and extraction is to minimize risk that dental infection will precipitate ORN.
• All patients scheduled for radiation therapy or chemotherapy for tumors of the head and neck require a dental consultation.
The purpose of dental consultation prior to therapy:

1- Inform the patient anticipated tissue change and reduction of salivary flow rate and consequently he or she will be more susceptible to dental caries and dental infection after radiation.

2- Examine the dentition and determine which teeth have to be removed.

3- Explain to the patient the importance dental compliance.
Some questions arise:

1- which teeth should be extracted?
2- how does patient compliance impact these decisions?
3- how should the teeth be extracted?
4- how long should the patient wait to begin radiation therapy after tooth extraction?
5- how can the remaining dentition be maintained during and after radiation therapy?
Factors control extraction or retention of teeth

Patient related factors

concomitant chemotherapy

Radiation delivery factors
Patient related factors

- **Condition of the residual dentition**
  - Advanced caries
  - Periapical infection
  - Periodontal bone loss
  - Furcation involvement
  - An aggressive policy of extraction is recommended in these situations

- **Dental compliance of the patient**
  - An aggressive policy of extraction is recommended in patients with poor dental compliance

- **Maxillary teeth vs mandibular teeth**
  - Mandibular teeth are scrutinized more closely than maxillary teeth since maxillary teeth in the field can be extracted post radiation with minimal risk of osteoradionecrosis
a) Condition of the residual dentition:

- Goal should be to place the dentition in optimal condition to decrease the risk of serious infection after therapy.

All teeth with *questional prognosis* (advanced caries with pulp exposure, periapical infection, PDL problems) **should be extracted before radiation** (mandibular teeth in the clinical target volume)

Ex: class II or III furcation involvement of mand molar teeth in the radiation field especially if the dose of conventional fractionation is greater than 55 Gy.
Condition of the residual dentition

- Furcation involvement (red arrows) of mandibular molars within the gross tumor volume if the dose is above 5500 cGy.

In times past, periodontal abscesses were a prime initiator of osteoradionecrosis, and the osteos (arrows) initiated in this manner frequently led to resection of major portions of the mandibular body.
Periodontal infection led to osteoradionecrosis in this patient.
b) Mandible versus maxilla:

- Almost all ORN occur in mandible more than maxilla because maxilla more favorable vasculature so extraction of maxillary teeth within gross tumor volume or clinical target can be performed after radiation with little risk of bone infection.
C) Dental compliance of patient:

- With the preventive measure developed in the last years the compliance patient can maintain his or her dentition in excellent health.

- Hygiene become increasingly difficult after treatment but exceedingly important.

- Trismus, impaired motor function, and surgical morbidities compromise oral hygiene procedures, patient must possess the motivation and the physical ability to maintain their dentition properly.
2-Radiation delivery factors

- Urgency of treatment
- Mode of therapy
- Prognosis for tumor control
- Dose, Volume of mandibular body within gross tumor volume
-Behavior of the tumor may preclude irradiation dental extraction because delay radiotherapy secondary to healing could compromise control of the disease.
Some patients present with large anaplastic, rapidly growing tumors that need immediate treatment. In such patients dental extractions need to be deferred.* Control of the tumor is obviously the most important consideration.

*This situation occurs very rarely. When it does both the radiation therapist and the dentist must accept the risk of future dental complications.
b) Mode of therapy:

#CRT [Conventional Radiation Therapy]:

- Using CRT allow radiation to traverse important structure before reaching tumor.

Radiation is usually delivered via bilaterally opposed equally weighted fields and must traverse important structures before reaching the tumor.
-The size and extent of the field determine the risk of complication such as caries and or bone necrosis.

-[oral tongue or oral floor of mouse tumor]
Large volume of mandible are exposed to tumoricidal level and more susceptible to ORN from diseased teeth still after therapy so removing mandibular teeth within the field prior to therapy.

-[nasopharyngeal tumor]
Conservative approach recommended
Post radiation extraction can be done with low risk.
#IMR(Intensity Modulated Radiation):

- It is a method of radiation that focuses the highest doses to local tissues in and around tumor.

It is advantageous because the volume of tissue irradiated to high dose is reduced compared to that irradiated in CT.

- Highest doses are directed to tissues with the gross tumor volume and smaller volumes of mandibular body receive a high dose, the incidence of ORN is decreased.

- Mandibular teeth in clinical target can be retained because ORN is extremely rare when dose less than 60Gy.
Brachytherapy:

It is used in combination with CT
2 portions of beam therapy (external + internal)
-After course of CT which limited to 50 – 60Gy radioactive source is implanted in the gross tumor volume delivering another 25 - 30Gy and the tissues associated with and adjacent to gross tumor receive doses up to 85Gy.
-Extraction of teeth after radiation therapy does not involve high risk unless the teeth and bone are adjacent to the site of the implant site.

So, pretreatment extraction of pathologic teeth located close to the implant site should be considered.
• ORN if happens probably not due to dental disease but due to combination of dosage from the implant and the external beam dosage which exceeds the maximum level of tissue tolerance locally.
C) prognosis for tumor control:

- If the clinician thinks that the remaining teeth will cause the patient unnecessary pain and discomfort during his/her remaining days, they should be extracted.

D) dose, volume of mandibular body within gross tumor volume:

- The higher the dose the higher the incidence of post-radiation sequelae.
- Almost ORN occurs at doses equivalent to 65 Gy.
- If large volume of mandibular body included in gross tumor the greater the risk of ORN.
Extraction of impacted third molar requires prolonged time for healing (3 weeks-1 month) and delaying the onset of radiation therapy. So if radiation is required immediately, no extraction is done.

-Partially erupted molar if retained increase risk of per-icornitis which could lead to ORN.
**Surgical Procedures:**

- When mandibular teeth extracted radical alveolectomy should be performed, the edge of tissue flap everted, and primary closure obtained.

-Radical alveolectomies are preferred for two reasons:

1) Enable primary closure

2) Smooth sharp edge.
Surgical procedures

- Radical alveoleectomy
- Edges of the mucoperiosteal flaps should be freshened, the edges everted and primary closure obtained*
- Teeth should be removed in segments to facilitate primary closure
- Antibiotic coverage

Time for healing before the start of radiation is different according to many factors (progress by patient...
Radical alveolectomy and primary closure

A radical alveolectomy was not performed on this patient. Note the irregular bony bearing surfaces. These sharp bony projections will not remodel after therapy and therefore this patient is not a candidate for complete dentures.
2#Postradiation dental care
CONTRAVERSY exists

- Some clinicians have proposed that diseased teeth in the radiation field can be removed with little or no risk of bone necrosis, while others suggest that postradiation extraction of these teeth creates a significant risk.

- The most important factors to consider are:
  
  Dose of radiation to bone supporting the teeth considered for removal
  
  The volume of mandible within gross tumor volume
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<td>&gt;65</td>
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<td>• High risk to ORN</td>
<td>• Low risk to ORN</td>
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<td>• Endodontic ttt is safe</td>
<td>• Atraumatic teeth extraction</td>
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<td>Intermediate</td>
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<td>• Controlled by patient factors</td>
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<td>• Chemoradiotherapy</td>
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<td>• Amount of body of mandible</td>
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<td>• Sign of radiation mucositis (scarring)</td>
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<td>• Acute infection</td>
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<td>• Endodontic ttt is done</td>
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<td>• If extraction necessary (HBO)</td>
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#A new approach to patient requiring post radiation dental extraction (Lyons and Ghazali) :

**Drug combination (before extraction)**

(Pentoxifylline) vasodilator that facilitate blood flow by decreasing platelet aggregation and thrombus formation (twice daily for 8 weeks)

(Tocopherol) free radical scavenger.(daily of week of surgery)
Dental maintenance:

(Topical fluoride)

- Used in with radiation-induced xerostomia dramatic decrease in the incidence of radiation caries.

- In existing caries lesion, the presence of fluoride is highly effective in accelerating surface remineralization.

(Calcium phosphate demineralization)

- Can remineralize subsurface lesions.

- CPPs stabilize high concentration of calcium and phosphate ions and fluoride ions at the surface of the tooth by adhering to plaque and the pellicle.
Follow-up and restorative care:
- If preventive measure and stringent oral hygiene measure are not maintained, caries can destroy the entire dentition within 6 months.

- The dentist should attempt to remove all caries present and restore the affected teeth with provisional restoration using remineralizing restorative material.

- Complete coverage restoration may be considered for patient with good oral hygiene and caries control for key teeth that serve as partial denture abutment and for anterior teeth for esthetic.

Endodontic therapy as an alternative to post-tradiation extraction
Radiation

- Principles of radiation therapy
- Indications of radiation therapy & planning
- Oral effects of radiation
- ORN
- Dental management of irradiated patient
  - Prosthetic management of irradiated patient
Prosthetic Management
Patient comes to the prosthodontist

Before radiation

- Radiotherapy prosthesis

After radiation

- Removable dentures
- Implants
Radiotherapy prosthesis
Importance of radiotherapy prosthesis

- Reduce the side effects of radiation
- Protect the vital nearby tissues
- Increase the accuracy of radiation and allows reproducibility
- Increase the patient cooperation as it decreases the side effects
Requirements

- Comfort
- Minimal weight
- Stability
- Accuracy
- Strength
- Easy to repair and clean
- Allow patient to breath easily
- Allow visualization of tissue
Radiotherapy Prostheses

Positioning stent
Shielding stent
Recontouring stent
Tissue bolus device
Radium applicator
Radiation beam director
Flouride stent
Tissue Displacement Prosthesis positioning stent
• Positioning stents are useful for **tongue and floor of mouth** lesions treated with CRT. (external source)

• It is used to **rearrange tissue** topography within the radiation treatment volume and displace normal tissue away from the high-dose radiation treatment volume.

• An inferior position of the tongue and mandible allows a lower radiation field, thus sparing significant amounts of the parotid gland from radiation resulting in higher levels of salivary output after therapy.
- Master casts are made and mounted on the articulator at an open vertical dimension (1/2 - 2/3 the maximum opening) 15-20 mm.
- Acrylic resin stent is fabricated on casts.
- Flat plate of acrylic resin is attached to the stent that depresses the tongue.
- A hole is made in the anterior horizontal segment to ensure reproducible tongue position.
Extension used to depress the tongue

Tip of the tongue fits in this hole

For ease of insertion, the opening should not exceed 25 mm

25 mm
(2) Shielding or radiation protector
- Shielding is helpful when a patient is to receive a unilateral dose of radiation (buccal mucosa, skin, and alveolar ridge).
- It is used to shield the vital structures adjacent to radiation from excessive unnecessary doses (tongue, salivary glands, opposite side of mandible).
Cerrobend alloy:

- It is the shielding material

- It is placed in a reservoir medial to the shield so it can help in reduction of backscattered radiation to normal structures.

- Cerrobend alloy has lower melting point (70°C) compared to lead (327°C) so can be melted and poured in a cavity in the prosthesis without affecting acrylic resin.
- An acrylic resin reservoir was developed on the medial aspect of the mandible.

- The walls of such reservoirs should be at least 0.5 cm thick to prevent backscatter to mandible.

- The reservoir was filled with cerrobend alloy and an acrylic resin cap was added to seal the alloy in place.
A shield for a patient presenting with a squamous carcinoma of the buccal mucosa. Note that the shield separates the mandible from the maxilla.
3- Recontouring stent

This type of stent is indicated when treating skin lesions associated with the upper and lower lips. When the therapist adjusts the beam to the midline, the dosage delivered will be less at the corners of the mouth, because of the convex curvature of the lips and face in this region.

A stent can be employed to flatten the lip and the corner of the mouth, thereby placing the entire lip in the same plane. Such stents often are combined with a shield.

They are easily fabricated by forming dental modeling plastic to the desired dimensions. This pattern is invested and processed in acrylic resin.
Combination bite opener shield for squamous ca of lower lip

Purpose:

a) Reduce radiation dose to normal tissues medial to the tumor
4) **Tissue bolus devices**
Following **orbital surgery and maxillectomy**, **Irregular tissue contour** create uneven radiation dose distribution and cause difficulty for the radiation oncologist.

**A bolus** is a tissue equivalent material placed directly on or in irregular tissue contours to produce a more homogeneous dose distribution.

The materials for a bolus in the head and neck region are **saline, wax, and acrylic resin**.
The device is composed of a palatal stent, rubber bladder and a hose connector.

In this patient a saline filled bladder was used to fill a radical maxillectomy defect with a tissue equivalent material.
This tissue bolus is made of acrylic resin. Patient is 3 weeks S/P partial palatectomy and is to receive postoperative radiation therapy.

The appliance fills the defect with acrylic resin and is made of two pieces to allow for easy insertion and removal.

The device also separates the mandible from the maxilla and keeps the tongue below primary treatment volume.
5) Radiation – positioning stents
Carrier (Applicator)
Radium Applicator
A device used to administer the radiation source to confined area. Its function is to hold the radiation source securely in the same location during the entire period of treatment. It is mainly used with brachytherapy utilizing radio-isotopes positioned in or close to the tumor.
• The radioactive source may be **preloaded** or **afterloaded** in the radiation carrier

• For **preloaded technique**, the source is positioned within the prosthesis (carrier) just prior to insertion of the carrier so medical staff receive some radiation.

• For **afterloaded technique** the radiation carrier is designed with hollow catheters in predesigned location. Once the radiation carrier is in position, radioactive isotopes are threaded in the hollow tubing so this technique reduces the exposure of the medical staff to radiation.
Patient presented with severe trismus, so the radiation carrier was made of a flexible silicone material.

The radioactive sources are inserted after the patient inserts the carrier.
6-Radiation Beam Director
Peroral cone positioning device (Beam locator)
A prosthesis used to direct and re-locate the path of radiation to an oral tumor during the course of radiation.
Indication

Small superficial lesions in accessible locations in the oral cavity

The tumor site receives a higher dose of radiation while sparing adjacent vital tissues such as the teeth and salivary glands.
For an edentulous patient, mandibular and maxillary record bases are fabricated. The actual peroral cone, or a cylinder of the same diameter of the cone is used to form an acrylic resin ring, 5 to 6 cm in length. Thick tinfoil is wrapped around the cone to insure its separation from the autopolymerizing acrylic resin which is used to form the ring.

For dentulous patients, maxillary and mandibular occlusal indices are fabricated and the acrylic resin cone attached in a similar fashion.
7- Fluoride stent

- These are transparent acrylic stents constructed for dentate patients to carry fluoride material to decrease the incidence of radiation caries.

- It creates enough space between an old metallic filling and the mucosa preventing the backscattered radiation that lead to mucositis.
Prosthetic management of irradiated patient
Soft liners

Risks Related to ORN

Prosthetic management of irradiated patient

Timing of denture placement

Prosthetic procedures

Implants
Risks for Osteoradionecrosis

- Risks of osteoradionecrosis are minimal if patient was already edentulous and old denture wearer (neuromuscular control).

- The ORN is actually more common in patients who require removal of teeth prior or after completion of radiation therapy.

- It is important after extraction to perform radical alveolectomy as if not done, the alveolar ridge will be irregular which increase the risk of bone exposure and ORN.
Silicon Soft Liners

- **Aim:** To minimize mucosal trauma in mandibular dentures and distribute the forces by acting as a cushion.

- **Contraindicated because:**
  1. Reduced Wettability + (xerostomia) ..... tissue irritation due to friction by dentures.
  2. Poor Adjustability of silicon ➔ Tissue abrasion
  3. Rapid deterioration of silicon liners due to increase in fungi populations
Controversy Exists regarding when dentures should be constructed for irradiated patients

Some Authors suggested:

- 12-18 Months after radiotherapy
- 2-3 Years after mucosal healing
- At least one Year post Radiotherapy
  or
  can be inserted immediately?
Patients edentulous prior to the tumor diagnosis who are experienced denture wearers

- New dentures can be made or existing dentures reinserted as soon as the mucositis has resolved.
- If the tumor site lies within the area of a denture extension area or the bearing surfaces, the denture should be checked with pressure indicating paste (PIP) and disclosing wax prior to reinsertion.

Patients dentulous prior to undergoing preradiation or postradiation extractions

- Denture bearing surfaces should be carefully examined for contour irregularity, telangiectasia, and scar before proceeding with denture fabrication.
- Some such patients qualify immediately, others may never be good candidates for mandibular dentures.
Prosthetic Procedures

- Examination
- Impressions
- Vertical Dimension
- Occlusal Schemes
- Delivery and Post Insertion Care
- Implants in irradiated tissues
Examination

History

- History of radiotherapy
  - Nature of the Tumor and Mode of TTT
  - Dose to denture bearing surfaces

- History of Use of Dentures (future success)

Oral Examination:

Appearance, Scars, mucositis, fibrosis, Trismus, saliva, Denture foundation area (tori, tuborisions, undercuts)
Condition of oral mucous membranes

- Telangiectasia, mucosal atrophy and bearing surface boney contours

- This patient presents with both telangiectasia of the bearing surface mucosa and irregular boney bearing surfaces.
- In such instances the denture bearing surface epithelium may be only 5-6 cell layers thick.
These two patients were treated with CRT with opposed mandibular fields and the dose to the mandibular body was 70 Gy. Exam revealed mucosal atrophy and telangiectasia on the denture foundation surfaces. Both patients are poor candidates for mandibular dentures because of the high risk of mucosal perforation and osteoradionecrosis. However, a maxillary denture can be worn with little or no risk to the patient.
Contours of the bony bearing surfaces and presence of bony undercuts

- Irregular contours on the mandibular bearing surface may contraindicate the fabrication of a lower denture if these surfaces are within the gross tumor volume and the dosage is high (above 65 Gy).

- During function the mandibular denture slips and slides over the mucosa during function and prior to closure the tongue seats the denture on the bearing surfaces. If the denture is not properly seated when the closure occurs mucosal injury can result.
Salivary flow rates

Consequences of reduced flow rates:

- Compromise tolerance of dentures particularly the mandibular denture
- Compromised peripheral seal of the maxillary denture
- Increases the risk of tissue irritation particularly in the mandible because:
  - Its reduced bearing surfaces as compared to the maxilla
  - The mandibular denture slips and slides over the bearing surface during function.
Trismus

- Most commonly seen in patients with tumors of the soft palate, tonsil and nasopharynx where the muscles of mastication receive high dose levels (about 10-50% in such patients)
- Made significantly worse by concomitant chemotherapy
- Trismus may require the reduction of the vertical dimension of occlusion in order to facilitate entrance of the bolus
Scarring

Scarring at the tumor site within the denture foundation area or at the periphery of the denture

This patient is a good candidate for complete dentures but care must be taken to avoid overextension of the denture adjacent to the scar associated with the tumor site. A mucosal perforation in this area would probably lead to an osteoradionecrosis.
Any condition which compromises the prosthetic prognosis in nonirradiated patients assumes added significance in irradiated patients.

- The clinician should examine the denture foundation area thoroughly for undercuts, tori, high tissue attachments, enlarged maxillary tuberosities, flabby and redundant tissue, lack of attached gingiva, retruded tongue position, unfavorable floor of mouth contours and abnormal jaw relationships.

- For example, mandibular ridges such as these with severe bilateral undercuts or excessive ridge resorption with little attached keratinized mucosa are poor candidates for complete denture service following radiation therapy.
Impressions

• Conventional border molding using custom tray and modeling plastic is used for making impressions.
• Avoid over extensions by properly molding the borders.
• Lingual extension of the lingual border of mandibular denture should not be overextended could result in a mucosal perforation.
• The lingual flange should be used for stability and support rather than retention.
• Petrolatum may be used to prevent sticking of the modeling plastic to dry mucosa.
• Zinc Oxide may cause discomfort, and main objective is to displace tissues as least as possible.
• **Reducing** the Vertical Dimension should be considered in order to:

1) Decrease Forces applied to the supporting mucosa and bone

2) With Excessive trismus, entrance of the bolus is more easily accomplished by increasing the interocclusal space.
Occlusal Schemes

- **Lingualized or monoplane** occlusal schemes with balancing ramps → To decrease horizontal forces.
- **Setting of posterior teeth** should be done with special attention directed toward attaining a proper buccal horizontal overlap → avoid buccal mucosa injury and necrosis.
Delivery and Post insertion Care

- Laboratory Remount
- Tissue Surface (rough areas, pressure areas, polishing)
- Clinical remount
- Instructions:
  - Dentures to be removed if any soreness develops.
  - During sleeping, dentures not to be worn.
  - Initially, denture wearing is limited to mastication.
  - Recall appts (24, 48hrs, and every 3 months for first yr, if no complications, intervals can be prolonged)
Implants in irradiated tissues

- Success of implants in normal tissues requires implant anchorage, immobilization and formation of a clot between implant and osteotomy and release of growth factors.
- These processes are compromised in irradiated bone, and anchorage of implants are probably mechanical and not biologic.
• Long term function of implants depends on presence of viable bone that is capable of remodeling and turnover when it is subjected to stresses associated with supporting, retaining and stabilizing prosthetic restorations.

• Implantation in irradiated patients require careful considerations including:
  - Risk of osteoradionecrosis.
  - Benefit provided by implants
  - Morbidity associated with implant placement or failure.

Success/failure rate appears to depend upon the anatomic site selected, the dose and the use of Hyperbaric Oxygen.
• Predictability of Implants in irradiated bone

Animal Studies:

- Implants in irradiated bone will have lower success rates than in non-irradiated bone.
- Since anchorage in irradiated bone is mainly mechanical rather than biologic, load bearing capacity of implants in irradiated bone is lower than that in non-irradiated bone.
• **Human Data**

After Many studies, authors reached:

- Its safe to place implants in irradiated bone exposed to **less than 55 Gy**

- In Doses **greater than 65 Gy**, risk of osteoradionecrosis would be significant. Placement of implants requires course of Hyperbaric oxygen.

- For Doses **between 55-65 Gy**, Individual patient factors such as dose per fraction, etc. should be considered when assessing the risk.
• **Irradiation of existing Implants:**

Irradiation of Existing implants results in backscatter that may result in tissues near the source receiving a higher dose than other tissues in the field. (15% more just 1 mm from the implant)
• Addition Scatter may occur due to noble metals involved in **bars** and **restorations** that may be attached to the implants.

• In this case the backscatter may approach 80%.

• Question was whether the implants to be removed prior to radiotherapy or not?
• **Granstrom Protocol:**

Surgically burial of the implants beneath mucosa prior to radiation.

**Disadvantages:**

Primary closure is difficult, resulted in tension along the suture line. So it usually dehisces and the implants and cover screws became exposed.
• **UCLA Protocol**
  - Removal of the restoration
  - Attaching titanium healing abutments to the implants prior to radiotherapy.
  - After radiotherapy, the abutments and/or superstructure may be reattached in most instances.

But in the mandible, the decision to return abutments and super structures is based on several factors including dose, type of prosthesis, hygiene, patient compliance, etc.