*Section A-Research paper*
***ISSN 2063-5346***

# ROLE OF MAXILLOFACIAL STENTS DURING RADIOTHERAPY FOR PATIENTS WITH HEAD AND NECK CANCER

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## ABSTRACT
Maxillofacial prosthodontics involves rehabilitation of patients with defects or deficits of face, jaws and surrounding soft tissues that may have occurred through developmental defects, traumatic injury or any disease. Radiation can damage areas in the head and neck region that are not necessarily affected by cancer. Prosthetic devices can be fabricated to anchor or protect facial structures from radiation exposure. Positioning devices fabricated by Prosthodontists protect these areas during treatment.

Maxillofacial Prosthodontists play an essential role in palliative care team as well, he/she is the primary person involved in many facets of patient care, and is therefore the individual who is in the best position to coordinate in smooth functioning required in this complex rehabilitative process which can be enhanced using various surgical stents and splints. All these prosthetic appliances can fulfil the needs of such patients and prevent the development of further complications thus alleviating their discomfort and help them to live a better life.

**KEY WORDS**: Radiation stent, Radiation therapy, Post radiation complications

## INTRODUCTION
Palliative care is defined according to World Health Organisation[1] as "an approach that improves the quality of life of patients and their families facing the problems associated with life-threatening illness, through the prevention and relief of suffering by means of early identification and impeccable assessment and treatment of pain and other problems, physical, psychosocial and spiritual."

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Radiotherapy (RT) has successfully treated patients with head and neck cancer, which is a well-accepted method[2]. According to statistics, 40% of the malignancies diagnosed in India are oral cancers[3].

Although radiation techniques have advanced, a variety of oral side effects are still accompanied with this procedure, including radiation caries, taste loss, xerostomia, erythema, mucositis, trismus, and osteoradionecrosis, which significantly reduces the patient's quality of life[4].
Cancer-related disability, especially when chronic, affects all spheres of living for the patient: physical, functional, psychosocial, and vocational. All terminal care patients are susceptible to oral problems, which include pain, fungal and viral infections, poor denture stability, dysphagia, nutritional problems, xerostomia, aesthetic loss and compromised speaking ability. All of these problems lead to oral dysfunction, which causes unnecessary pain and suffering and commonly jeopardize the patient's quality of life[5].

The patient's capacity to speak, eat, and swallow can be improved with the help of a maxillofacial prosthodontist as part of a multidisciplinary approach to palliative care. Growing demands on dental professionals for more understanding of oral symptoms associated with systemic disease and their dental care are being placed on them[6]. Other issues that should be taken into consideration while treating patients receiving radiotherapy include tooth hypersensitivity, taste loss, oral bacterial translocation, and periodontal breakdown[7,8].
For both patients and caregivers, the oral side effects of head and neck radiotherapy are demoralising. It has been determined that the volume of oral tissue exposed to such radiations and the total cumulative radiation dosage are associated with the frequency and severity of mucositis. In order to reduce radiation dose in a healthy structure and lessen the negative consequences of radiation, recent studies[9] explored into the usage of specialised intraoral prosthesis.

A Maxillofacial prosthodontist can play his role in various stages of treatment planning of cancer patients. Before the start of radiotherapy patients can be provided with various radiations stents and customized stents to be used during the therapy and once radiotherapy is over, patients can be provided with various prostheses which can be critical requirements to improve the quality of life for individuals whose rehabilitation would be a lifelong proposition. Through such rehabilitation, normal function may not be achieved but optimal function should always be attained and normalcy should always be sought[10].

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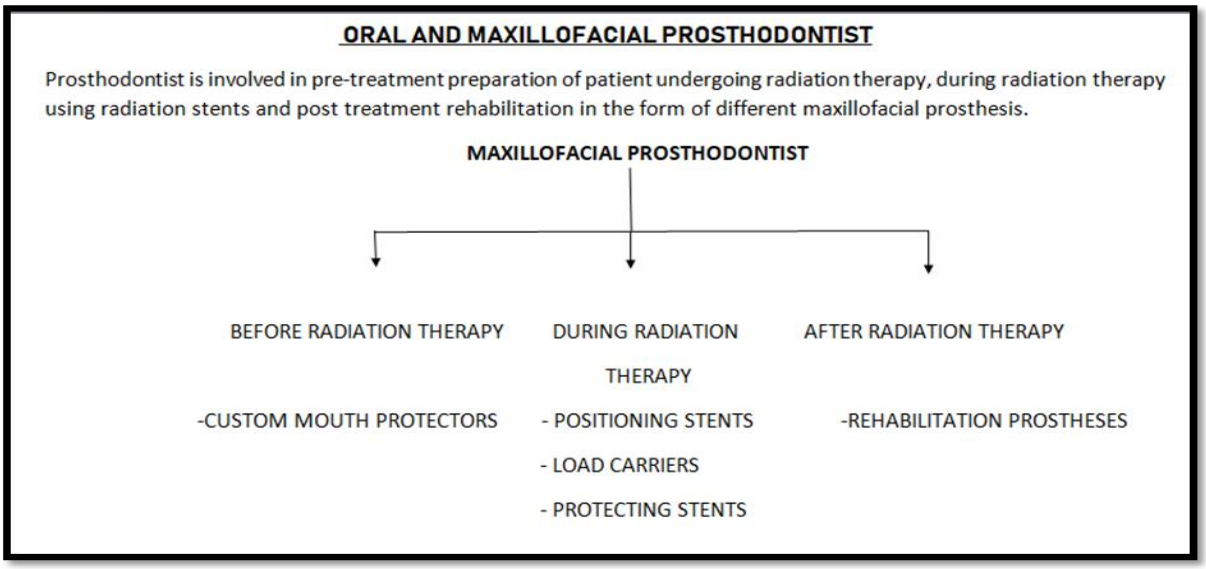
***ISSN 2063-5346***




***I. BEFORE THERAPY*** - Radiotherapy protective prostheses can be created and utilised during the treatment as a preventative strategy or to lessen the severity of the negative effects. These prostheses are used to cover healthy tissues from radiation exposure, protect important structures from displacement or damage, pinpoint diseased areas during treatment with repetitive beam positioning. Flexible mouth trays that cover the teeth can be created prior to the start of radiotherapy and are used to apply topical fluoride to the teeth to prevent radiation-induced dental issues[11].

**1. CUSTOM MOUTH PROTECTOR** – These protectors are indicated in severe cases. Irritation caused to painful edematous mucosal tissues is protected with the help of flexible smooth protectors. This also helps in maintaining nutritional status of the patient during therapy. Radiation patients frequently experience hypersensitivity of the teeth due to temperature changes. The hypersensitivity normally goes away in 4 to 6 weeks with daily use of fluoride gel in customised mouth protectors for 10 to 15 minutes thrice a day. These mouth protectors are fabricated prior to radiation exposure using thermoplastic sheets.

***II. DURING THERAPY***

**1) POSITIONING STENTS**- This type of stent are generally useful for displacing tongue and floor of the mouth in conventional radiation therapy procedures. These stents also aid in maintaining the spatial relationship of mandible to maxilla. In IMRT (Intensity Modulated Radiation Therapy), these stents can aid in treatment planning. Positiong stents can be given to dentulous as well as edentulous patients.[17]

A) **Position Maintaining Device** - Position maintaining stent (Fig.1) is employed to maintain the movable components in the radiotherapist's ideal setting. It is employed when multiple therapy sessions are necessary and the structures must be set up in a predetermined and consistent manner. They are frequently utilized to position structures like the tongue and soft palate.

B**) Perioral Cone Positioning Device** – Perioral cone positioning device (Fig.2) is utilised to focus the radiation beam only on the necessary location. Its major goal is to retain the cone in a fixed and reproducible position during treatment to minimise cone movement. It is used to treat superficial lesions such as subglottic region, tonsil lymphoma, squamous cell carcinoma, cancer of the pisiform sinus, and nasopharynx lesions that affect the hard and soft palate as well as the anterior floor of the mouth[6].

C) **Dosimeter Positioning Device** - This device (Fig.3) can be used to determine how much dosage is needed to be supplied to a lesion and how much has already been administered. The following formula can be used to determine the absorbed dose:

**D=AEave*1.6E-13J/MeV*1E3g/kg.**
D= Absorbed dose, A=Radioactivity, Eave= Average energy
E= HxW1 where H= Equivalent dose, W1=Weighing factor
J= Joule, MeV= Million electron Volts

D) **Intraoral Positioning Appliance for Stereotactic Radiotherapy** – This nonsurgical prosthesis (Fig.4) delivers fractionated radiation doses to the lesion from a variety of angles. The radiation oncologist can enhance the target dose while reducing the dosage to normal tissues by fusing the dosimetric benefits of stereotactic precision with the biologic benefits of dosefractionation. For the treatment of intracranial tumours like pituitary adenomas, acoustic neuromas, meningiomas, and craniopharyngiomas, traditional surgery and/or conventional radiation therapy can both be replaced with stereotactic radiotherapy. The metal spheres included in the intraoral positioning device are utilised as reference points to check the location and orientation of the head inside the stereotactic space.

E) **Tissue Bolus Device**- Irregular tissue contours lead to uneven radiation dose distribution resulting in development of isolated hot spots which can be prevented by using tissue bolus device. A bolus is tissue equivalent material (saline, wax, acrylic resin) placed directly on or in irregular tissue contours to smoothen them and resulting in uniform distribution of dose. The radiation oncologist is consulted about the treatment field and the amount of radiation to be delivered. This information is used to develop bolus extending beyond the edges of the treatment field, thus simplifying the dosimetry calculations for oncologist.[17]

**2) RADIATION LOAD CARRIER** - They are used to transport radiation sources either directly into the tumour (interstitial) or close to the treatment site (intracavitary). Preloaded carriers and post loaded carriers are the two types.[17]

A) **Pre-Load Radiation Carrier**- In this type of carrier (Fig. 5), the material which is radioactive is first put into a polyethylene tube with a reduced diameter before being added to the stent and cerrobend sheath. It is used to transport radiation sources either directly into the tumour (interstitial) or adjacent to the treatment site (intracavitary).

B) **After-Load Radiation Carrier** - Because the radioactive elements are introduced after the carrier (Fig. 6) is in place, the post loading technique, as opposed to the preloaded technique, reduces the radiation exposure to people handling and configuring the device. This method

involves implanting a radioactive source within the tumor's tissues. This method has two applications: both detachable and permanent implantation. The after-loading technique has been developed for use with surface applicators to treat soft tissue malignancies of the body, such as lymphoma of the maxillary gingiva, carcinoma of the cheek, and buccal mucosa[13].

C) **Custom Made Trays-** common problem with radiotherapy is backscattering from large dental restorations which may result in severe localized mucositis. This can be prevented by using these custom fluoride trays during therapy, thus providing sufficient space between the mucosa and metallic restorations to minimize backscattering effects.[17]

**3) PROTECTING STENT** – These are also known as shielding stents. Radiation stents often use a shielding and tissue-equivalent bolus material. Uninvolved tissues are frequently protected from damage by lipowitz metal or cerrobend alloy from the therapeutic radiation used for the head and neck malignancies treatment. This fusible eutectic alloy is composed of 50% Bi, 26.7% Pb, 13.3% Sn, and 10% Cd. These stents are frequently made using the traditional facial moulage process. Recent developments include the utilisation of rapid prototyping technologies and computer-aided design and manufacturing (CAD/CAM). A 1cm thickness of Cerrobend alloy will prevent transmission of 95% of an Mev electron beam.

A) **Tongue Depressing** - This stent's (Fig. 7) main function is to depress the tongue and shield it from radiation exposure. The apparatus also straightens the mandible and protects the parotid gland from radiation therapy. It comprises of an interocclusal stent that extends lingually from both alveolar ridges and a flat acrylic resin plate that depresses the tongue. They are recommended for malignancies of the head, neck, and tongue. The absence of stents leads to tongue, buccal mucosa, and retromolar trigone lesions, which increase the risk of cheek and tongue biting.[13]
B) **Displacing Stent** - They are employed to remove the critical structures from the radiation field by moving or displacing them. It is frequently used to treat tumours that affect the buccal mucosa, tongue's posterolateral margins, and the mandibular alveolus. The maxilla is protected from undesirable radiation exposure by the stent's (Fig. 8) design, which divides the maxilla from the mandible.

The type of radiation used, the condition of the diseased hard and soft tissues, the patient's ability to open their mouth, and the needs of the treating radiotherapist are some of the factors that determine whether a shielding metal or alloy is included in radiation stents. Radiation stents are frequently made of acrylic resin. These stents are created using traditional prosthetic methods. The other preferred material is silicone.

C) **Recontouring Stents** – are used in treating upper and lower lip skin lesions. These stents are basically used to flatten the lip and corner of the mouth, placing them in same plane and are used along with shield thus resulting in a homogenous dose distribution and protecting surrounding tissues from radiation exposure. [17]

*Section A-Research paper*
***ISSN 2063-5346***

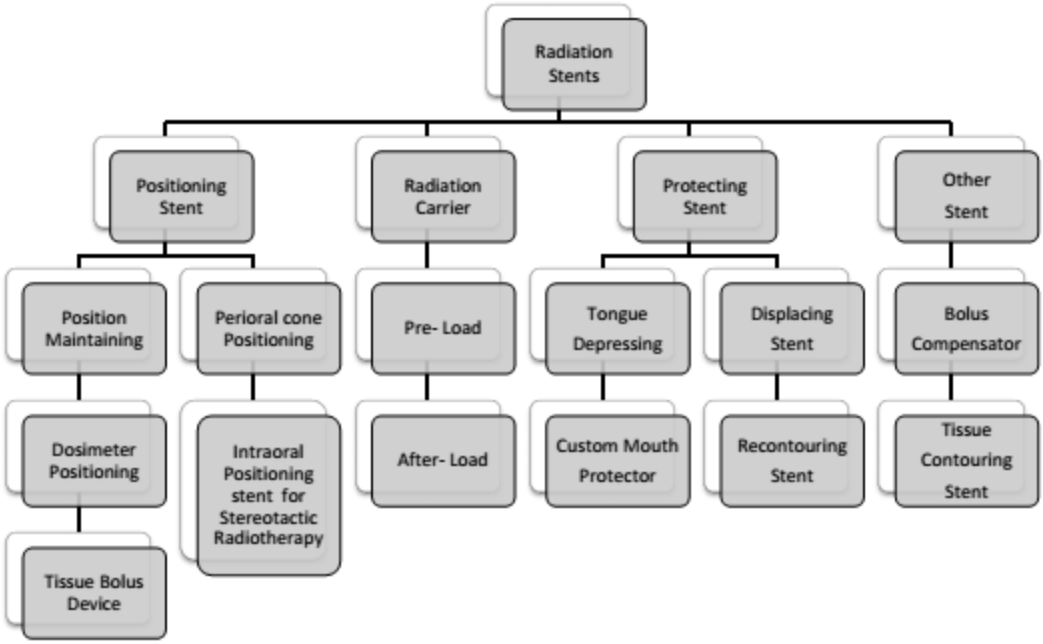



Fig.1
Positioning Stent

Fig. 2
Perioral Cone Positioning Stent

Fig. 3
Dosimeter Positioning Stent

Fig.4
Intraoral Positioning stent for Stereotactic Radiotherapy

Fig.5.
Pre- Load Carrier

Fig.6
After Load Carrier

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***ISSN 2063-5346***

Fig. 7
Tongue Depressing Stent

Fig.8.
Displacing Stent

**III. AFTER RADIATION THERAPY**-: **Flexi Dentures**: The hard acrylic material of conventional hard dentures and the age-related sensitivity of mucosa in many patients who wear them can induce pain. A dentist can provide flexible dentures in any of these scenarios because, as their name suggests, they are incredibly flexible due to the nylon base they are made of.

**Dental implants:** Dental implants are high-tech but preserve more teeth than fixed partial dentures as they do not need an abutment tooth for support. The bone which once supported the teeth begins to degenerate when they are lost. Dramatic changes in one's appearance may occur from this, like deeper wrinkles, collapsed and unnatural-looking skin around the mouth. When replacing missing teeth, large number of older people are choosing dental implants as a treatment modality over dentures. If older adults are free of systemic diseases and cancer, their success rates with implants are high as compared to those of younger people. Patients receiving intravenous bisphosphonates are not recommended for dental implants. All patients receiving bisphosphonate therapy must be aware of the possibility of implant loss and the possibility of necrosis of bone the operated jaw. Informed consent prior to dental implant surgery is a must[12].

**Denture Care** - Plaque accumulation, which can irritate the tissues under the dentures, must be avoided by denture users. To prevent the growth of bacteria, thoroughly clean the dentures every day and remove them at night. Denture wearers encounter higher salivary candida levels as compared to dentate patients [14].

Denture odours can be prevented by soaking the them in water (250 ml) and bleach (15 ml) for approximately 30 minutes. Metal fatigue can be caused if partial dentures are soaked in bleach solution. Soaking them in benzalkonium chloride (1: 750) is also recommended. As Gram-negative bacteria can grow within 24 hours, Benzalkonium chloride should be formulated daily. Denture base distortion can occur due to boiling[15].

Disinfection of the denture base can be done by microwaving it at high power for 5 minutes in water. Distinctive vessels of water, mouthwash, 0.12% chlorhexidine, listerine antiseptic or 100 000 IU of nystatin suspension can be used for storing dentures [16]. Because mouths change over time, a variety of treatments may be used to treat candidiasis. In order to prevent discomfort, increased bone loss, and infections, fit of the dentures must be checked.

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**Medicament Carrier:**
The purpose of this acrylic stent is to keep healing pastes in touch with the oral mucosa. It can be modified to carry and keep a palliative paste at a desired place for use during chemotherapy or in the treatment of osteonecrosis. The base plate is formed on a plaster cast and includes relief in the lesion area.

**Trismus appliances:**
Mouth opening can be increased gradually by using the following devices:
1-Simple devices: The simple devices create a unilateral force but give the patient discretion over the timing and amount of pressure needed to gradually improve jaw separation.
2- Trismus stents/ Dynamic bite opener: Consists of stents for the maxilla and mandible connected to a steel framework. When the device is placed in the mouth, elastic bands create a bilateral opening force that may be altered by switching the elastics.

Consists of rubber bulb and tubing, inflatable paediatric blood pressure bag, maxillary and mandibular stents. The inflatable bag is positioned between the stents after the stents have been implanted. Squeezing the rubber bulb inflates the bag by separating the stents. 10 seconds of pressure maintenance is followed by 1 minute of rest. This procedure is recommended to be followed for 10 mins thrice a day. This appliance is used for both dentate and edentate patients.
Rehabilitation of cancer patients is a great challenge for a prosthodontist. Reconstruction surgeries can be performed to rehabiliate the cancer patients. Rewarding area of maxillofacial prosthodonticts is rehabilitation of patients with orofacial defects post cancer therapy in the form of removable dentures, obturators, nasal prosthesis, ocular prosthesis, auricular prosthesis which could be implant retained as well

## CONCLUSION
Because of lack of well-designed studies, clinicians responsible for preradiation preparation and postradiation maintainance of patients have to rely on clinical case series data. As a part of preradiation dental evaluation process, maxillofacial prosthodontist is often requested to fabricate radiation stents. The request for particular stent is depends on type, location, method of radiation therapy. In this article we have attempted to describe various radiation stents designs and their application in different clinical situations. Active participation of Maxillofacial Prosthodontists along with radiation oncologists, medical oncologist and maxillofacial surgeons is essential for making an intelligent and practical contribution to care of cancer patients.

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