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# The Prosthodontic Pathway of the Oral Cancer Patient

**Abstract:** Oral cancer patients undergo life-altering curative treatment that consists of surgery or a combination of surgery and radiotherapy. This can severely alter the functional anatomy of the oral cavity and create a challenging environment for successful oral rehabilitation. A multidisciplinary team approach is required to rehabilitate these patients successfully. It is essential to have assessment by an oral rehabilitation specialist before treatment, especially where primary rehabilitation interventions are being considered.

Following cancer treatment, patients may suffer from a range of difficulties, from dento-facial appearance, to chewing, speech and swallowing. This dysfunction often leads to psychosocial problems, such as reduced self esteem, social contact and quality of life. Conventional prosthodontics has a role to play in the management of these patients but osseointegrated implants (OII), can be required to overcome the anatomical and physiological barriers. OII can be used in an environment where there is poor soft tissue function or little bone support, and where there is a dry mouth.

**Clinical Relevance:** This paper introduces readers to the prosthodontic pathway taken by some oral cancer patients. It provides an overview of current oral rehabilitation techniques that supplement the supportive dental care provided by general dental practitioners and their team after cancer treatment.

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Head and neck cancer is the fifth most common cancer by incidence and the sixth most common cause of death from cancer worldwide.<sup>1</sup> Oral cancer is the most prevalent type of head and neck cancer. In the UK in 2006, there were 5,325

people diagnosed with oral cancer and the incidence is increasing; Cancer Research UK has reported a 44% increase since 1995.<sup>2</sup> More than 90% of head and neck cancers are squamous cell carcinomas and the progression of the disease results from alterations in the cellular and molecular pathways in the squamous epithelium.<sup>3</sup>

Head and neck cancer treatment comprises surgery, radiotherapy, chemotherapy, or a combination of these modalities. However, for oral cancer, primary surgery is the treatment of choice and this is followed by radiotherapy in patients with advanced disease. The focus of this paper is to summarize the role of prosthodontics in oral rehabilitation. The aim of surgical treatment is resection of the tumour with clear margins whilst maintaining as much post-operative function as possible. In addition to tumour ablation, a neck dissection can be indicated to remove lymph glands in the path of tumour drainage. Also, in large defects, reconstructive surgery is carried out using microvascular free tissue transfer.

Loss of anatomical structures including: teeth, mandible, maxilla, tongue, soft palate, alveolar ridges, sulci
Altered oral anatomy: loss of lip competence, altered muscle insertions, altered muscle balance, altered tongue function
Loss or altered sensations: loss of proprioception, taste
Trismus
Scar tissue and bulky flaps

**Table 1.** The effects of radical surgery on oral cancer patients.

Oral cancer treatment often leaves patients with significant problems which have to be overcome. Successful rehabilitation can be achieved through the expertise of a specialist maxillofacial prosthodontist who is cognisant of the needs and expectations of the patient.

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Oral mucositis
Loss of taste – Dysgeusia/hypogeusia
Erythema
Xerostomia
Radiation caries
Trismus
TMJ dysfunction
Muscle fibrosis
Osteoradionecrosis
Changes in oral flora – candidal infections, gingivitis

**Table 2.** Effects of radiotherapy treatment on oral cancer patients.

## Challenges in oral rehabilitation for the maxillofacial prosthodontist

The possible effects of radical surgery include altered oral anatomy, loss of teeth and anatomical structures, significant scarring and bulky flaps, loss or alteration of sensation, and trismus (Table 1).<sup>4</sup> This can severely affect a patient as he/she can be left with substantial loss of function within the oral cavity as well as a distorted facial appearance. Modern surgical microvascular techniques permit the radical resection of tumours with the ability to reconstruct significant soft and hard tissue defects. However, the psychological effect of such radical treatments must also be borne in mind when managing this group of patients. The altered oral environment presents a challenge for prosthodontic rehabilitation, and conventional techniques may not be adequate for successful rehabilitation.

Radiation treatment can also cause many side-effects, such as oral mucositis, loss of taste, erythema, xerostomia, radiation caries, trismus, glossitis, TMJ dysfunction, muscle fibrosis, and osteoradionecrosis (ORN) (Table 2).<sup>5,6</sup>

Xerostomia is one of the most significant effects of radiotherapy. Xerostomia predisposes patients to increased caries experience, candidal infections, difficulties in swallowing and compromises the ability to obtain

a peripheral seal around prosthodontic appliances.

For dentate patients, the risk of caries is particularly significant. Caries rates are increased in irradiated patients indirectly through the radiological destruction of the salivary glands, causing xerostomia, and possibly through direct effects of radiation on the tooth structure itself.<sup>7,8</sup> The loss of taste can also contribute to radiation caries as patients will sometimes try to overcome their lack of taste with sweet or strong flavoured foods. Preventive advice for these patients prior to radiotherapy is therefore imperative (Table 3). Dentate patients are also at risk of other oral diseases and infections, such as candidal infections, gingivitis and periodontal disease owing to the change in the oral environment and saliva, which in turn changes the oral flora.

Trismus, TMJ dysfunction and muscle fibrosis also have a significant effect on dentate patients. This is mainly due to the restricted mouth opening preventing access for both the patient and the clinicians. Reduced access for the patient presents problems in maintaining a high standard of oral hygiene, which is essential for the patients. For the clinician, reduced access presents problems whilst attempting to carry out dental treatment. During pre-treatment oral rehabilitation, screening the degree of trismus expected is

often taken into account and the 'shortened dental arch' (SDA) concept may be applied.<sup>9</sup> The absence of molar teeth reduces the maintenance element for both the patient and clinician, with the remaining anterior single-rooted teeth being more accessible and simpler to treat.

After radiotherapy, patients are also at risk of osteoradionecrosis (ORN), with the risk increasing over time, owing to the continuing effects of endarteritis on the tissues. The pre-treatment dental screening is very important. Any teeth with a doubtful prognosis should be removed before radiotherapy is commenced to reduce the risk of ORN. The SDA concept can also be an advantage here as removal of the molar teeth potentially reduces the risk of ORN, which is highest in the posterior mandible.

For edentulous patients, radiotherapy may also produce problems. Xerostomia again is an issue, as it reduces the lubrication around a prosthodontic appliance, which can make it less comfortable and less retentive, especially in the upper arch where an effective border seal is needed. Mucositis can also make wearing a tissue-borne prosthesis unbearable as it will be resting and placing a functional load on an inflamed mucosal surface. Trismus is also a major problem in making, placing and removing prostheses. Modified impression techniques may be required in such cases. Trauma from

**Toothbrushing:** soft toothbrush, 2x daily, fluoride toothpaste.

**Fluoride mouthwash, gel, tooth mousse**

**Aqueous chlorohexidine gluconate mouthwash**

**Gentle swabbing of the oral tissues:** gauze swabs soaked in chlorohexidine can be used to clean the oral tissues, saline if chlorohexidine cannot be tolerated.

**Dietary advice:** along with the dietician, sugary foods are often used as a comfort during cancer treatment; dietary supplements are also high in sugar; patients may also be using a PEG tube for supplements if their oral function is too poor to take enough food orally.

**Moistening of mouth and lips:** frequent sips of water, lip balm for lips, unflavoured oils for mouth and lips at night, artificial saliva substitutes.

**Appliance care advice:** prosthesis removed and cleaned twice daily with tooth or denture brush, with suitable cleaning agent, antifungals as prescribed on to the fitting surface; remove all dentures at night and if ulceration appears, except for surgical obturators where appropriate advice will be given by specialist.

**Table 3.** Prevention and oral care advice for cancer patients.

a denture could also lead to ORN when placed on irradiated tissues. Oral infections, such as candidiasis, can also be a problem and good denture hygiene is imperative if this is to be minimized or prevented.

### Implications for prosthodontic oral rehabilitation from a patient perspective

When patients are first diagnosed with oral cancer, their main concern is with survival. After cancer treatment, however, their concerns then shift towards obtaining and maintaining a good quality of life (QOL). There have been many studies looking at QOL and these have shown that patients regard oral functions highly in terms of quality of life and, when these functions are impaired, patients often suffer psychologically.<sup>10</sup> Rogers *et al*<sup>11</sup> demonstrated that, following successful treatment of oral cancer, the most important issues reported by patients in terms of QOL were chewing, speech and swallowing, closely followed by appearance, especially in female patients.

### Prosthodontic oral rehabilitation of the oral cancer patient

The prosthodontic needs of oral cancer patients include the rehabilitation of oral form and function that have been lost through treatment. Prosthodontic treatment options include: maintenance of a functional dental arch (shortened dental arch), fixed prostheses (bridgework), removable partial dentures (RPDs), maxillary obturators, implant-retained fixed or removable prostheses, and complete dentures. To accelerate oral rehabilitation, a treatment plan should be devised (with the patient's support) as early as possible, and preferably before cancer treatment. Patients should follow a prosthodontic pathway similar to that outlined in Figure 1. This shows patients moving through a pre-cancer treatment oral rehabilitation assessment, primary interventions at the time of surgery, and secondary interventions after cancer treatment.

The time interval between diagnosis and treatment for oral cancer is usually short. Suitable patients will be seen by the oral rehabilitation team for a pre-treatment assessment and planning. This is in

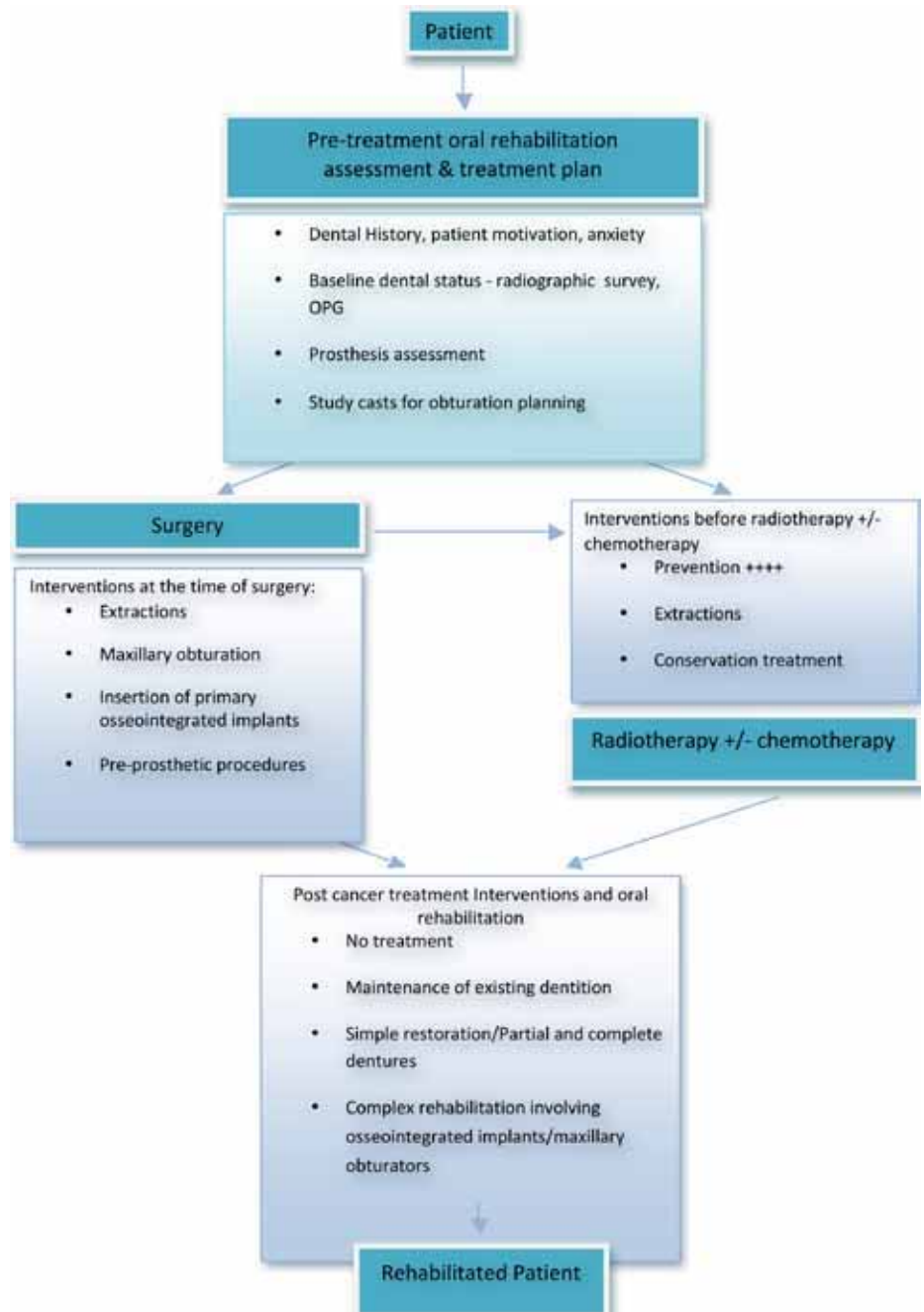


Figure 1. The Liverpool Oral Cancer Prosthodontic Pathway.

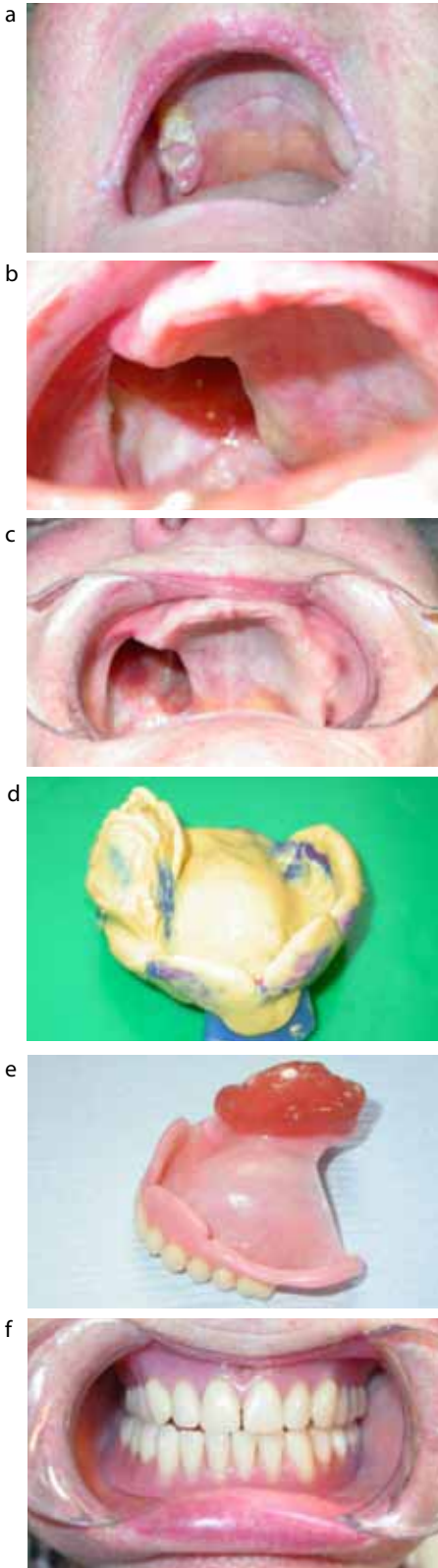
accordance with the NICE guidelines for oral management of oncology patients.<sup>12</sup>

### Pre-cancer treatment assessment: dental and oral rehabilitation screening appointment

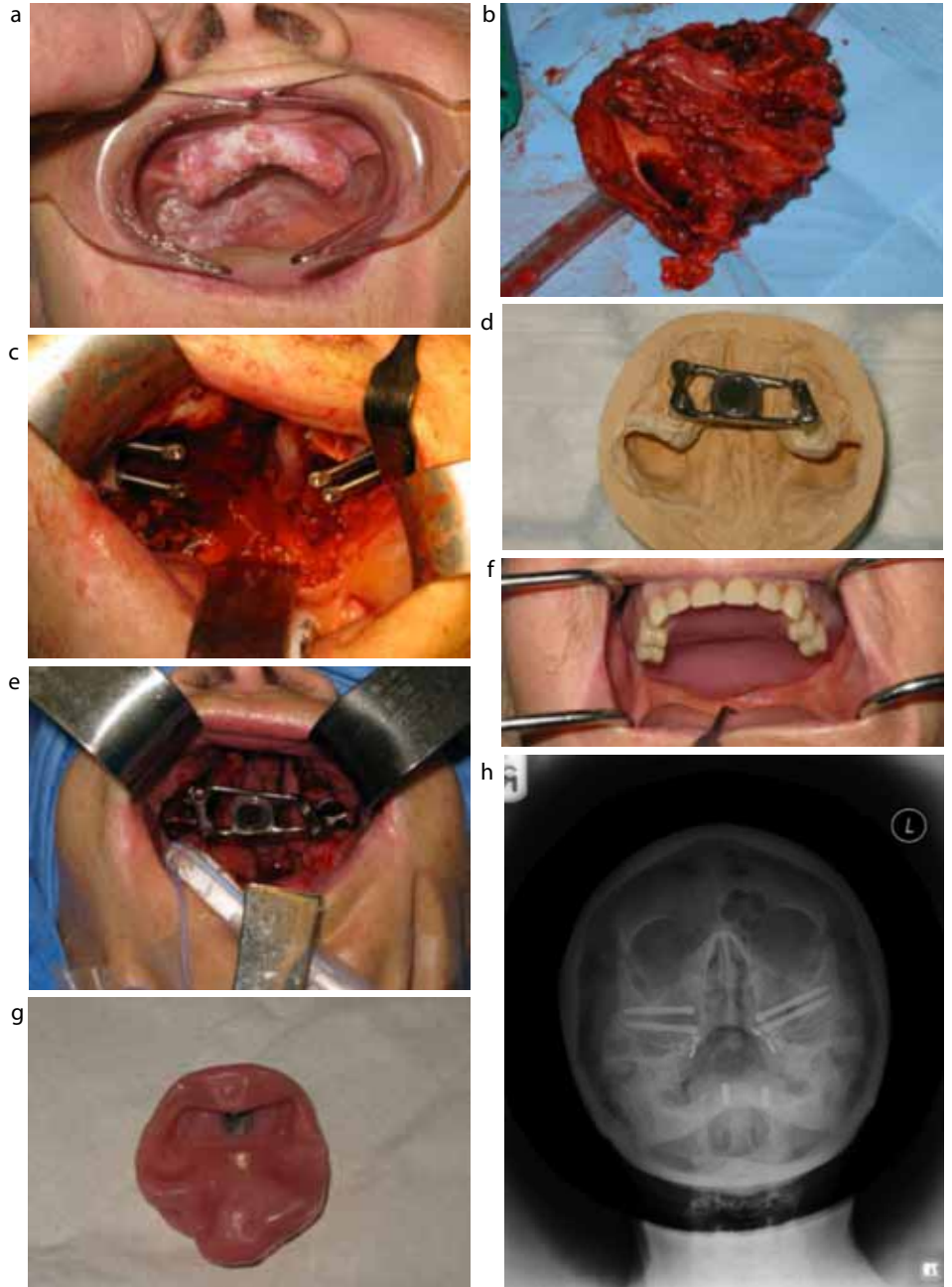
Within the pre-treatment

assessment, a thorough dental history is taken, patient factors such as motivation and anxiety are assessed, baseline dental status is recorded with a radiographic survey, and impressions may be taken for surgical obturators. If required, a treatment plan will then be devised at this stage for dental interventions before surgery and radiotherapy, during





**Figure 2. (a–f)** This case shows squamous cell carcinoma of the posterior alveolus and palate. Patient after surgery and construction of a definitive obturator.



**Figure 3. (a–h)** This case shows a complete maxillectomy, placement of zygomatic osseointegrated implants and magnet abutments to retain an obturator prosthesis.

surgery and after cancer treatment.

Before surgery and radiotherapy, prevention and oral care advice (Table 3) are of key importance and should be emphasized to the patient and carer. Where patients are likely to require dietary supplements they should be strongly advised to rinse

thoroughly following ingestion orally or to ingest via a PEG feeding tube if one has been placed. Outstanding restorative treatment should be completed where possible and extractions of all teeth with a doubtful prognosis should be completed a minimum of 10 days, and preferably 3 weeks before radiation treatment.<sup>13</sup>

### During cancer surgery – primary rehabilitation interventions

At the time of surgery, a number of other surgical interventions may also be carried out to maximize the patient oral rehabilitation. These include extractions, maxillary prosthetic obturation, primary OI placement and pre-prosthetic procedures such as vestibuloplasty.

Whilst maxillary malignancy is relatively rare (only approximately 6% of all head and neck cancers), its management is complex. A proportion of cases can be reconstructed surgically with micro-vascular free flaps, however, for some patients a maxillary obturator will be the treatment of choice. The retention of an obturator prosthesis is dependent on the size of the maxillary resection and presence, number and quality of any remaining teeth. The indication for placement of implants increases with the size of the maxillary defect, as larger defects provide significant challenges to prosthesis retention without implants. Two examples of maxillary obturators are shown in Figures 2 and 3.

Primary implant placement can be carried out at the time of tumour resection in suitably selected cases (Table 4). Traditionally, implants were placed secondarily following oncological resection and reconstruction, and there has been some controversy over the ideal timing of implant placement.<sup>14</sup> The major advantage of primary implant placement is that implant placement and osseointegration can take place before the commencement of radiotherapy and, therefore, the process of oral rehabilitation can be accelerated for the patient. With this method, careful case selection and pre-surgical planning are necessary, and close team-working between the oncological surgeon and maxillofacial prosthodontist is required.<sup>15</sup> A primary implant case is presented in Figure 4.

### Post cancer treatment interventions and oral rehabilitation

After cancer treatment patients are often left with some significant problems. The case for oral rehabilitation will be assessed and a decision made on the best course of treatment for the individual patient. For some patients, no attempt at

- Anterior tumours
- Clinically negative neck (N0)
- Favourable tumour behaviour
- Motivated patient
- Well maintained dentition
- Risk factor control
- Intact mandible
- Edentulous mandible where surgery will significantly compromise conventional denture wearing

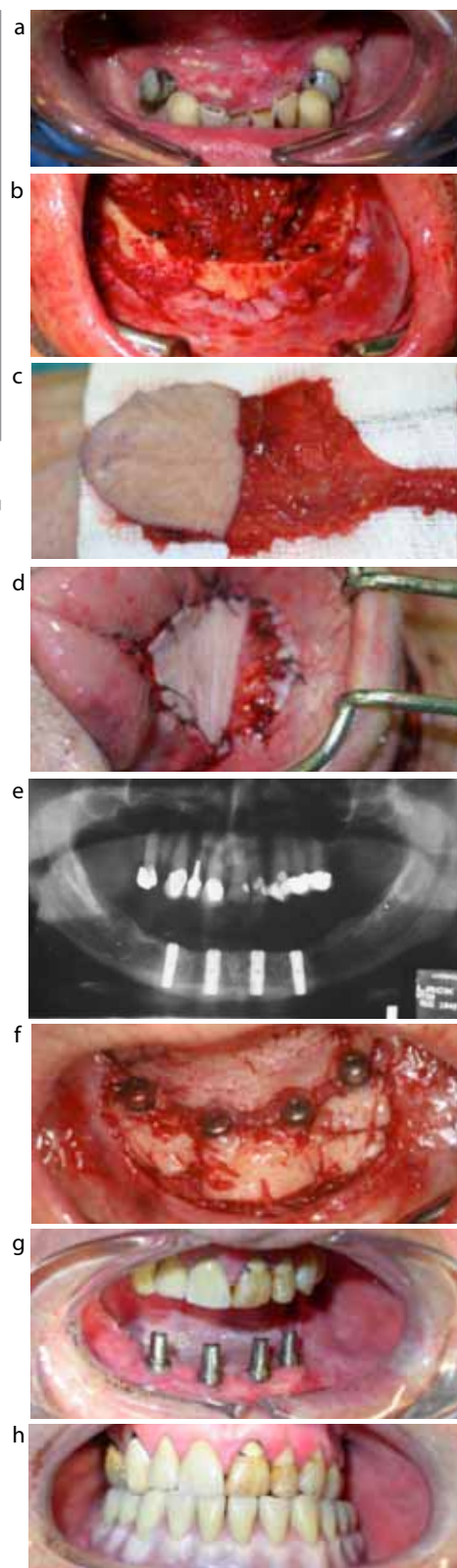
**Table 4.** Indications for primary implant placement.

- Cancer factors: site, definitive pathology pTNM, margins, depth of invasion, nodal yield
- Extra-capsular spread
- Mouth opening
- Tongue function
- Swallowing ability/PEG status
- Dental/periodontal status – oral hygiene compliance
- Social factors – smoking/alcohol
- Radiotherapy
- Bone availability
- Skeletal relationship
- Metal hardware position
- Soft tissue flaps and overall quality

**Table 5.** Patient assessment for secondary implant placement.

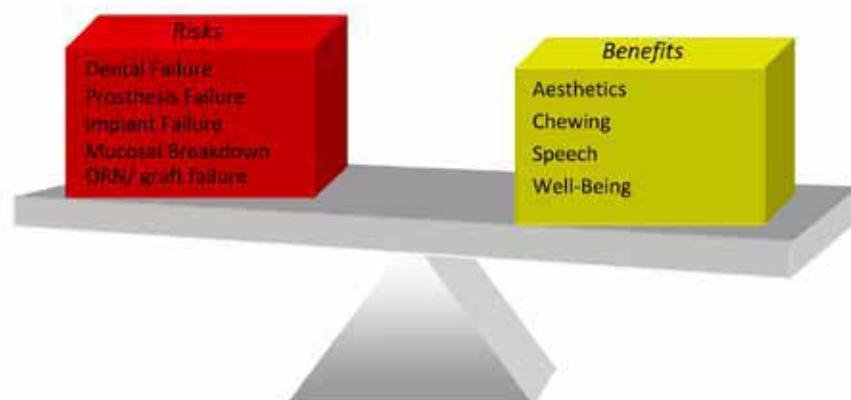
prosthetic treatment may be the option of choice, especially where patients may not be able to tolerate a denture and may wish to continue as they are. For patients who require prosthodontic rehabilitation, initially they may be treated with conventional appliances. If conventional treatment cannot be implemented owing to anatomical barriers, or if it has been tried and is unsuccessful, patients may then be considered for secondary implant-based treatment.

Secondary implant placement requires careful patient case selection



**Figure 4. (a–h)** Squamous cell carcinoma of the floor of the mouth. This case shows rehabilitation after mandibular resection using a primary implant-retained bridge.





**Figure 5.** Patient selection factors for secondary implant rehabilitation.

as there are many risks factors that contribute to the failure of implants. The assessment of the patient includes following a checklist of patient factors like those shown in Table 5.

Firstly, patient cancer factors are taken into account. The site of the primary tumour and associated reconstructive techniques used will have a strong association with the subsequent anatomical deformity with which the patient may be left. The degree to which normal anatomical structures are remaining is indicative of whether a conventional prosthetic approach is required or an implant-assisted prosthesis is required after surgery. Information on the definitive pathology, the margins, depth of invasion and extra-capsular spread can be obtained after surgery and this gives a good indicator of prognosis for the patient.<sup>16</sup> If the prognosis for the patient is not good, oral rehabilitation with secondary implants may not be appropriate or, indeed, cost-effective.

The clinician must gauge the residual oral functions, such as mouth opening, tongue function and swallowing ability. In a patient with poor mouth opening and tongue function, using dietary supplements may not benefit from rehabilitation with secondary implants. Poor mouth opening means access for the clinician and the patient to maintain oral hygiene around the implants may be difficult, putting the patient at risk of infection around the implant sites, especially if the patient

has had or will have radiotherapy. If the patient does not have sufficient mouth opening and tongue function to be able to eat food and relies upon a PEG tube and dietary supplements, oral rehabilitation restoring the dentition may not be beneficial, as the oral function is not good enough to utilize the restored dentition, apart from for the improvement in aesthetics that may be gained.

The dental and periodontal status of the patient is also important to review here. Existing periodontal disease and poor oral hygiene compliance may put the patient at risk of peri-implantitis, which could lead to the failure of the implant. Social factors such as smoking and alcohol consumption are also taken into account as continual heavy smoking and drinking is a definite contra-indication to implant placement. This is also due to the increased risk of peri-implantitis and possibility of recurrence.

Radiotherapy is a significant risk factor for implant failure and may predispose the patient to ORN, especially in the heavily irradiated mandible.<sup>17,18</sup> The use of OIIs in patients who have undergone radiotherapy has been extensively reviewed, and some authors regard radiotherapy as a definite contra-indication to implant placement, owing to the risk of ORN, unless placed in conjunction with hyperbaric oxygen (HBO).<sup>19</sup> However, this subject is controversial because other authors find no significant difference in implant

failure rate when radiotherapy is used, and whether hyperbaric oxygen is used to prevent ORN.<sup>17</sup> The amount of clinical research in this area is limited and it has been suggested by authors that more randomized clinical trials are needed to establish the effectiveness of HBO in this regard.

The decision to treat should compare the potential benefits to the patient of the implant-retained prosthesis to the potential risks associated with surgery in his/her particular case (Figure 5).

## Conclusion

Oral rehabilitation of oral cancer patients aims to optimize the function and aesthetics of patients following treatment. Assessment prior to surgery is best practice as it allows an opportunity for dental screening and discussion with the patient about the possible oral rehabilitation options within the framework of the patient's cancer journey. Oral function is a priority for patients and is a key factor related to patients' reported outcomes (health-related quality of life). Hence it is essential to integrate all aspects of dental care between the primary and secondary sectors in order to achieve best outcomes.

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