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Reconstruction following tumour ablation is a key component in the management of OCSCC. Decision making with regards to reconstruction should not influence the ablative procedure. Notwithstanding the importance of facial aesthetics, preser - vation or restoration of speech, chewing, swallow and oral continence are of paramount importance. The oral cavity is a unique site. It contains hard and soft tissues, including the dentition, is bathed in saliva and is anatomically complex. It ultitude is the opening to the aerodigestive tract and has a m of motor and sensory nerves. Like any defect, reconstruction of the oral cavity should aim to replace resected tissue with similar tissue. The reconstruction ladder ( Figure 53.7 ) is a useful algorithm and can be applied to the oral cavity . Additionally , general reconstruction principles apply: namely , use the simplest method that will meet reconstruction aims, replace lost tissue with similar tissue, consider vascular - ised tissue in a previously irradiated recipient site and alwa ys ve an alternative should your primary reconstruction fail. ha While free tissue transfer (‘free flaps’) has revolutionised reconstruction following ablation of an OCSCC, there are instances, for example owing to patient comorbidities, where a local or regional flap is appropriate. Owing to the extensive and consistent blood supply in the head and neck, local flaps in this region are safe and pre dictable. Smaller defects not requiring substantial soft tissue or bone for reconstruction can be reliably reconstructed with flaps such as, but not limited to, the facial artery m yomucosal (FAMM), nasolabial, buccal fat pad, tongue and palatal flaps Regional and pedicled flaps include tissue(s) from other parts of the head and neck, such as the temporalis and platysma flaps, as well as those from more distant sites such as the latissi mus dorsi, deltopectoral and pectoralis major flaps. Free flaps A free flap is a portion of vascularised tissue harvested from a distant donor site and transferred to an area requiring recon struction where its artery and vein are anastomosed locally , thereby providing an independent blood supply . Most tissue types, including skin, fascia, muscle, tendon and bone, can be tissue can be replaced with similar tissue(s). Soft-tissue reconstruction In oral cavity reconstruction, common soft-tissue flaps used include the radial forearm free flap (RFFF; Figure 53.8 ) and anterolateral thigh (ALT) flap. Alternative soft-tissue free flaps include rectus abdominis, latissimus dorsi, medial sural artery perforator and lateral arm flaps. The relative merits of these flaps are outlined in Table 53.5 . Composite reconstruction The fibula is the most commonly used bone-containing (composite) flap globally , while the iliac crest (DCIA), scapula (including tip of scapula) and composite RFFFs are also used, each carrying specific pros and cons. Chimeric flaps, where osseous and soft-tissue components are independently mobile (e.g. the thoracodorsal system of free flaps), are advocated for certain complex reconstructions. The relative merits of the more common composite flap donor sites are outlined in - Table 53.6 . Reconstruction by anatomical subsite Soft-tissue reconstruction . Intraorally this includes the tongue, floor of the mouth, buccal and retromolar mucosa as well as the soft palate. As outlined - previously the most commonly used soft-tissue flaps are the RFFF and ALT . The RFFF provides a thin, non-hirsute and pliable flap with a long vascular pedicle and so can be useful where significant bulk is not required. The ALT ( Figure 53.9 ), however, owing to its increased bulk, is far more suited to - tongue reconstruction where bulkiness is crucial in creating a seal between the oral cavity and soft palate during speech and swallowing. The ALT also facilitates multiple skin paddles and/or muscle components, where necessary .

• Healing by secondary intention • Primary closure • Skin grafting • Local /f_l aps • Regional /f_l aps • Microvascular free tissue transfer Figure 53.7 The reconstruction ladder. TABLE 53.5 Relative merits of common soft-tissue /f_l aps. Donor site RFFF ALT MSAP Donor site +++ ++ ++ morbidity Pedicle length ++++ +++ ++ 18 /uni00A0 cm 12 /uni00A0 cm 10 /uni00A0 cm Quality of ++++ +++ +++ vessels Artery: Artery: Diameter Artery: 3 /uni00A0 mm 1.25 /uni00A0 mm 2.1 /uni00A0 mm Vein: 1.5 (3 /uni00A0 mm if Vein: 2 /uni00A0 mm Vein: cephalic) 2.3 /uni00A0 mm No atherosclerosis Soft-tissue ++ ++++ ++ paddle 12 /uni00A0×/uni00A0 5 /uni00A0 cm 16 /uni00A0×/uni00A0 8 /uni00A0 cm 10 /uni00A0×/uni00A0 5 /uni00A0 cm Two-team +++ ++++ ++++ operating ALT, anterolateral thigh; ELAF , extended lateral arm /f_l ap; LD, latissimus dorsi; MSAP , medial sural artery perforator; RFFF , radial forearm free /f_l ap; TDAP , thoracodorsal artery perforator. TDAP Lateral arm Rectus LD ++ ++ +++ ++ + ++ ++++ + 7 /uni00A0 cm 8.5 /uni00A0 cm 15 /uni00A0 cm 6 /uni00A0 cm; increased with ELAF ++++ ++ ++++ ++++ Artery: 2.7 /uni00A0 mm Artery: Artery: Artery: 2.7 /uni00A0 mm Vein: 3.4 /uni00A0 mm 3.5 /uni00A0 mm 1.5 /uni00A0 mm Vein: 3.4 /uni00A0 mm No atherosclerosis Vein: 4 /uni00A0 mm Vein: 2.5 /uni00A0 mm No atherosclerosis ++++ ++++ ++ +++ Muscle: 35 /uni00A0×/uni00A0 20 /uni00A0 cm 25 /uni00A0×/uni00A0 10 /uni00A0 cm 12 /uni00A0×/uni00A0 5 /uni00A0 cm Muscle: Skin: 18 /uni00A0×/uni00A0 7 /uni00A0 cm 6 /uni00A0×/uni00A0 25 /uni00A0 cm Skin: 13 /uni00A0×/uni00A0 25 /uni00A0 cm + ++ +++ +

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Mandible reconstruction Reconstruction with composite free flaps is now the gold standard for segmental mandibular defects ( Figures 53.10 and 53.11 ). The choice of flap is varied and depends on factors including the site, size and complexity of the defect, patient comorbidities and indeed surgeon training and preference. While it is possible to leave small posterior sites unrecon structed, reconstruction of an anterior defect is particularly important, and challenging, in order to achieve satisfactory function for the patient. The following general principles may help to plan mandib ular reconstruction: /uni25CF reconstruction of the anterior mandible is always more challenging; /uni25CF although the lengths of the bone and pedicle are often cited as factors in choosing the donor site, the average defect is 6–10 /uni00A0 cm and usually immediately adjacent vessels for microvascular anastomosis mean that these are not usually an impediment; /uni25CF use the curvature of the chosen bony flap to follow the nat ural shape of the mandible, thereby reducing the number of potential osteotomies; /uni25CF in an edentulous case, it may be helpful to slightly reduce the span of the mandibular segment to avoid a resultant class III appearance, where the mandible protrudes beyond the opposing maxilla, giving a very prominent chin position; /uni25CF free bone can become a nidus for persistent infection, par ticularly following radiotherapy . Maxillary reconstruction The main aims of maxillary reconstruction are as follows: /uni25CF restore facial contours and aesthetics; /uni25CF separate sinonasal cavities from the mouth; /uni25CF restore soft palate competence to facilitate speech and swallowing; /uni25CF restore/provide for replacement of dentition. - A classification system for maxillary defects is useful for both treatment planning and discussion with colleagues. The most widely adopted classification is that proposed by Brown and Shaw; this classification considers both the vertical and - horizontal extent of the defect. Classes I–VI ( Figure 53.12 ) describe the increasing size in a vertical dimension, while the horizontal extent is described by the letters a–c. Although not absolute, one of the advantages of this classification system is that it implies management. Class I defects are easy to repair with the only reconstruc - tive requirement being to separate the oral and nasal/antral cavities. Local flaps are often satisfactory , and the RFFF is the most commonly used free flap. Class II defects can be restored in a similar fashion to class I, especially w hen mor e posteriorly - located. However, composite (bone-containing) free flaps are usually required for anterior defects, and class IIc defects, as well as situations where the existing dentition is not adequate to retain a prosthesis. In classes III and IV , support for the contents of the orbit is lost, as well as support for the anterior cheek and alveolus. A prosthesis alone will provide a suboptimal result. The recon - structive goals are to support the orbital contents and facial skin, - ensure bony continuity between the remaining alveolus and zygomatic buttress (ideally su ffi cient to facilitate endo-osseous implant placement), as well as seal the oral and nasal cavities. Therefor e, a composite free flap (e.g. the thoracodorsal free flap) is suitable for fulfilling these requirements.

Figure 53.9 The use of an anterolateral thigh /f_l ap to reconstruct a left partial glossectomy/ /f_l oor of the mouth ablative defect.

(b) (c) (d) Figure 53.10 Management of a right mandibular squamous cell carcinoma utilising virtual surgical planning (VSP) and a /f_i bula free /f_l ap. /uni00A0 (a) Radiographic images demonstrating tumour in the right mandible. /f_l ap with the cutting guide in situ . (d) Final reconstruction clinically and radiographically. (b) VSP highlighting both resection and reconstruction. (c) The /f_i bula free

(c) Figure 53.11 Right mandibular squamous cell carcinoma ablative defect. Orthopantomogram showing the bony defect in the right body/ angle (a) . This was reconstructed with a deep circum /f_l ex iliac artery (DCIA)/iliac crest free /f_l ap. The surface anatomical markings for a right DCIA free /f_l ap are demonstrated with a typical incision (b) . Note the virtual surgical planning cutting guide on the iliac crest bone component and the associated well-vascularised muscle paddle (internal oblique muscle) reconstruction (d) . 1 Vertical component 1 Horizontal component Local flap Pedicle flap Obturator Soft-tissue FF Composite FF Figure 53.12 Maxillectomy defect classi /f_i cation and proposed reconstructions. Note that an updated version was published in 2010, but this diagram provides a useful visual representation of proposed reconstruction according to the class of defect. (Reproduced with permission from Brown JS, Rogers SN, McNally DN, Boyle M. A modi /f_i ed classi /f_i cation for the maxillectomy defect. (d) (c) subsequently inset for the mandibular and intraoral defect 2 3 4 a b c Head Neck 2000; 22 (1): 17–26.)

Evolution in zygomatic implant technology can sup port prosthetic rehabilitation and restoration of low-level maxillectomy defects in combination with soft-tissue flaps. In select cases, this can remove the necessity for composite free flaps. It should be pointed out that pr osthetic reconstruction, using an obturator denture, of a maxillary defect remains a reasonable and sometimes appropriate alternative to fr sue reconstruction. However, studies have shown that free flap reconstruction results in improved functional and aesthetic outcomes when compared with prosthetic obturation. Zygomatic implants and zygomatic implant perforator (ZIP) flaps Zygomatic as well as oncological or co-axis implants, used in conjunction with a fixed or removable prosthesis, or indeed with a free flap, have improved our ability to quickly restore dentition post maxillectomy . Recently , the use of zygomatic implants that perforate a soft-tissue free flap (used to close an oroantral/oronasal communication) and placed immediately after tumour ablation has been described ( Figure 53.13 - Virtual surgical planning The use of virtual surgical planning (VSP) in oral cavity reconstruction is increasing. Potential benefits include reduced operating time, greater accuracy and improved aesthetic/ functional outcomes. Patient-specific surgical stents and cutting guides for both the tumour and donor sites are made preoperatively , based on ee tis - CT scans and software ( Figure 53.14 ). The surgeon performs based on the resection and therefore the the surgery virtually; size and shape of reconstruction required, cutting guides are provided for both the oral resection and donor site harvesting ( Figure 53.15 ). Prefabricated reconstruction plates can also be made.

Figure 53.13 A zygomatic implant perforator used to reconstruct a left hemi-maxillectomy defect (courtesy of Prof. C Butterworth). (a) (c) Figure 53.14 Virtual surgical planning. (a) A virtual mandible (green) with an obvious bony defect. overlaid. (c) The /f_i nal reconstruction plan with a two-part (osteotomised) scapula osseous component.

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