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Fabrication of customized mouth opening and tongue depressing Prosthetic stent for head and neck radiotherapy- A Case Report

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ABSTRACT: The prevalence of head and neck cancers increases worldwide, the therapeutic arsenal of its management mainly includes surgery, radiotherapy (RTH), and the combination of these two therapies. Chemotherapy is also used as an adjuvant treatment. Normal tissue reactions limit the use of radiotherapy in the management of patients with head and neck neoplasms. Customized intraoral stents can help prevent unnecessary irradiation of various normal tissues thus reducing severity of reactions. This case report describes steps involved in fabrication of customized mouth opening and tongue depressing stent for head and neck radiotherapy.

Key-words: Volumetric modulated arc therapy (VMAT), Oral stents, Mouth opening and tongue depressing stent (MOTD)

I. INTRODUCTION:

Radiotherapy (RT) to treat head and neck cancers has long been a standard approach with the objectives of treating the pathology and preserving organ function [1.] External beam radiation therapy (EBRT) in head and neck cancers is indicated as a definitive treatment alone or in combination with chemotherapy, or as adjuvant therapy after tumor resection surgery [2.] Technological advances and alternative approaches have been directed to customize the radiation dose and target volume to maximize therapeutic efficacy while minimizing side effects [3.] However, it is still difficult to protect organs at risk, especially in locally advanced tumors. However, it is not an easy task to meet the aim of RT, which delivers a curable dose to a target volume while minimizing the dose to organs at risk (OARs) near the target volume because head and neck (H&N) tumors usually overlap or are adjacent to normal organs. There are many OARs of concern in the RT planning for H&N cancer, such as the brain, brainstem, optic apparatus, parotid gland, submandibular glands, pharyngeal muscles, laryngeal structures, and oral cavity (OC), including the tongue. Volumetric modulated arc therapy (VMAT) is a novel radiation technique, which can achieve highly conformal dose distributions with improved target volume coverage and sparing of normal tissues compared with conventional radiotherapy techniques. VMAT also has the potential to offer additional advantages, such as reduced treatment delivery time compared with conventional static field intensity modulated radiotherapy (IMRT).[3]

Oral stents can be used during RT for oropharyngeal cancer (OPC) to better position the oral tissues to facilitate normal tissue sparing and/or immobilize the tongue.. Tongue-depressing oral stents can be used in base of tongue (BOT) cancers to displace. The BOT target volume away from the non-target palate and helps to immobilize the tongue to facilitate tongue/target position reproducibility and accurate RT delivery.[4]

The most used radiation devices include mouth opening, tongue depressing (MOTD) stents and tongue-deviating stents.[7] MOTD stents are used to displace the tongue, mandible, and submandibular glands inferiorly away from the field of radiation forcarcinomas of the maxilla, nasopharynx, maxillary sinus, or soft palate.[6] In addition, when used for carcinomas of the tongue, mandible, or oropharynx, these stents substantiallyreduce radiation to the maxilla and parotid glands.[6] MOTD stents also help immobilize the patient's head, which is critical for maintaining a stable and precise repeatable position of the target throughout the fractionated radiation treatment. Radiation stents along witha thermoplastic mask conformed over the patient's face and head have been reported to improve the accuracy of the radiation delivery and reduce errors in 3 dimensions.[5]

II. CASE REPORT:

A 66-year-old male patient undergone tongue cancer with stage of T2-N0-M0 was requested for position control device from the surgeon and radiotherapist. Histologic finding included squamous cell carcinoma of the base of the tongue, Patient was referred to Department of Prosthodontics, Crown and Bridge, Government Dental College and Hospital, Ahmedabad; three weeks after surgical excision and asked to make tongue depressing stent which could maintain the stable and repeatable position of patient during 6000cGy- in 30 fractions (200cGy planned dose per fraction) in 6 weeks for irradiation treatment. Intra oral examination revealed surgical healing wound on the right side of base of tongue and comprehensive dental examination was done and there was no need of any dental intervention (figure 1.) Dental counseling done before VMAT (Volumetric Modulated Arc Therapy) included a comprehensive discussion of radiation-associated morbidities, at-home oral care guidelines, and the importance of lifelong regular professional dental maintenance.

A custom MOTD radiation stent fabrication followed the technique as described by Bart Johnson et al.

Maxillary and mandibular impressions were made with irreversible hydrocolloid(imprint; DPI, India), and poured in dental stone type 3 (Kalstone India), and models were made (figure 2.)

A bite registration made using Aluwax (Aluwax; Aluwax Dental Products Co) with open mouth position with the intent to keep mouth open around 22mm derived from the results of study by Kazuma[8] et al. 2022 the regression equation with the range of mouth opening as the response variable and the attenuation amount of the irradiation dose of the palate as the explanatory variable was $y = 0.21x + 19$.and mounted on class 2 three point articulator (Jabbar &co.India)

Auto polymerizing clear cold cure resin (DPI RR, Cold cure, India), molded and placed in form of horseshoe-shaped segments of the material over each model arch to engage the cusp tips and after material sets another two vertical struts between the posterior segments of the horseshoe-shaped segments were made from same material. Then a horizontal plane for tongue depression extended posteriorly beyond the second molars; the terminal part of this plane was angled downwards to prevent the posterior tongue from moving superiorly during radiation therapy.

III. DISCUSSION:

Radiation stents have been developed and utilized over decades as they repeatedly position the oral cavity and its anatomic structures in a consistent position during each fraction of RT, which may help in minimizing the adverse effect of RT as well as maximizing local control of tumor [6]Patients treated with tongue-depressing stents and bilateral neck RT showed significantly less moderate/severe dysphagia and mouth/throat sores. Besides the overall beneficial effect on long-term toxicity, the tongue-depressing stent has been previously shown to improve patient and oral immobilization during treatment [4] This improvement in immobilization can lead to an improved image quality in MRI [4,] which is often fused with the planning CT for better target and organ at risk delineation.

Kaanders et al. [9]described the workflow for manual fabrication of radiation stents for HNC RT purposes. They set criteria for stent quality that included: (1) adequacy and reproducibility of the stent with regard to tissue positioning; 2) ease of insertion and removal; (3) patient tolerance and stability in the treatment position; (4) simplicity of design; and (5) safety (especially with reference to aspiration.

prefabricated radiation devices are readily available but do not offer the same benefits and customization that can be created by a maxillofacial prosthodontist using a patient's records.[10]

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Legends:

Figure 1- Intraoral post-surgical occlusal view of maxillary and mandibular arch

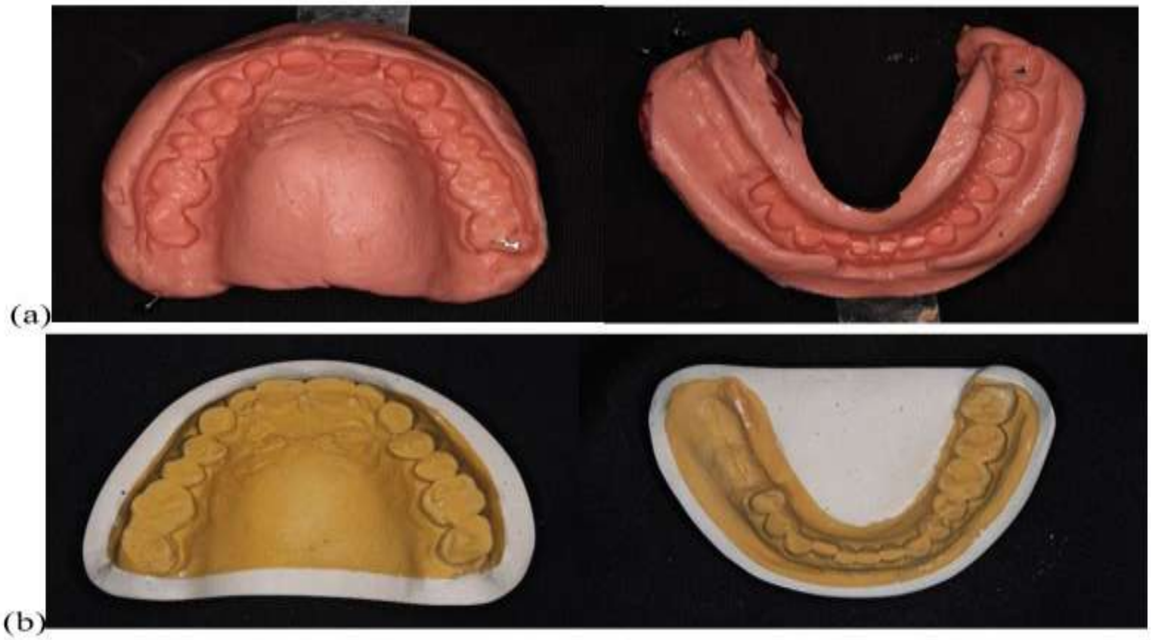

Figure 2- (a) Primary impression of maxillary and mandibular arch is taken, and (b) casts are made

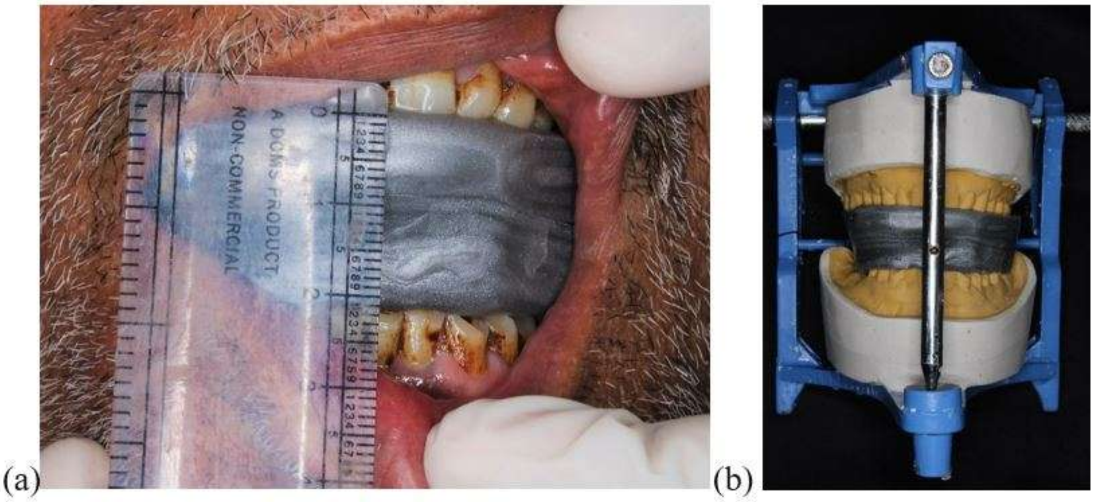

Figure 3. (a)Interocclusal bite record kept at around 22mm and (b) mounted on three point articulator.

Figure 4. Front, occlusal, and lateral view of stent

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Figure 5. Stent in situ

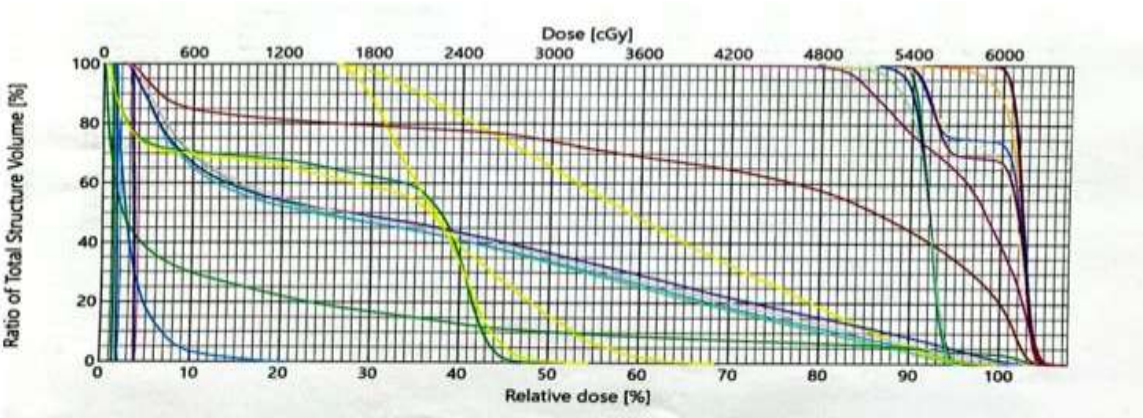

Figure 6. Cumulative dose volume histogram

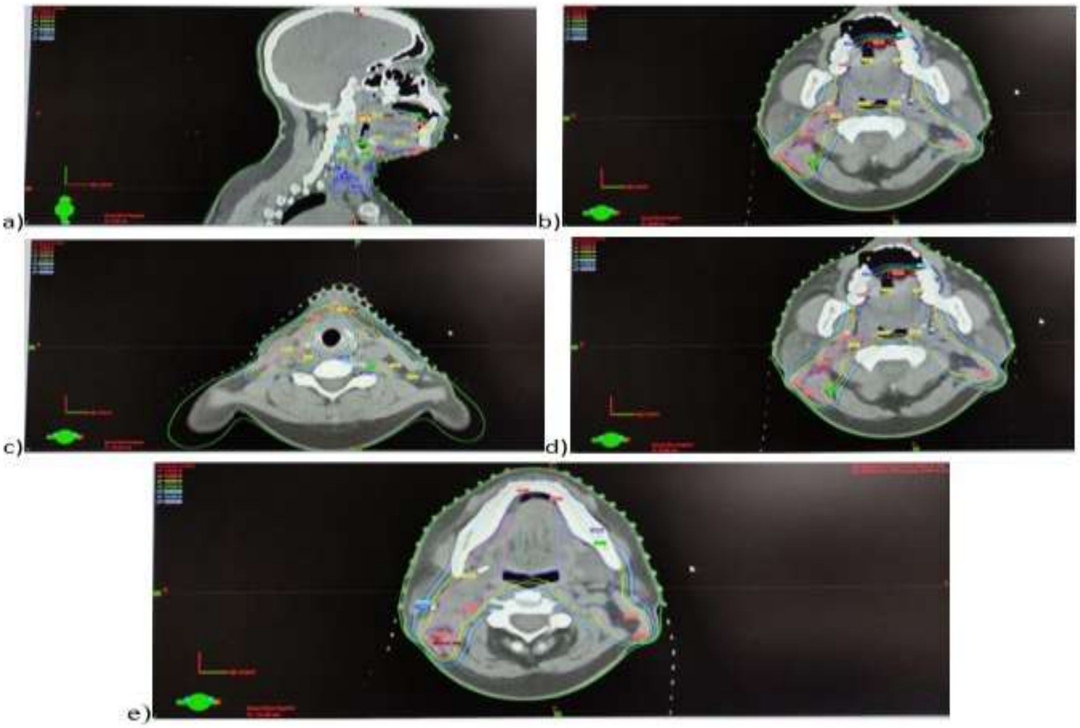

Figure 7.a) Dosimetry planning in lateral view b) to e) Selected transverse sections showing planned depth of penetration of proton beam radiation.