

# Restorative and prosthetic challenges in oral cancer patients: a narrative review

Highlighting the restorative and prosthetic challenges that shape recovery, function and quality of life following treatment for mouth cancer.

## Introduction

Oral cancer, as defined by the World Health Organization, includes cancers of the lip, oral cavity, and oropharynx, ranking as the 13th most common cancer globally.<sup>1,2</sup> In 2020, there were 377,713 new cases and 177,757 deaths related to lip and oral cavity cancers.<sup>2</sup> The vast majority of these malignancies are squamous cell carcinomas (SCC), accounting for more than 90% of oral cancer cases.<sup>3</sup> Treatment options include surgery, radiotherapy, and chemotherapy, used individually or in combination depending on tumour location, stage, age, and comorbidities (Figures 1A-1C).<sup>4</sup> Surgery remains the gold standard for many oral cancers.<sup>5</sup> However, both the disease and its treatments can lead to significant functional and aesthetic issues, including difficulties with mastication, deglutition, speech, and salivary hypofunction.<sup>6</sup> Consequently, oral rehabilitation plays a crucial role after cancer treatment, involving prosthetic reconstruction tailored to restore function, appearance, and quality of life.<sup>7</sup>

## Complications after oral cancer treatment

### Trismus

Trismus, defined as an inter-incisal opening  $\leq 35$ mm, occurs frequently after radiotherapy due to fibrosis of the masticatory muscles.<sup>7</sup> Trismus complicates eating and oral hygiene for the patient, and intra-oral access for vigilance, impression making, and jaw registration and prosthesis fit for clinicians.<sup>7</sup> In severe cases (<15mm opening), prosthesis insertion becomes extremely difficult, and obturators may not achieve an adequate seal because of restricted access.<sup>8</sup> Early implementation of jaw-stretching exercises improves long-term outcomes.<sup>7</sup>

### Hyposalivation

Radiation therapy often reduces salivary flow by 50-60% within the first week, impairing buffering capacity and antimicrobial protection.<sup>9</sup> Consequences include rampant caries, poor denture retention, and Candida infections.<sup>9</sup> Thick, ropy saliva is common among post-radiotherapy patients, which increases denture friction, disrupts peripheral seal formation, and reduces impression accuracy.<sup>10</sup> Management involves: saliva substitutes, such as BioXtra (BioXtra Ltd, Hatvan, Hungary) and Biotène (Haleon PLC, Weybridge, England), which act as oral lubricants and moisturisers; parasympathomimetic stimulants, such as pilocarpine and cevimeline, which act as muscarinic agonists; and, high-fluoride prophylactic toothpastes such as Colgate Duraphat 5,000 (Colgate-Palmolive, New York, USA), which act as anti-caries agents.<sup>9</sup> For many patients living with hyposalivation, oral moisturisers and stimulants remain unsatisfying and potentially expensive treatments. The regular sipping of plain water is typically a preferred management strategy for many.

### Radiation caries

Teeth exposed to radiation undergo structural changes, including reduced micro-hardness of dentine and impaired enamel prism integrity, particularly around the dento-enamel junction (DEJ).<sup>11</sup> Radiation-induced caries typically affects atypical tooth surfaces, progressing rapidly due to hyposalivation and enamel demineralisation.<sup>12</sup> In many situations, teeth fracture at the gingival margin and are unrestorable. Preventive strategies include: fluoride varnishes, such as Colgate Duraphat High Fluoride Varnish (22,600ppm sodium fluoride); meticulous professional and at-home oral hygiene; and, regular recalls for supportive therapy at three-month intervals.<sup>12</sup>



FIGURE 1: Examples of intra-oral squamous cell carcinoma (SCC) in three different patients. 1A and 1B are typical examples of early anterior floor of mouth invasive SCCs, both of which are amenable to surgical treatment. 1C illustrates a late presentation of a large oro-pharyngeal SCC with central necrosis and rolled borders, which is inoperable, but may undergo palliative treatment with radiotherapy.

**Kumud Gogna**  
Dental student<sup>1</sup>

**Afnan Al Maini**  
Dental student<sup>1</sup>

**David Mc Reynolds**  
BA BDentSC MFDS RCSEd  
DdChDent(Pros) FFD RCSI(Pros)

Prosthodontist<sup>1</sup>  
ORCID profile:  
<https://orcid.org/0000-0003-4427-1788>

**Denise MacCarthy**  
BDS NUI FDS RCS (Edin) M Dent Sc  
Consultant Restorative Dentist<sup>1</sup>

**Edward Cotter**  
BA BDentSc FFD RCSI MS  
Prosthodontics  
Prosthodontist<sup>2</sup>

**Osama Omer**  
BDS Dip HSM DIU AFAAID MSc PhD  
FDSRCSI FFD RCSI  
Consultant Restorative Dentist<sup>1</sup>

1. Dublin Dental University Hospital  
Trinity College Dublin  
2. Hermitage Dental Suite 10, Dublin

### Corresponding author:

Dr David McReynolds  
E: david.mcreeynolds@dental.tcd.ie



FIGURE 2: 2A shows an example of a hair-bearing fibula free flap reconstruction of the mandible following hemi-mandibulectomy, with poor oral hygiene, prior to maxillofacial prosthodontic reconstruction, including plaque-induced gingival hyperplasia of fibro-epithelial tissue adjacent to the transmucosal aspect of the LL4 dental implant. 2B illustrates the same patient post-prosthetic reconstruction, with improved professional and at-home oral hygiene, including stabilisation of soft tissue inflammation, achieved through motivation and professional instruction.

| Table 1: Complications and prosthetic implications |                                            |                                                            |                                                                                                                                                       |
|----------------------------------------------------|--------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Complication                                       | Cause                                      | Prosthetic impact                                          | Management                                                                                                                                            |
| Trismus                                            | Fibrosis from radiotherapy                 | Limitations in prosthetic insertion/removal                | Jaw-stretching exercises                                                                                                                              |
| Hyposalivation                                     | Radiotherapy-induced salivary gland damage | Poor prosthesis retention, oral discomfort, rampant caries | Salivary substitutes and oral lubricants, high-fluoride varnishes and toothpastes, regular plain water sipping                                        |
| Mucositis                                          | Chemo-radiation injury                     | Denture intolerance                                        | Soft denture relines and denture adjustments                                                                                                          |
| Osteoradionecrosis                                 | Radiation-induced hypovascularity          | Implant failure, poor mucosal healing, chronic infection   | Prophylactic dental extractions pre radiography, avoidance of dental extractions and atraumatic extraction technique where required post radiotherapy |
| Bulky flaps                                        | Free flap reconstructions                  | Poor prosthesis stability                                  | Implant-supported restoration                                                                                                                         |
| Hair-bearing flaps                                 | Radial forearm/fibula harvest              | Hygiene issues, halitosis                                  | Laser epilation or flap revision                                                                                                                      |

Mucositis

Chemoradiation-induced mucositis manifests as erythema, ulceration, and pain, often limiting denture tolerance and severely impacting quality of life.<sup>13</sup> Mucositis reduces tolerance of any removable prosthesis, as minor trauma from denture flanges or borders can significantly worsen ulceration.<sup>13</sup> Regular assessment and adjustment of dentures, including relining with tissue conditioners, are necessary to minimise friction and irritation. Any mucosal ulceration should be treated before fabricating new prostheses.<sup>13</sup>

Osteoradionecrosis

Osteoradionecrosis (ORN) is defined as exposed, non-healing irradiated bone persisting for >3 months.<sup>14</sup> Radiation-induced hypovascularity reduces tissue resilience, and even minor denture trauma can precipitate ulceration and necrosis.<sup>14</sup> Implant placement is high risk, with irradiated bone showing markedly increased implant failure and peri-implant complications that may trigger ORN.<sup>15</sup> Risk reduction includes: pre-radiation dental assessment and prophylactic dental extractions; avoiding post-radiation extractions where feasible; regular review to arrest and delay dental disease; and, relining ill-fitting dentures to prevent mucosal injury.<sup>14</sup>

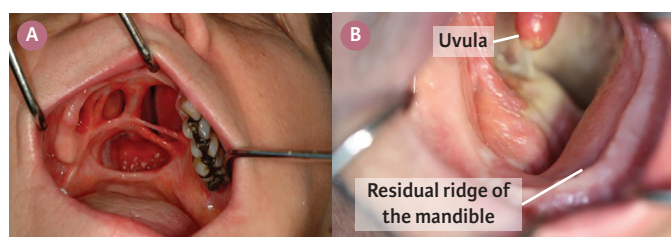
Hair-bearing free flaps

Flaps harvested from the radial forearm or fibula regions may introduce intraoral hair, leading to poor oral hygiene and halitosis. Dental implants placed in such flaps often manifest with plaque-induced fibro-epithelial hyperplasia, which may engulf access to the implant head (Figures 2A and 2B).<sup>16</sup> Management may include laser epilation or flap revision if at-home oral hygiene measures do not suffice (Table 1).<sup>16</sup>

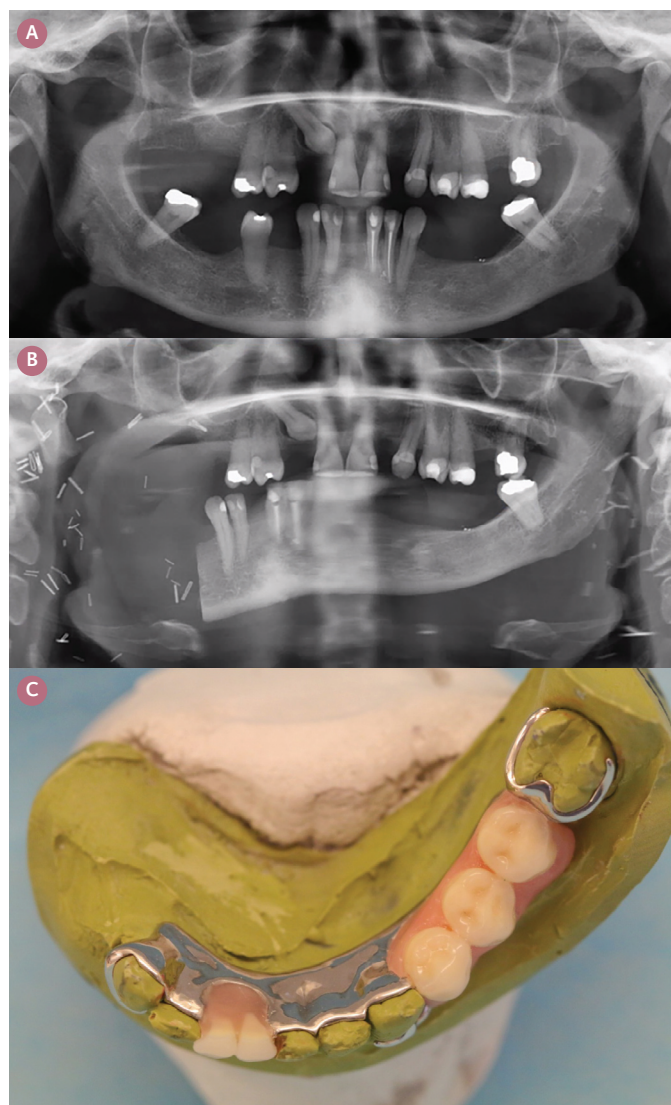
Impact of oral cancer treatments on prosthetic rehabilitation

Altered oral anatomy

Surgical management of oral cancer can significantly alter intra-oral and peri-oral structures. Tooth loss, changes in ridge form, disrupted muscle attachments, loss of lip competence, bulky free flaps, sensory disturbances, trismus, and facial contour changes all affect prosthesis fit, retention, stability, and overall patient adaptation.<sup>8</sup> These changes reduce available restorative space, alter functional boundaries, and often require repeated adjustment as tissues continue to remodel postoperatively. Microstomia is a common consequence of lip reconstruction, particularly following techniques such as the Karapandzic flap.<sup>17,18</sup> Reduced oral aperture restricts denture



**FIGURE 3:** Residual surgical fenestration is illustrated, affecting the hard palate in 3A, creating an open communication between the oral cavity and nasal cavity. In a different patient, 3B illustrates the intra-oral view following total glossectomy. Both post-surgical defects significantly complicate impression making and increase the risk of aspiration during restorative procedures.



**FIGURE 4:** Surgical defect following hemi-mandibulectomy surgery, without flap reconstruction, demonstrating significant mandibular deformity, and deviation of the mandible to the side with the deformity (4A and 4B). A 'J-shaped' cobalt-chrome framed sectional removable partial denture is made to restore form, function and aesthetics insofar as is feasible given the nature of the defect (4C).



**FIGURE 5:** Scar tethering of the buccal and labial sulcus on the resected left side. Such defects will affect the development of a peripheral seal and stability of a removable reconstruction. The application of a tissue-borne removable modality in such a situation will require that denture teeth are placed in a more lingual position than is normative to accommodate a new centralised neutral zone.

insertion, limits border extension, and complicates impression procedures. Prosthodontic ingenuity may be required to overcome restricted access.<sup>17</sup> Post-surgical fenestrations (**Figure 3A**) and glossectomies (**Figure 3B**) further increase aspiration risk during prosthodontic procedures and may complicate impression making.<sup>8</sup> Appropriate blocking of undercuts, maintaining an upright patient position, and careful selection of impression techniques are essential to minimise these hazards, and ensure an accurate and safe prosthetic workflow.<sup>8</sup>

#### Mandibular prosthesis – challenges following oral cancer treatment

- Partial mandibulectomy compromises the stability, support, and retention of mandibular dentures, especially when resections extend to the midline (**Figure 4**).<sup>8</sup>
- Post-radiation lymphoedema in the floor of the mouth can alter posture, limiting lingual extension of the denture, and affecting retention and stability.<sup>8</sup>
- Loss of tongue bulk, sensation, and mobility complicates control of mandibular dentures. Effective mastication requires positioning the food bolus on mandibular occlusal surfaces, making tongue position relative to the occlusal plane critical. If resection extends to the tongue base, the tongue may become immobilised in a detruded position, losing effective interaction with teeth and palate.<sup>8</sup>
- Severe mandibular deviation and fibrosis-induced angular jaw motion pathways create lateral occlusal forces that dislodge dentures and increase mucosal irritation and ulceration.<sup>8</sup>
- Posterior lip retraction can prevent adequate denture flange extension, requiring lingual placement of teeth, which may create dislodging forces. If the lip and cheek are scarred on the resected side, denture extension attempts can worsen dislodgement, and complicate fit and function (**Figure 5**).<sup>8</sup>
- Increased soft tissue bulk may encroach on tongue space, limit mobility, and obliterate the sulcus, compromising denture fit, retention, and stability.<sup>8</sup>
- Frequently, a fixed (**Figure 2**) or removable implant reconstruction (**Figure 6**) on a reconstructed neomandible represents a gold-standard approach in scenarios where tissue-borne removable modalities have a poor-hopeless prognosis.



**FIGURE 6:** Placement of dental implants in the mandible post resection, as illustrated in 6A, permits fabrication of a sophisticated and satisfying fixed or removable reconstruction. In this example, a complex implant overdenture (6B and 6C) provides a level of function that resembles a fixed dental reconstruction, while permitting prosthesis removal for at-home hygiene procedures, and personal and professional recurrence vigilance.



**FIGURE 7:** Intra-oral view of a patient following left hemimaxillectomy (7A). A survey crown and precision attachment cobalt-chrome framed obturator closes the maxillary defect (7B). Reline material is visible at the peripheral seal in response to post-surgical remodelling of the scar band. The obturator restores function, aesthetics, and separation of the oral and nasal cavities (7C).

### Maxillary prosthesis – challenges following oral cancer treatment

- Loss of anatomy from hard palate, alveolar ridge, or tuberosity ablation further reduces the prognosis of a removable prosthesis (**Figure 3A**, **Figure 7A** and **Figure 8B**).<sup>8</sup>
- Radiation-induced fibrosis of palatine salivary glands compromises the peripheral seal needed for denture retention.<sup>8</sup>
- Mandibular deviation post radiation may cause the maxillary tuberosity on the resected side to impinge on the coronoid process, hindering impression material extension and prosthesis fit.<sup>8</sup>
- Pedicle or free flaps for soft tissue reconstruction complicate denture extension. Altered anatomy and scarring may reduce available space, challenging denture seating.<sup>8</sup>
- Soft tissue flaps (such as the radial forearm flap) reline the oral cavity and separate compartments, but may remove features like the mucocutaneous scar band and medial palatal shelf, worsening prosthesis stability.<sup>19</sup> Such a lack of proper flap support is termed the “waterbed” or “trampoline” effect.<sup>20</sup>
- Tissue changes may continue for at least a year post healing (**Figure 7**). Obturator movement during function can worsen these changes, often requiring prosthesis relining or rebasing (**Figure 7B**).<sup>8</sup>
- The presence of teeth adjacent to defects improves prognosis by assisting

retention, stability, and support (**Figure 8**). Sometimes, these teeth are splinted to enhance load-bearing capacity.<sup>8</sup>

### Conclusion

Restorative and prosthetic rehabilitation of oral cancer patients is multifaceted and highly individualised. Treatment-induced complications including trismus, xerostomia, mucositis, ORN, altered anatomy, and microstomia create significant clinical challenges. Successful rehabilitation depends on early recognition of complications, appropriate timing of intervention, and meticulous prosthodontic planning tailored to each patient's anatomical and functional limitations. Innovative approaches such as implant-supported prostheses, sectional dentures, flap reconstructions, and obturator design are increasingly central to restoring oral function and aesthetics. Ultimately, patient-centred, holistic care is essential to improve long-term quality of life.

### CRedit author statement:

**Kumud Gogna:** original draft preparation and writing – review and editing.

**Afnan Al Maini:** original draft preparation and writing – review and editing.

**David McReynolds:** supervision, visualisation, project administration, writing – review and editing.

**Denise MacCarthy:** conceptualisation, supervision, writing – review and editing.

**Edward Cotter:** conceptualisation, supervision, writing – review and editing.

**Osama Omer:** conceptualisation, visualisation, supervision, writing – review and editing, project administration.

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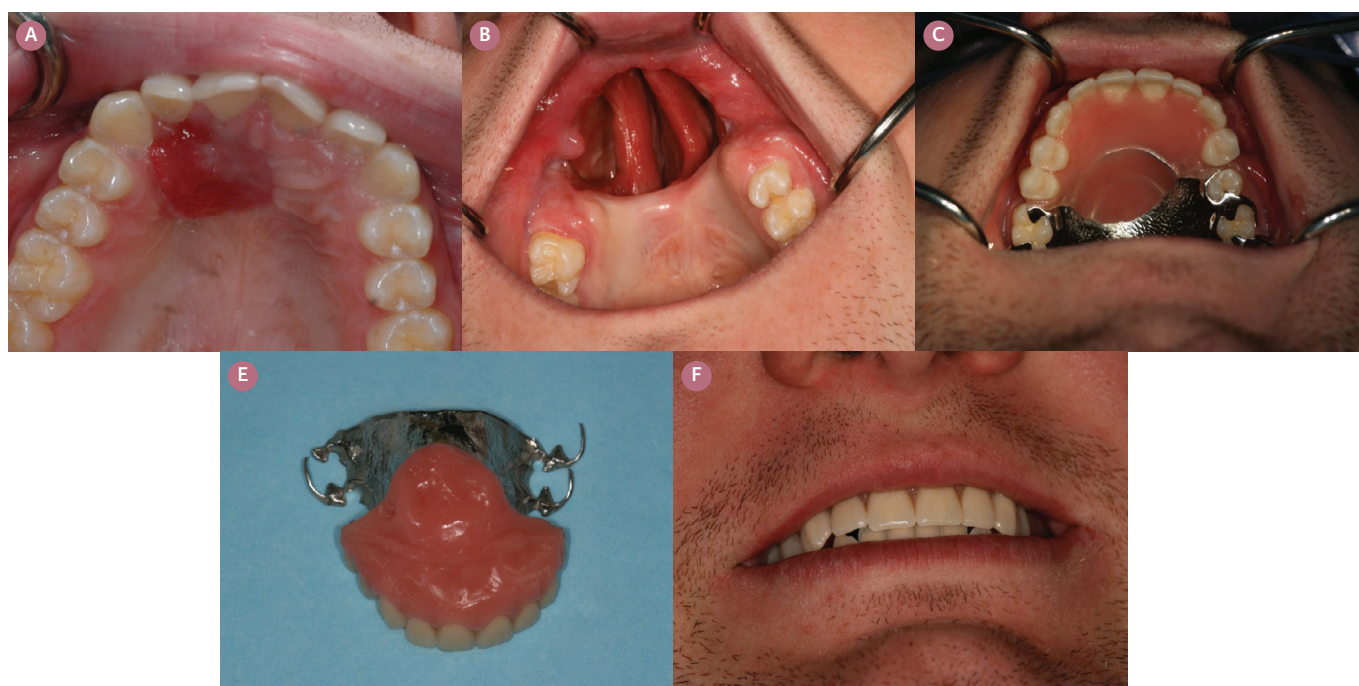


FIGURE 8: Surgical and maxillofacial prosthodontic management of a SCC associated with HPV infection in the anterior maxilla. 8A illustrates the pre-operative appearance of the SCC. 8B illustrates the surgical resection defect and resultant oro-nasal communication. The communication is obturated with a cobalt-chrome framed removable partial denture with an acrylic bulb, which restores aesthetics, phonetics and function, while permitting prosthesis removal for cleansability and recurrence vigilance.

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