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Case Series

Brachytherapy using radiation carriers: Case series

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ABSTRACT

Brachytherapy reduces the post radiation sequalae as the dose required is lower than external beam radiation therapy (EBRT) and limits the area of exposure. This case report outlines two different patients managed by fabrication of radiation carrier prosthesis for the duration of the brachytherapy.

1. Introduction

In brachytherapy radiation, dose is delivered at close proximity to the lesion via sealed radioactive sources through interstitial, intercavitary or surface application.

The prosthetic devices used for brachytherapy may be classified as stents, splints, shields, carriers or positioners.[1] Radiation carriers carry radioactive sources closer to the lesion, allowing concentrated dose of radiation to be applied to a confined area by means of capsules, seeds, tubes, or needles, and thereby decrease the radiation injury of adjacent healthy tissues.[2]

2. Case Report I

A 52-year-old patient was referred to the Dept of Prosthodontics for provisioning of a radiation carrier for a lesion on the right side of soft palate. The tumor classification was $T_1N_0M_0$. The patient was planned for interstitial brachytherapy to the soft palate lesion post conventional radiotherapy [50 Gy of EBRT to the local region (spine sparing)]. The size of the lesion was 6 x 8 x 3 mm in size [Figure 1 (a)].

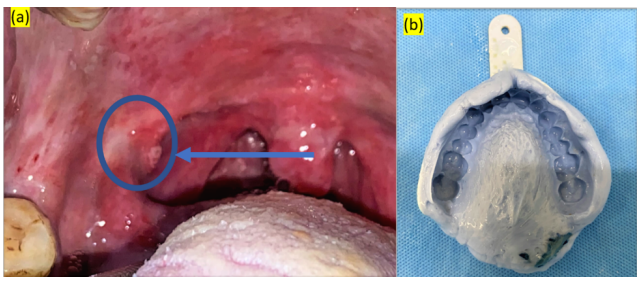

Fig. 1: (a) Pre-oprative intraoral photo with the lesion (b) Irreversible hydrocolloid impression recording the location of the lesion.

For fabrication of the radiation carrier an irreversible hydrocolloid impression (Zelgan 2002, Dentsply, India) of the maxillary arch was made using a thermoplastic tray (Transform, Astek Innovations Ltd, UK) after modification with VLC acrylic resin (Individo Lux, Voco, Germany) so as to record the lesion [Figure 1 (b)]. The cast was fabricated with Type III gypsum (Kalstone, Kalabhai, India). A consultation was held with the radiation oncology team to determine the position and proximity of the brachytherapy catheters (Flexible Implant tubes, Nucletron, Netherlands)

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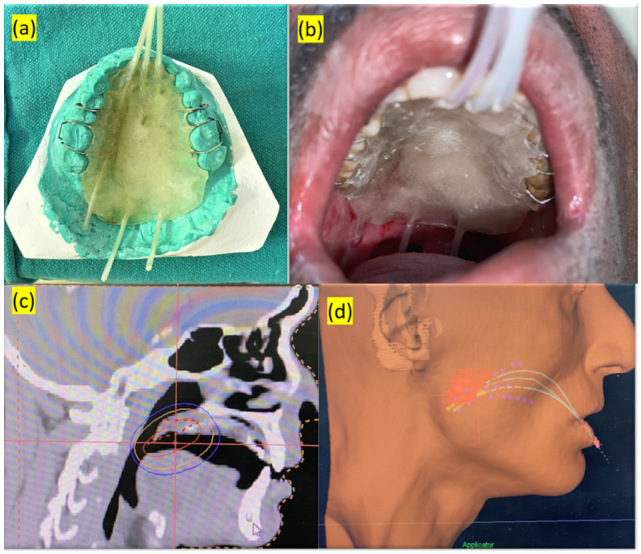

Fig. 2: (a) Finished prosthesis (b) Try-in of prosthesis (c & d) Verification of position of catheters in the treatment planning and dose delivery software

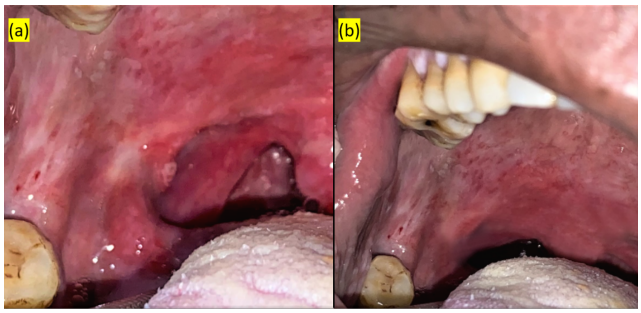

Fig. 3: (a&b) Pre-operative vs Post-operative figure showing resolution of the lesion

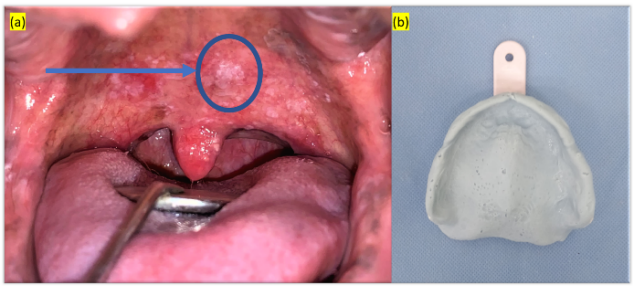

Fig 4 (a) Pre-operative intraoral photo of the soft tissue lesion with the lesion encircled (b) Irreversible hydrocolloid impression recording the location of the lesion in the intra-oral arch

Fig. 4: (a) Pre-operative intraoral photo of the soft tissue lesion with the lesion encircled (b) Irreversible hydrocolloid impression recording the location of the lesion in the intra-oral arch

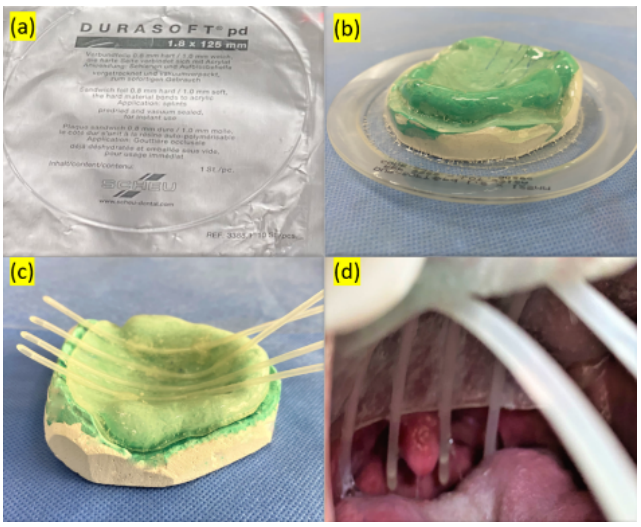

Fig. 5: (a) Durasoft PD sheet used for fabrication of radiation stent (b) Vacuum formed sheet adapted (c) Finished prosthesis (d) Try-in of prosthesis

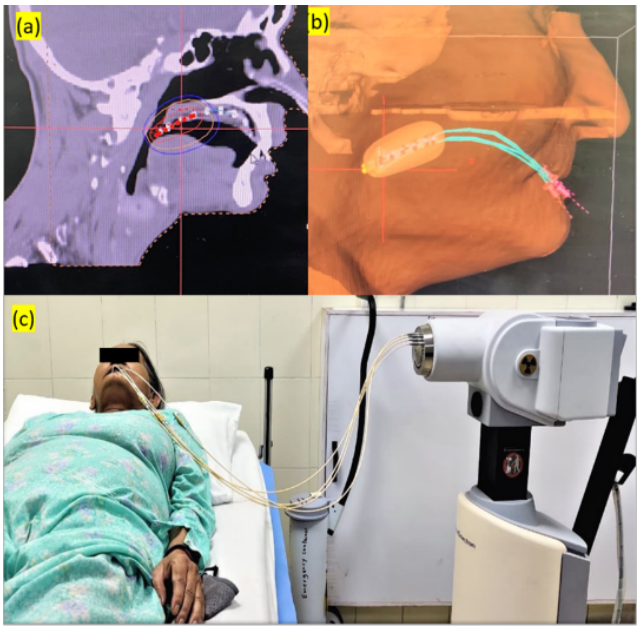

Fig. 6: (a & b) Verification of the catheters position in the patient (c) Patient undergoing brachytherapy

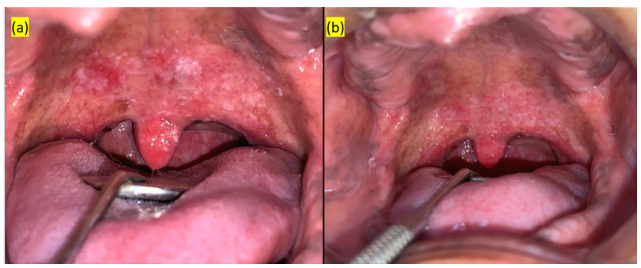

Fig. 7: (a & b) Pre-operative vs Post-operative figure showing resolution of the lesion

within the prosthesis. It was decided to place 3 catheters with 5 mm space between them while ensuring that the lesion was within a 5 mm distance from the catheters.

The prosthesis was fabricated with clear auto-polymerising polymethyl methacrylate (PMMA) resin (DPI-RR Cold Cure, DPI, India) using the dough method to ensure uniformity and retained using Adam's clasps and pinhead clasps. Brachytherapy catheters (Flexible Implant tubes, Nucletron BV, Netherlands) were placed on the prosthesis using clear auto-PMMA resin (DPI-RR Cold Cure, DPI, India) [Figure 2 (a)]. The processed prosthesis was then evaluated in the patient's mouth and adjusted for comfort. [Figure 2 (b)]. The position of the catheters was verified using NCCT [Figure 2 (c & d)]. The completed prosthesis was evaluated in the patient, polished, and delivered. The patient's brachytherapy was carried out as prescribed using the brachytherapy device (Nucletron Microselectron - HDR, Elekta, Sweden). The radiation dose of 6 Gy was delivered once daily on 5 consecutive days for approximately 8 minutes per day. The treatment volume included the area of the gross tumour and extended 5 mm laterally and 2 mm inferiorly to the margins of the lesion. The sequelae of treatment included mild mucositis, which presented after 1 week of treatment. Approximately 3 months after treatment, the lesion showed complete resolution [Figure 3 (a & b)].

3. Case II

The second case was a 58-year-old mother of a serving soldier diagnosed with a Squamous cell carcinoma (SCC) lesion of soft palate and pharynx ($T_1N_0M_0$). It was an ill-defined mass measuring 5 mm x 7 mm x 3 mm, centred on the left side of soft palate and pharynx [Figure 4 (a)]. The patient was planned for EBRT of 50 Gy followed by interstitial brachytherapy of the lesion.

An impression was made of the maxillary arch [Figure 4 (b)] and a cast was fabricated. The patient was completely edentulous since approximately 2 years making retention of the prosthesis challenging. 4 catheters (Flexible Implant tubes, Nucletron BV, Netherlands) were planned using the same guidelines as used in Case I.

A vacuum formed thermoplastic sheet (Durasoft PD, Scheu-dental, Switzerland) was planned to be used for the fabrication of the prosthesis [Figure 5 (a)].

Post adaptation of the vacuum forming Durasoft – PD sheet, [Figure 5 (b)] it was trimmed and finished. The catheters were fixed using clear auto-PMMA resin (DPI-RR Cold Cure, DPI, India) [Figure 5 (c)]. The try-in of the prosthesis was done and verified [Figure 5 (d)]. following which the position was verified in the brachytherapy software [Figure 6 (a & b)]. Once the position was verified the patient underwent interstitial brachytherapy as prescribed [Figure 6 (c)]. Post treatment the lesion completely resolved itself [Figure 7 (a & b)].

4. Discussion

EBRT of the head and neck region has side effects that are debilitating for the patient such as mucositis, ulcerations, xerostomia, dysgeusia.[3] The primary advantage of brachytherapy is that it allows highly specific radiotherapy exposure, thereby minimizing the exposure to normal tissues.[4]

There are various prosthesis which are indicated in conjunction with Brachytherapy such as the positioning stents which displace the normal tissues away from the source of radiation, or shielding stents which by incorporating alloys such as Cerrobend prevent tissues to be shielded from radiation or radiation carriers (radiation positioning stents) which were used in the two cases discussed.[2]

The radiation stents position the radiation source in the same place over the period of treatment and keep the radiation source in proximity to the tumor tissue (intra-cavitary) or directly into the tumor (interstitial).[1]

The radiation carriers are used in brachytherapy to position the radioactive sources in close proximity to the affected site. These may be of two types - preloaded or afterloaded.[2] In this case series, both were afterloaded radiation carriers.

Brachytherapy prostheses may be fabricated of either silicones for extra oral carriers or PMMA resin for intra-oral carriers.[5,6] In the first case, radiation carrier was stabilised with clasps, as the patient was dentulous.[7]

Use of the Durasoft PD in the second case facilitated easy fabrication and comfort to the patient and ensures the adherence to the principles of an ideal radiation carrier as mentioned earlier. The soft polyurethane on the inner surface gave patient less discomfort while the hard polyethylenterephthalat-Glycol Copolyester allowed the acrylic used to stabilize the catheters to bind with the outer surface.

Randal et al, in his article laid down objectives of radiation carriers, as – (1) the carrier should reproducibly conform to the anatomy, (2) allow fixation of the catheters and (3) Should be comfortable enough to wear for several days.[7]

5. Conclusion

Radiation carrier is a prosthesis which allows treatment of intra-oral malignancies through brachytherapy. These customised prostheses allow concentrated dose of radiation to be applied to the affected area while sparing the unaffected structures. The modalities discussed in this case series are adaptable to any irregular surfaces in the oral cavity.

6. Source of Funding

None.

7. Conflict of Interest

None.

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