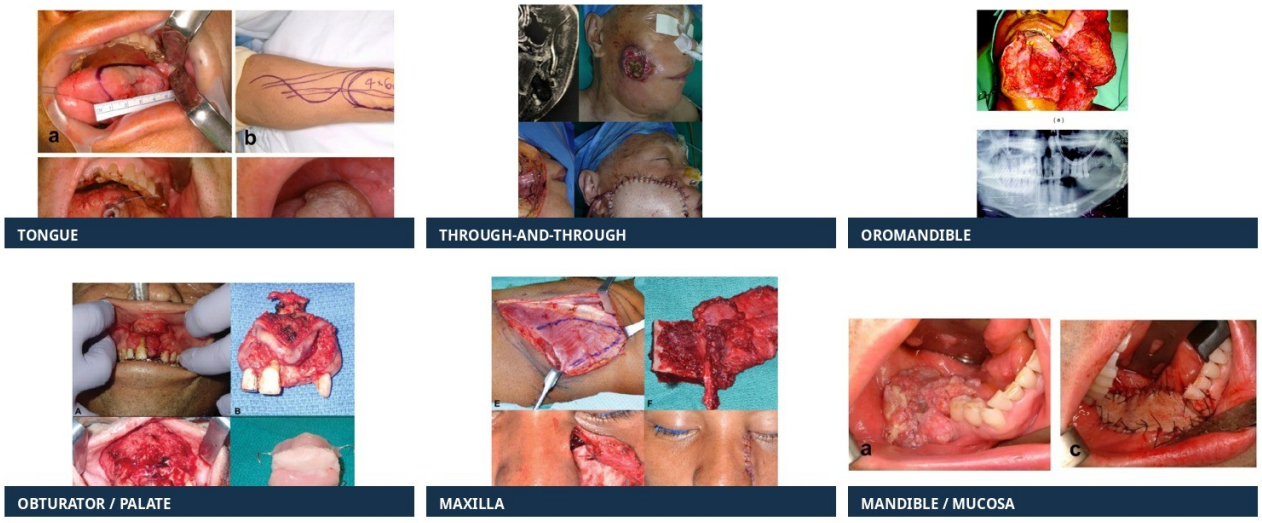
# FREE-FLAP RECONSTRUCTION FOR HEAD AND NECK CANCER

## VOLUME III

## Reconstruction by Defect

Oral cavity, mandible, maxilla, pharynx, skin, and skull-base decision making




*Cover montage. Representative tongue, through-and-through cheek, oromandibular, palatal, maxillary, and mandibular reconstructions. Open-access web figures; full credits in Appendix D.*

**A resident-level guide to defect-specific reconstructive planning**

Resident study guide • July 2026

CHAPTER 0

# Orientation

How to move from an ablative specimen to a defensible reconstructive plan

Volume I taught the defect audit and Volume II described the donor-site toolkit. Volume III brings those two halves together. It is organized by the defect the ablative surgeon creates, because that is how reconstructive decisions arise in the operating room and how they are commonly tested on boards.

The central habit is to describe the defect in functional language before naming a flap. A "hemiglossectomy" may leave a mobile tip and intact tongue base, or it may include floor of mouth, tonsillar fossa, mandible, and external skin. Those are not the same reconstruction. Likewise, "maxillectomy" can mean a small palatal communication suitable for an obturator or a three-dimensional orbitomaxillary defect requiring bone, lining, volume, and external cover. The operation name is a starting point; the residual anatomy determines the solution.

This volume deliberately emphasizes geometry, remaining function, and failure modes. It does not prescribe a single institutional flap algorithm. High-volume centers differ in their preferred donor sites, virtual planning workflows, recipient-vessel choices, and perioperative protocols. A resident should therefore be able to explain why a construct meets the defect, recognize a reasonable alternative, and identify the feature that would make the plan fail.

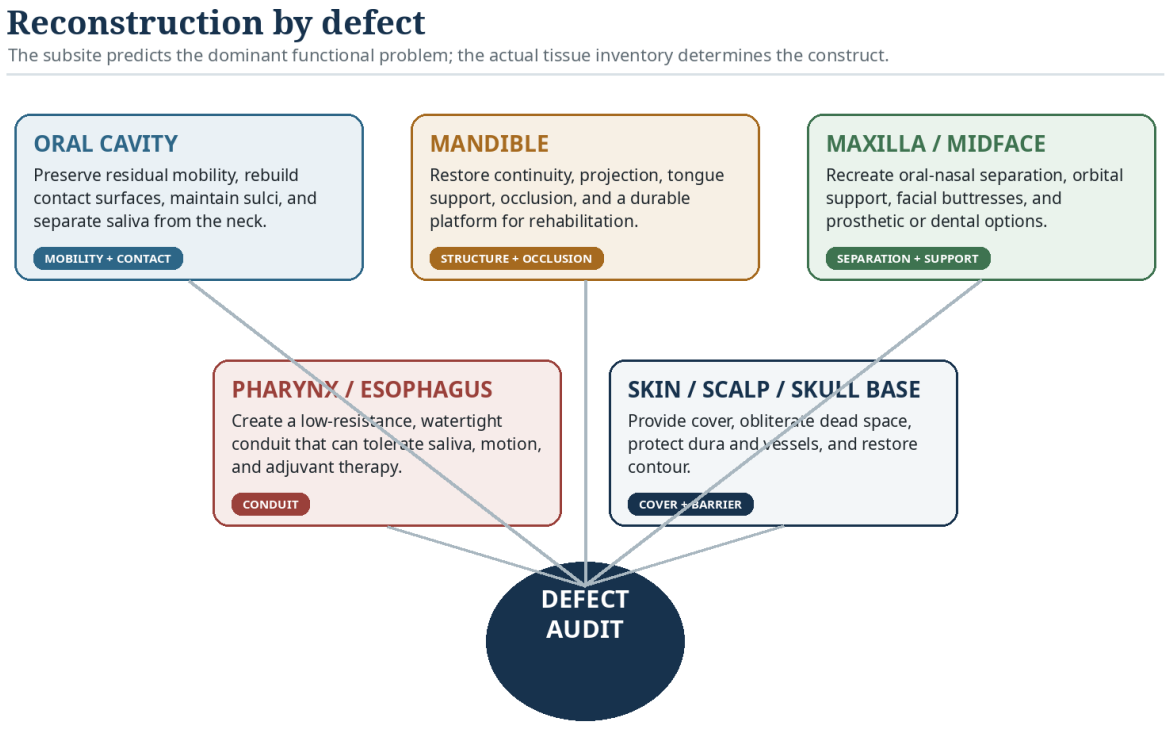



*Figure 1. Reconstruction by defect. Each subsite has a dominant functional problem, but the final construct still depends on the complete tissue inventory. Original synthesis diagram created for this guide.*

## Learning objectives

1. Describe oral-cavity defects according to residual tongue mobility, floor-of-mouth geometry, mucosal surface area, and external skin loss.
2. Choose an appropriate tissue profile for partial, subtotal, and total glossectomy defects and explain how flap shape influences speech and swallowing.
3. Classify mandibular and maxillary defects using commonly tested systems and connect the classification to functional reconstructive goals.
4. Distinguish primary closure, patch reconstruction, circumferential reconstruction, onlay reinforcement, and interpositional closure in the pharynx.
5. Explain when an obturator, local or regional flap, or free flap is likely to provide the best functional solution.
6. Identify the barrier, dead-space, support, and external-cover requirements of scalp, temporal-bone, orbital, and skull-base defects.
7. Generate a primary construct, backup construct, and concise oral presentation for common boards and call scenarios.

**SERIES BOUNDARY** This volume focuses on defect-specific selection and inset goals. Detailed harvest anatomy is in Volume II; recipient-vessel selection, microvascular technique, and perioperative execution belong to Volume IV; monitoring and salvage belong to Volume V.

CHAPTER 1

# The Defect-Specific Method

Translate the resection into a hierarchy of functional and geometric requirements

A reliable reconstruction begins with a structured description that can survive changes in the operative plan. The most useful description contains five layers: subsite, residual function, missing tissue, compartment relationships, and expected treatment environment.

## Start with what remains

Residents naturally focus on what has been removed, but postoperative function often depends more strongly on the quality of the residual native anatomy. A thin radial forearm flap can be an excellent hemiglossectomy reconstruction when the tip, contralateral intrinsic musculature, and tongue base remain mobile. The same flap may be inadequate after near-total glossectomy because there is too little native muscle to propel the bolus or contact the palate. Similarly, a limited mandibular body defect with preserved symphysis behaves differently from an anterior arch defect of the same length.

The reconstructive question is therefore not simply “How much is missing?” It is “Which native structure will perform the function, and what must the flap do to support it?” In many partial defects, the flap should remain passive: provide lining, prevent tethering, preserve a sulcus, and allow the remaining organ to move. In larger defects, the flap becomes a static prosthesis made of living tissue: it creates bulk, contact, shape, or a conduit that substitutes for an absent organ.

## Define the dominant failure mode

Every defect has several possible complications, but one or two usually dominate planning. A lateral tongue defect may fail through tethering and loss of mobility. A subtotal tongue defect may fail through insufficient palatal contact. An anterior mandibular defect may fail through loss of projection and tongue support. A maxillectomy may fail through persistent oral-nasal communication, globe malposition, or poor prosthetic retention. A circumferential pharyngeal defect may fail through fistula or stenosis. Naming the dominant failure mode makes flap selection more rational.

*Table 1. The defect-specific questions that meaningfully change the construct.*

| Defect question | What it changes |
|---|---|
| What native motion remains? | Determines whether thin pliable tissue should preserve motion or bulk should substitute for absent function. |
| Which compartments communicate? | Defines the need for a watertight barrier and whether one or multiple epithelial surfaces are required. |
| Is structural support missing? | Triggers vascularized bone, cartilage, mesh, plate, or rigid suspension planning. |
| Is a conduit narrowed or absent? | Distinguishes primary closure from patch or tube reconstruction. |
| Will the field receive radiation or has it already been irradiated? | Raises the value of robust vascularized tissue and affects expected contraction and atrophy. |

| Defect question | What it changes |
|---|---|
| Is long-term dental rehabilitation a goal? | Changes the desired bone position, height, segment geometry, and timing of implant planning. |
| What must be monitored? | Influences skin-paddle placement and whether buried components need a separate monitoring strategy. |

## The resident presentation

**PRESENTATION TEMPLATE** "This is a [subsite] defect involving [lining / volume / bone / external skin] with loss of [dominant function or barrier]. Residual [native structure] remains. The reconstruction should [two or three priorities]. I would use [construct] because it supplies [required tissue profile], with [alternative] as a backup if [limiting factor]."

This format forces the presenter to show reasoning rather than recite a flap preference. It also creates a natural place to acknowledge uncertainty. When the final resection is not yet known, state the decision point: "If the orbital floor is preserved, soft-tissue obliteration may be adequate; if it is resected, the plan must also provide rigid orbital support."

CHAPTER 2

# Partial Tongue and Floor-of-Mouth Defects

Preserve native mobility, prevent tethering, and maintain the oral sulci

The oral tongue is a mobile muscular hydrostat. After a limited resection, the best reconstruction usually supports the remaining tongue rather than attempting to replace its motion.

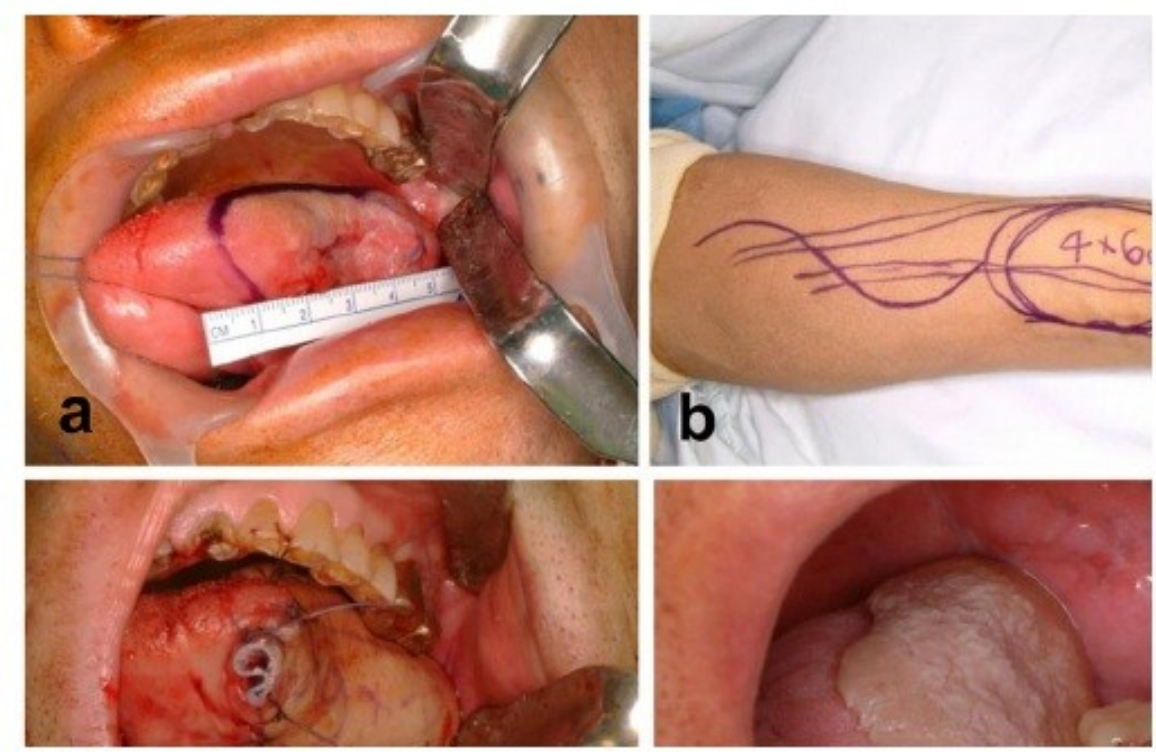



*Figure 2. Radial forearm free-flap reconstruction of a lateral tongue defect: resection, donor design, inset, and long-term appearance. The sequence demonstrates the thin, pliable tissue profile used to preserve residual tongue mobility. Kim et al., 2020; CC BY 4.0.*

## When primary closure is enough

Small, superficial defects can often be closed primarily or allowed to granulate, provided closure does not narrow the tongue, tether it to the floor of mouth, or pull the tip laterally. The percentage of tongue removed is an imperfect rule because defect location matters. A narrow longitudinal wedge may close with little functional penalty, whereas a broad ventral defect that crosses the floor of mouth can produce substantial tethering despite a smaller volume loss.

Primary closure should be judged dynamically. Before committing, imagine the remaining tongue attempting protrusion, lateral sweep, elevation to the palate, and clearance of the buccal sulcus. If the closure line becomes a short, tight vector that opposes those movements, a graft or flap may provide better function even if the defect appears technically closable.

## Why thin tissue is often favored

For partial glossectomy and hemiglossectomy, the reconstructive goal is typically to replace mucosal surface area without creating a heavy mass. The radial forearm free flap remains the classic boards answer because it is thin, pliable, reliable, and has a long pedicle. A thin ALT can provide a concealed donor site and similar function when body habitus and perforator anatomy permit. The ulnar forearm, lateral arm, and other thin perforator flaps are reasonable alternatives in experienced hands.

The flap should be sized to restore the native contour, not simply fill the visible hole. Excess bulk can restrict the contralateral tongue and obliterate the lingual sulcus; insufficient tissue can create a concavity that traps food and limits palatal contact. Some overcorrection is reasonable when adjuvant radiation and denervation-related atrophy are expected, but “more volume” is not automatically protective in a mobile partial tongue.

## Floor of mouth is a geometric problem

The floor of mouth anchors the tongue and forms the channel between the tongue, mandible, and alveolus. Reconstruction must preserve depth in the lingual sulcus and avoid a straight scar band from tongue to gingiva. A flap that is inset flat across the mandibular arch can shorten the floor and tether the residual tongue. Strategic folding, quilting, and fixation to periosteum can recreate a trough and keep the tongue separate from the alveolus.

The status of the mylohyoid and suprahyoid musculature also matters. A mucosal defect above an intact mylohyoid is primarily a lining problem. A composite defect extending through the mylohyoid into the neck requires a durable oral-neck barrier and dead-space management. When marginal mandibulectomy exposes bone or a reconstruction plate, the flap must also provide reliable coverage.

*Table 2. Partial tongue and floor-of-mouth patterns.*

| Clinical pattern | Preferred tissue behavior | Common error |
|---|---|---|
| Small lateral tongue; tip and floor intact | Primary closure, graft, or very thin flap | Closing under tension and pulling the tip toward the defect |
| Hemiglossectomy with mobile contralateral tongue | Thin pliable fasciocutaneous flap | Choosing excessive bulk that blocks residual motion |
| Ventral tongue plus floor of mouth | Thin lining shaped to preserve sulcus depth | Insetting a flat sheet that creates tongue-alveolus tethering |
| Tongue plus mylohyoid/neck communication | Watertight vascularized barrier with enough volume to protect the neck | Treating the defect as mucosa only |
| Tongue plus marginal mandible/plate exposure | Pliable lining with robust hardware coverage | Leaving a thin scarred surface over hardware |

**BOARDS PEARL** For a mobile partial tongue, the classic priority is thin, pliable tissue. For a large tongue defect with little native muscle, the priority shifts toward bulk and palatal contact. The resection extent—not a universal favorite flap—drives the answer.

CHAPTER 3

# Subtotal and Total Glossectomy

Build a stable neotongue that contacts the palate without obstructing the airway

Once most intrinsic tongue musculature is removed, reconstructive logic changes. The flap can no longer merely preserve movement; it must create a static shape that allows the residual tongue base, pharynx, jaw, and gravity to generate functional bolus transit.

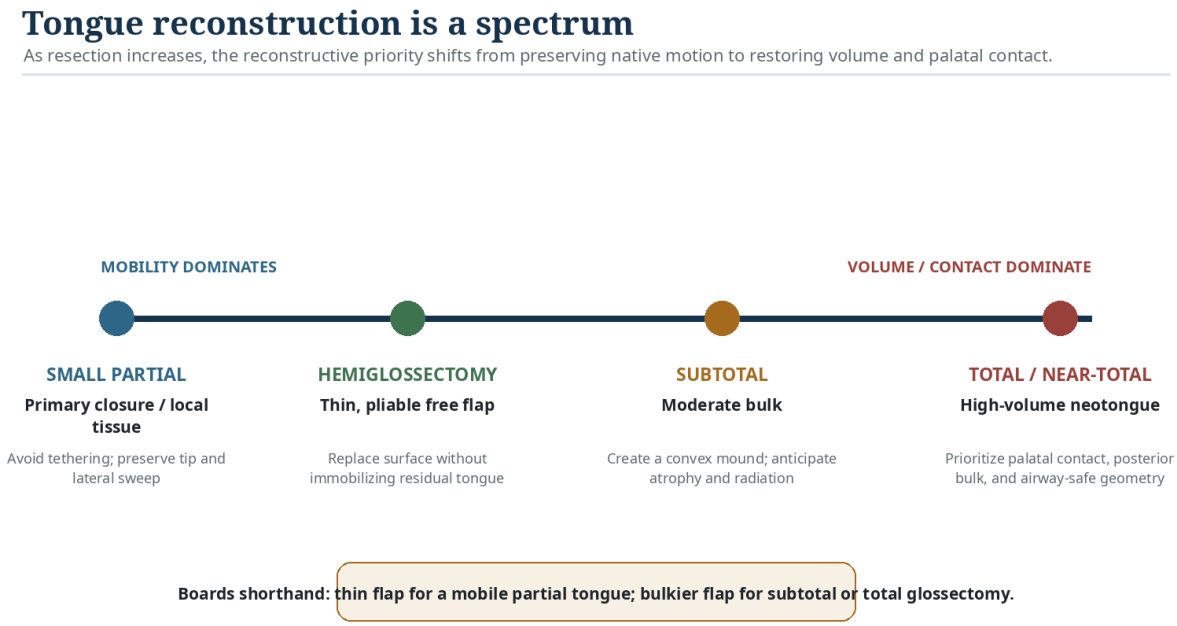



*Figure 3. Tongue reconstruction as a spectrum. The dominant goal shifts from mobility to volume and palatal contact as the resection becomes more extensive. Original synthesis diagram created for this guide.*

## The functional geometry of the neotongue

A useful neotongue is broad enough to contact the palate and lateral alveoli, convex rather than centrally hollow, and sufficiently posterior to assist bolus transfer toward the oropharynx. A flat flap sutured to the floor of mouth may heal uneventfully yet leave the patient unable to clear oral residue. Conversely, an excessively bulky flap can crowd the airway, impair mandibular closure, or obstruct prosthetic access.

Subtotal and total defects commonly favor a musculocutaneous or thicker fasciocutaneous ALT, rectus abdominis, profunda artery perforator flap, or another donor capable of providing substantial volume. The ALT is attractive because its thickness can be adjusted and muscle can be included. The rectus provides predictable bulk but at greater abdominal donor cost. A thin forearm flap may still be appropriate when the defect is mostly surface area and substantial tongue base remains, but it is not the default answer for a true total glossectomy.

## Anterior and posterior volume serve different purposes

Anterior volume supports oral competence and helps the neotongue meet the hard palate during articulation. Posterior volume fills the vallecular and tongue-base deficit and can improve contact with the posterior pharyngeal wall. However, posterior overfilling can narrow the oropharyngeal airway. The reconstructive team should therefore discuss whether the larynx is preserved, how much tongue base remains, whether a tracheostomy is planned, and what postoperative swallowing strategy is realistic.

When the larynx is preserved after near-total glossectomy, airway protection becomes a central concern. Sensation, laryngeal elevation, pharyngeal constriction, and patient cognition may matter as much as flap choice. A technically excellent neotongue cannot compensate for severe bilateral hypoglossal dysfunction, extensive base-of-tongue loss, absent laryngeal sensation, or profound frailty. Reconstruction and candidacy for laryngeal preservation must be considered together.

## Shape, fixation, and expected atrophy

The flap is commonly folded or partially de-epithelialized to create a dome. Fixation to the mandibular periosteum, hyoid region, or residual tongue can prevent dependent migration. A broad base reduces the risk of a narrow central trough. Teams often intentionally overcorrect volume because denervated muscle and fat may atrophy and adjuvant radiation may contract the construct. The amount of overcorrection is experience-dependent and should not compromise immediate airway safety.

Sensate reconstruction is biologically appealing and may improve oral awareness, but sensory recovery is variable and is not a substitute for preserving native lingual and laryngeal sensation when oncologically feasible. Motorized or reinnervated flaps remain specialized rather than standard boards answers. Rehabilitation with speech-language pathology and dental/prosthetic support is essential to convert anatomy into function.

*Table 3. Large tongue defects: reconstructive priorities.*

| Defect | Dominant goal | Common construct | Key risk |
|---|---|---|---|
| Subtotal oral tongue with preserved base | Convex bulk plus residual mobility | Moderate-volume ALT or other fasciocutaneous flap | Central trough or inadequate palatal contact |
| Near-total tongue with larynx preserved | Palatal contact, posterior propulsion, airway-safe volume | Bulky ALT, musculocutaneous ALT, rectus, PAP | Aspiration or oropharyngeal obstruction |
| Total tongue plus floor of mouth | Large three-dimensional mound and oral-neck separation | High-volume soft-tissue free flap | Dependent sag and loss of mandibular support |
| Tongue plus mandible | Independent structure and soft-tissue requirements | Fibula with skin/muscle, subscapular chimeric system, or two flaps | One skin paddle cannot reach all surfaces |

**CLINICAL JUDGMENT** “Total glossectomy” does not automatically mean one flap or one functional outcome. The amount of tongue base, laryngeal sensation, mandible, floor of mouth, and suprahyoid musculature preserved should be stated explicitly.

CHAPTER 4

# Buccal, Lip, and Through-and-Through Cheek Defects

Rebuild independent surfaces while preserving oral aperture and facial contour

A through-and-through cheek defect is not a large skin defect. It is a layered defect with external cover, intermediate volume, oral lining, and often losses of lip, commissure, facial nerve, parotid duct, or mandible.

*Figure 4. Through-and-through cheek reconstruction with a perforator-based ALT flap. The defect requires external skin, internal lining, intermediate volume, and contour—not merely coverage. Wang et al., 2020; CC BY 4.0.*

## Buccal mucosa and the oral aperture

Isolated buccal defects require thin lining that will not contract the commissure or obliterate the maxillary and mandibular sulci. A flap that is too thick reduces oral aperture and traps food. A flap

that is too small contracts and can worsen trismus, particularly after radiation. The posterior edge near the pterygomandibular raphe deserves attention because scar in this region can limit mandibular excursion.

Lip and commissure involvement adds a sphincter problem. Free tissue provides lining and cover but does not automatically restore orbicularis function. When the commissure is sacrificed, static suspension, local lip rearrangement, tendon or fascia slings, and later revision may be needed. The reconstructive plan should state whether oral competence is expected from preserved native muscle or from a static support construct.

## One folded paddle, two paddles, or two flaps

A single skin paddle can be folded to line the mouth and cover the face when the two surfaces are adjacent and the intervening volume is modest. The fold should not compress the perforator or create an ischemic distal segment. When internal and external surfaces are widely separated, oriented differently, or require different thicknesses, two perforator-based paddles on a common pedicle or a chimeric construct provide more freedom.

Very large composite defects may exceed the geometry of a single donor. Two free flaps can be more predictable than forcing one paddle to supply bone, oral lining, facial skin, and deep volume. Double-flap reconstruction increases operative complexity but can allow each tissue component to be optimized: fibula for mandibular continuity and ALT for large independent soft-tissue surfaces, for example.

## Intermediate volume and contour

The cheek is neither a hollow shell nor a solid block. The flap must replace enough subcutaneous volume to prevent a crater while avoiding an intraoral bulge that impairs mastication. De-epithelialized skin or fat can fill the central layer, and anchoring to the zygoma, masseteric fascia, or mandibular border can resist gravitational descent. The classic error is to call this “skin plus mucosa” and forget the middle: loss of subcutaneous tissue, masseter, parotid, or mandibular support produces the long-term hollow, ptosis, and asymmetry.

*Table 4. The layered audit for cheek defects.*

| Component | Question | Reconstructive implication |
|---|---|---|
| External skin | Are aesthetic units, eyelid, nasal sidewall, or commissure involved? | Skin color/texture, contour, and scar placement may drive paddle design. |
| Oral lining | How much buccal mucosa and sulcus are removed? | Use thin pliable tissue; avoid contractile straight-line inset. |
| Intermediate volume | Is masseter, buccal fat, parotid, or subcutaneous tissue absent? | Add de-epithelialized tissue or muscle to prevent contour collapse. |
| Facial nerve | Are dynamic branches sacrificed? | Plan nerve grafting, static suspension, or later facial reanimation. |
| Parotid duct | Can it be preserved or reimplanted? | Unmanaged salivary drainage may produce fistula or sialocele. |
| Mandible | Is there a marginal or segmental defect? | A separate osseous component may be required. |

CHAPTER 5

# Palate and Velopharyngeal Defects

Choose between prosthetic separation, static tissue closure, and dynamic valve preservation

Palatal reconstruction spans two different problems. The hard palate separates the oral and nasal cavities and supports dentition. The soft palate is a mobile valve that regulates speech resonance, nasal airflow, and swallowing.

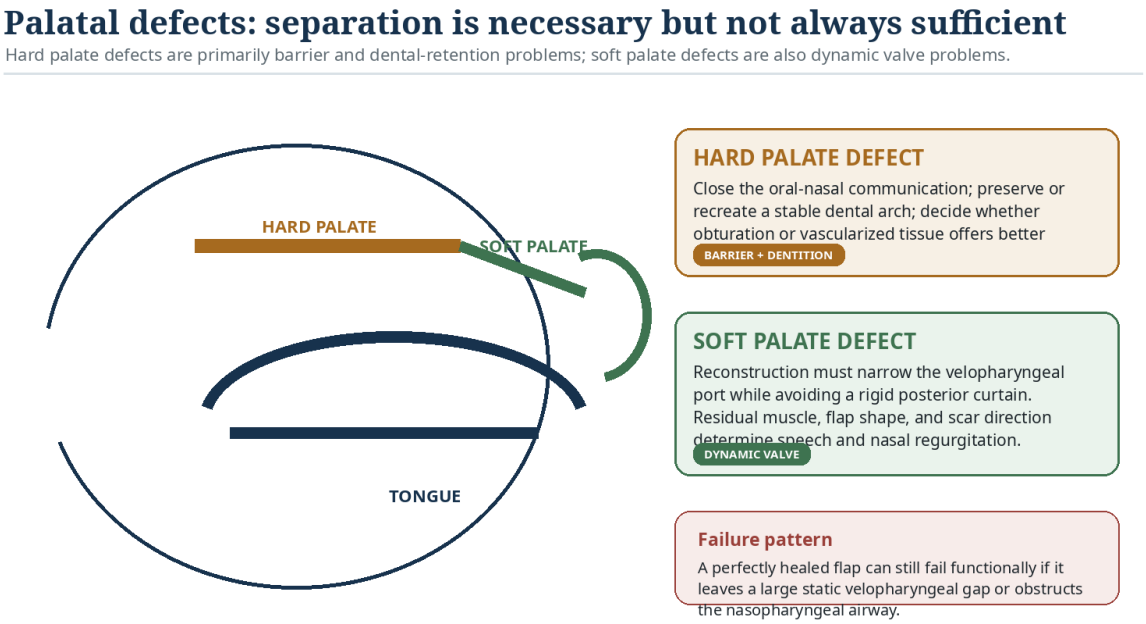



*Figure 5. Hard- and soft-palate defects have different dominant tasks. Hard-palate reconstruction emphasizes separation and dental support; soft-palate reconstruction must also address velopharyngeal function. Original schematic created for this guide.*

## Hard palate: obturator versus tissue

An obturator can be an excellent reconstruction for a limited maxillectomy. It restores separation without a major donor operation, is removable for inspection and cleaning, and can be modified as the defect changes. Success depends on retention, stability, and patient ability to manage the prosthesis. Preserved teeth—especially canines and contralateral dentition—provide critical support. Small posterior or unilateral defects with favorable undercuts are often more easily obturated than broad anterior or bilateral defects.

Obturators become less satisfactory when more than half of the palate or premaxilla is removed, when both canines are lost, when the defect includes orbital floor, facial skin, or skull base, or when severe trismus, xerostomia, poor dexterity, or limited access prevents prosthetic use. Free tissue creates permanent separation and can restore volume or bone, but it makes direct visual inspection of the cavity less simple and commits the patient to a larger operation. The choice should be made with prosthodontics before ablation whenever possible.

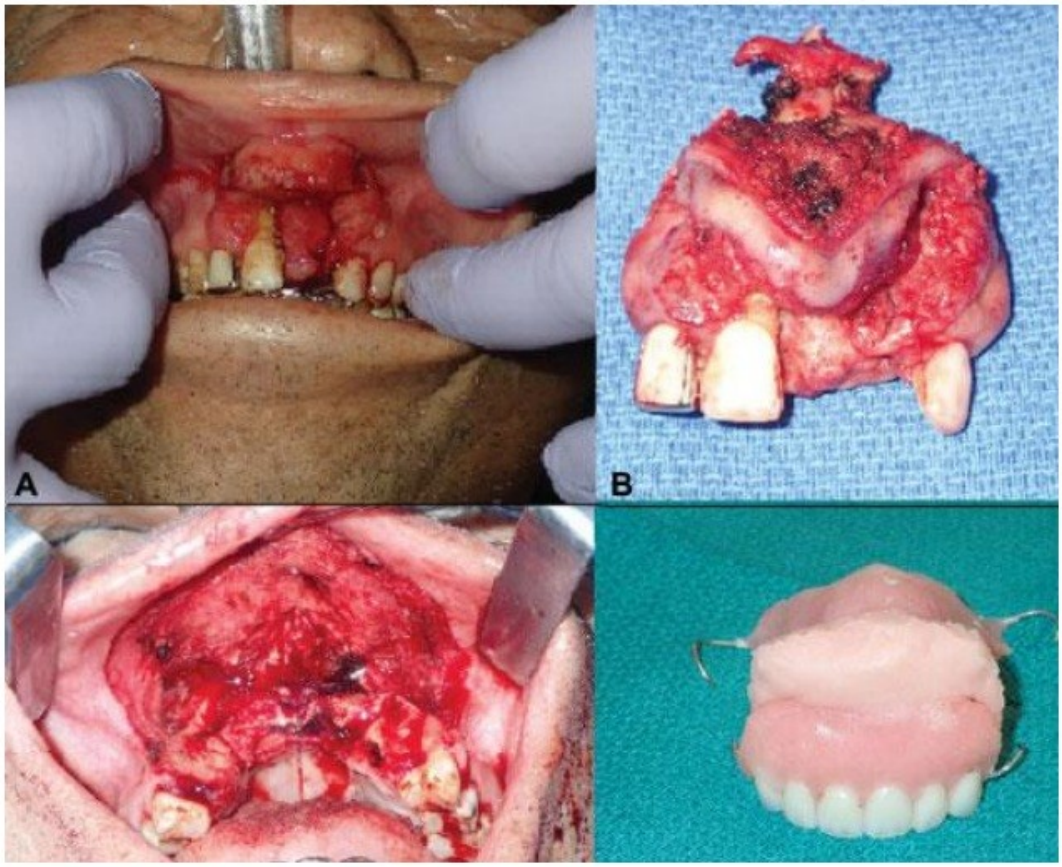



*Figure 6. A limited palatal/maxillary defect managed with an obturator. Residual dentition and defect geometry provide retention; larger anterior, bilateral, orbital, or skin-involving defects are less favorable for prosthetic rehabilitation. Vincent et al., 2019.*

## Soft palate: preserve the valve

A soft-palate reconstruction that merely closes the hole may leave severe hypernasality and nasal regurgitation. The remaining palate and superior pharyngeal constrictor must be assessed. Small lateral defects can sometimes be closed primarily or with a local myomucosal flap. Larger defects may use a thin radial forearm or ALT flap shaped to narrow the velopharyngeal port while allowing the residual palate and pharyngeal walls to move.

A folded flap can recreate oral and nasal surfaces. Tendon or fascia may be used for static suspension, but a rigid posterior curtain can obstruct nasal breathing or remain functionally incompetent. The inset should avoid a straight scar that pulls the residual palate laterally. When most of the soft palate is removed, the expected result is often a compromise rather than normal valve function; counseling and postoperative speech therapy are integral parts of the reconstruction.

## Boards-oriented selection

*Table 5. Palatal scenarios and first-line reasoning.*

| Scenario | Most defensible first consideration | Why |
|---|---|---|
| Small hard-palate defect; good dentition and dexterity | Obturator or local tissue | Low morbidity, inspectable cavity, favorable retention. |

| Scenario | Most defensible first consideration | Why |
|---|---|---|
| Large anterior/bilateral palatal defect; poor prosthetic retention | Vascularized tissue, often with bone if dental support is a goal | Permanent separation and restoration of arch/support. |
| Limited lateral soft-palate defect | Primary closure or local/regional tissue if tension-free | Preserves native dynamic tissue. |
| Large soft-palate defect with residual pharyngeal motion | Thin pliable free flap shaped to narrow the port | Provides surface area without excessive obstruction. |
| Palate plus maxilla/orbit/skin | Composite free-flap reconstruction | The problem exceeds simple separation. |

**BOARDS PEARL** The obturator question is not “old versus modern.” It is a patient-and-defect selection question. A well-retained obturator can outperform a poorly designed flap for a limited defect; a large unstable defect usually needs vascularized reconstruction.

CHAPTER 6

# Mandibular Defects: Classification and Goals

Understand why location and soft-tissue loss matter more than centimeters alone

The mandible is an arch that supports the tongue, lower face, dentition, and muscles of mastication. Segmental loss disrupts both structure and force transmission. Reconstruction must restore relationships, not simply bridge two bone ends.

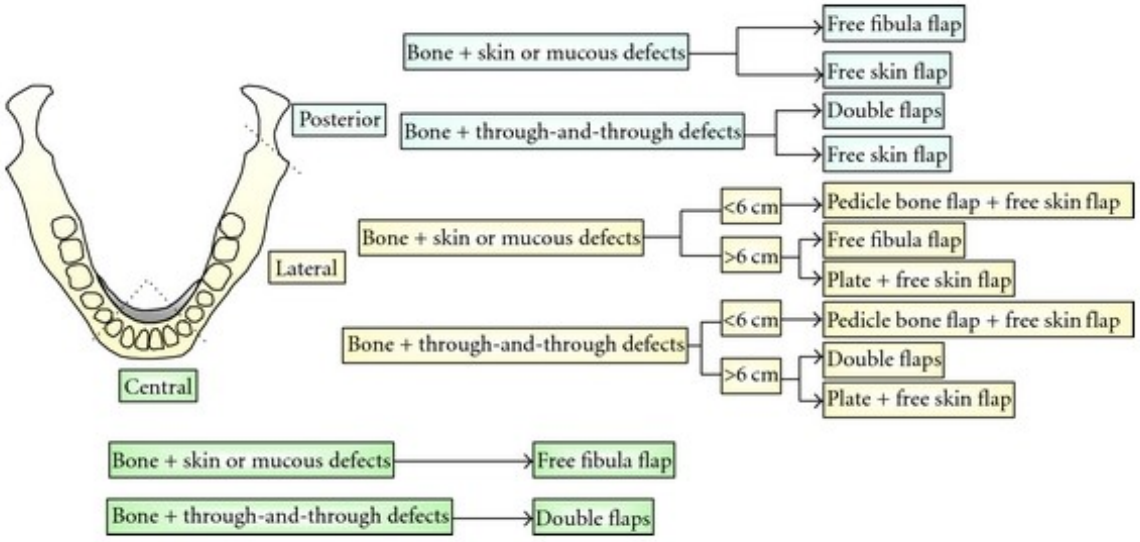



*Figure 7. Open-access oromandibular defect classification and reconstructive strategy. The diagram emphasizes central versus lateral location and the added complexity of skin, mucosal, and through-and-through components. Zhang et al., 2011.*

## Marginal versus segmental mandibulectomy

A marginal mandibulectomy preserves continuity and is primarily a soft-tissue and residual-bone problem. Reconstruction may require mucosal lining, protection of exposed bone, and maintenance of mandibular height sufficient to avoid fracture. In contrast, a segmental mandibulectomy interrupts the arch and usually requires vascularized bone when the patient can tolerate it and meaningful long-term survival is expected.

A reconstruction plate alone can maintain temporary continuity but is vulnerable to fatigue, extrusion, and fracture, especially in irradiated fields or when soft-tissue coverage is thin. Nonvascularized bone grafts are generally reserved for selected small defects in favorable, nonirradiated beds. Vascularized bone is the standard for most oncologic segmental defects because it tolerates osteotomies, heals in compromised tissue, and supports dental rehabilitation.

## The Jewer H-C-L classification

The Jewer system remains boards-relevant because it links defect location to complexity. C denotes a central defect that includes both canines. L denotes a lateral defect that excludes the condyle. H denotes a hemimandibular defect that includes the condyle. Letters can be combined, and modifiers

may describe associated tongue, mucosal, or skin loss. The classification is simple, but it reminds the learner that an anterior C defect has consequences disproportionate to its length.

Loss of the symphysis and parasymphysis detaches or alters the vector of genioglossus, geniohyoid, digastric, and mylohyoid muscles. The tongue can fall posteriorly, chin projection collapses, oral competence worsens, and the lower dental arch loses its reference. A lateral body defect may be longer yet easier to contour and less devastating to airway and projection.

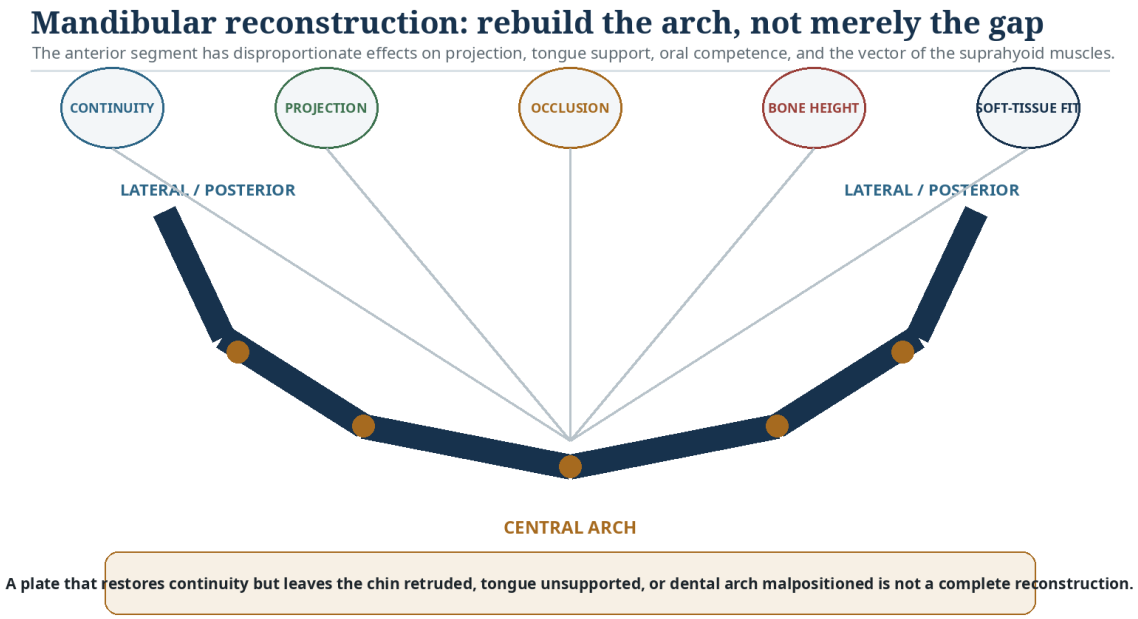



*Figure 8. Mandibular reconstruction must restore arch form, projection, occlusion, bone height, and soft-tissue support—not merely continuity. Original schematic created for this guide.*

*Table 6. Why mandibular location and associated tissue loss change reconstruction.*

| Mandibular feature | Why it matters |
|---|---|
| Anterior arch / both canines | Controls chin projection, tongue support, oral competence, and dental arch form. |
| Angle and ramus | Determines lower facial width and contour; affects osteotomy number and pedicle orientation. |
| Condyle | Adds joint position and ramus-height challenges; exact osseous replacement is not always required. |
| Dentate versus edentulous | Changes occlusal references, bone-height goals, and implant planning. |
| Mucosal surface area | Determines skin-paddle size and whether the lining can be reached safely. |
| External skin loss | May require a second paddle, chimeric construct, or second flap. |
| Tongue / floor-of-mouth loss | Often dominates functional outcome despite successful bony union. |

## The soft-tissue suffix is not optional

Bone classification alone cannot select a flap. The same lateral defect changes completely when accompanied by total tongue, external skin, or pharyngeal loss. Skin-paddle reach and pedicle geometry may require independent paddles, a chimeric construct, or a second flap; muscle or another soft-tissue component may be needed for dead space and plate coverage.

CHAPTER 7

# Mandibular Construct Selection

Match bone length, height, soft tissue, and dental goals to the defect

The fibula is the mandibular workhorse, but “fibula for mandible” is an incomplete algorithm. The correct construct depends on the bony geometry, number of osteotomies, soft-tissue requirements, donor vessels, patient mobility, and dental plan.

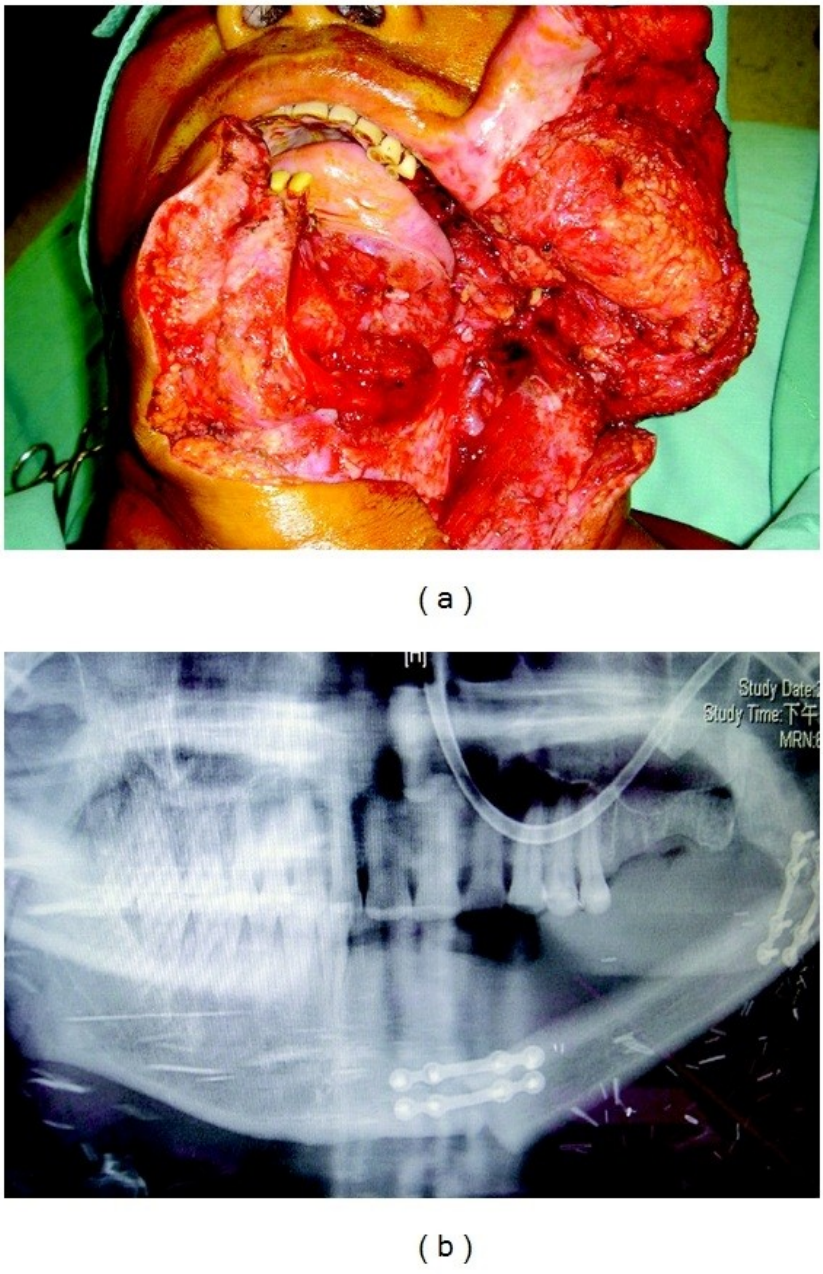



*Figure 9. Representative sequence of composite oromandibular reconstruction. Vascularized bone restores continuity while soft tissue replaces the intraoral or external component. Zhang et al., 2011; open access.*

## Fibula: length and osteotomy versatility

The fibula supplies a long segment of bicortical bone, tolerates multiple osteotomies because of segmental periosteal and endosteal blood supply, and accepts osseointegrated implants. It is the default for long body, angle, symphyseal, and multisegment defects. The skin paddle can replace oral or external tissue, and muscle can add volume. Its limitations are lower vertical height than the native dentate mandible, variable skin-paddle geometry, and the need for adequate lower-extremity vascular anatomy.

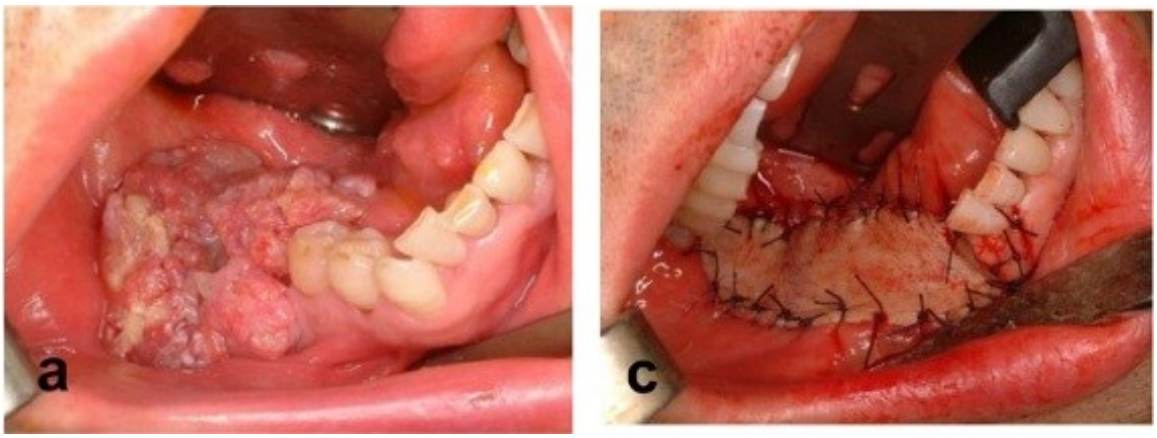



*Figure 10. Oral cavity tumor and healed intraoral skin-paddle reconstruction after fibula osteocutaneous transfer. Kim et al., 2020; CC BY 4.0.*

## Scapular system: independent components and soft tissue

The subscapular system is particularly valuable when the soft-tissue problem is as complex as the bone problem. Scapular tip, lateral border, latissimus, serratus, and skin paddles can be configured on branches of a common source system and positioned independently. This makes the system attractive for mandibular defects with large tongue, palate, cheek, or external skin loss. Bone length is more limited than fibula, and positioning may complicate simultaneous harvest, although modern supine or lateral modifications can mitigate this.

## DCIA and osteocutaneous radial forearm

The iliac crest offers greater vertical bone height and a natural curvature that can suit lateral or anterior mandible. It may be advantageous when dental implant height is a dominant goal. The internal oblique muscle can provide thin vascularized lining. Drawbacks include shorter pedicle, more difficult contouring for long multisegment defects, and abdominal or gait morbidity.

The osteocutaneous radial forearm provides thin pliable skin and a long pedicle with a limited segment of radius. It is most defensible for small lateral defects with major lining needs when fibula or scapula is unsuitable. Limited bone stock and donor fracture risk prevent it from being a general mandibular workhorse.

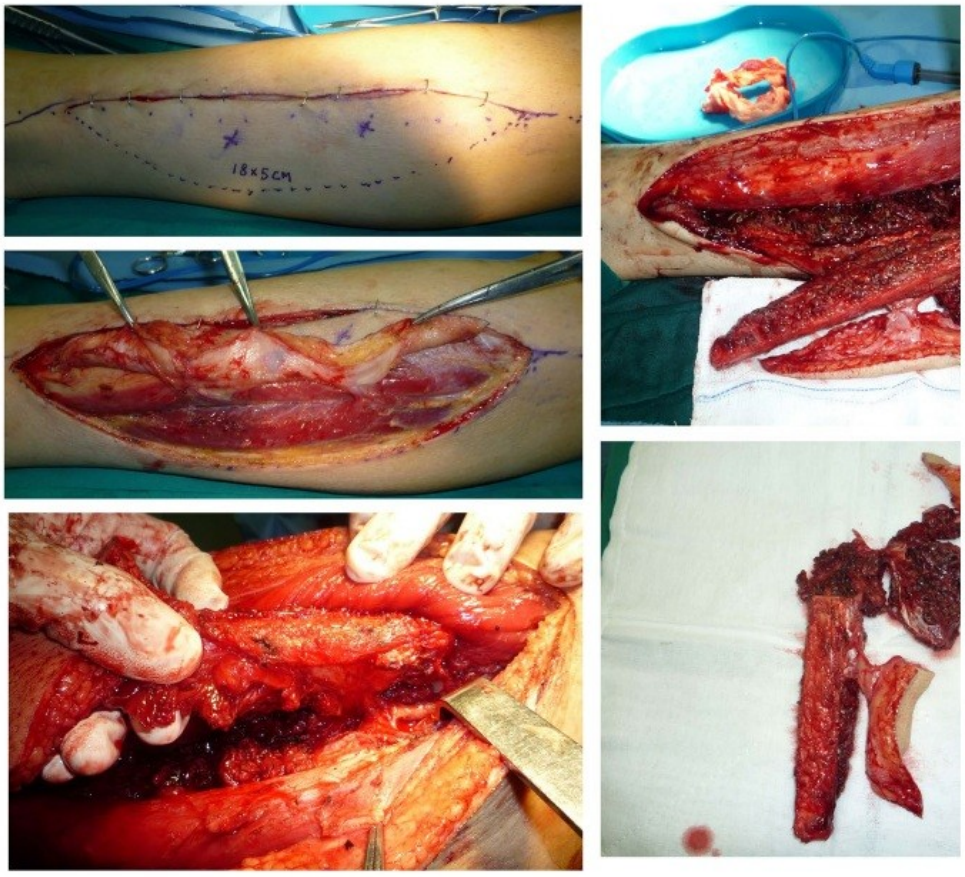



*Figure 11. Chimeric fibula design with vascularized bone and multiple soft-tissue components. Independent components can address spatially separated lining, volume, or cover requirements. Wang et al., 2020; CC BY 4.0.*

## Occlusion and dental rehabilitation

Restoring the inferior mandibular contour is not equivalent to restoring the dental arch. Bone can be plated low to recreate the lower border or positioned high to favor implants and occlusion. Double-barrel fibula, vertical distraction, patient-specific plates, and secondary grafting address the height discrepancy in selected patients. The ideal position depends on whether the patient is dentate, the opposing maxilla is intact, implants are planned, and the soft-tissue envelope permits prosthetic access.

Virtual surgical planning can improve osteotomy precision and segment position, but it does not replace intraoperative assessment of margins, condylar seating, soft-tissue tension, and pedicle geometry. Plans must tolerate a larger-than-expected resection. Immediate dental implants may accelerate rehabilitation in selected programs; delayed implants remain appropriate when oncologic, financial, radiation, or soft-tissue factors are uncertain.

*Table 7. Boards-relevant mandibular donor comparison.*

| Construct | Best fit | Limitation that changes the answer |
|---|---|---|
| Fibula | Long defects, multiple osteotomies, implant-bearing reconstruction | Lower vertical height; vascular disease; skin-paddle geometry. |

| Construct | Best fit | Limitation that changes the answer |
|---|---|---|
| Scapular/subscapular system | Complex three-dimensional soft tissue plus moderate bone | Shorter bone; positioning and harvest logistics. |
| DCIA iliac crest | High bone stock, natural contour, implant height | Shorter pedicle; abdominal/gait morbidity; less flexible for long multisegment defects. |
| Osteocutaneous radial forearm | Small lateral bone need plus thin lining | Limited bone and donor fracture risk. |
| Plate plus soft tissue | Palliative, medically frail, temporary bridge, or selected nonunion-tolerant scenario | Higher long-term plate exposure/fracture risk, especially with radiation. |

**BOARDS PEARL** Fibula is the classic answer for a long segmental mandibulectomy. Scapular system becomes especially attractive when independently mobile soft-tissue components dominate. DCIA offers height and contour. Osteocutaneous radial forearm is a niche option for small bone plus thin lining.

CHAPTER 8

# Maxillectomy and Midface Defects

Classify the vertical and horizontal loss before deciding on obturation, soft tissue, or bone

The maxilla is simultaneously a dental arch, facial buttress system, orbital platform, and boundary between the oral cavity, nose, sinus, orbit, and skull base. Three-dimensional loss can be deceptively large even when the external skin is intact.

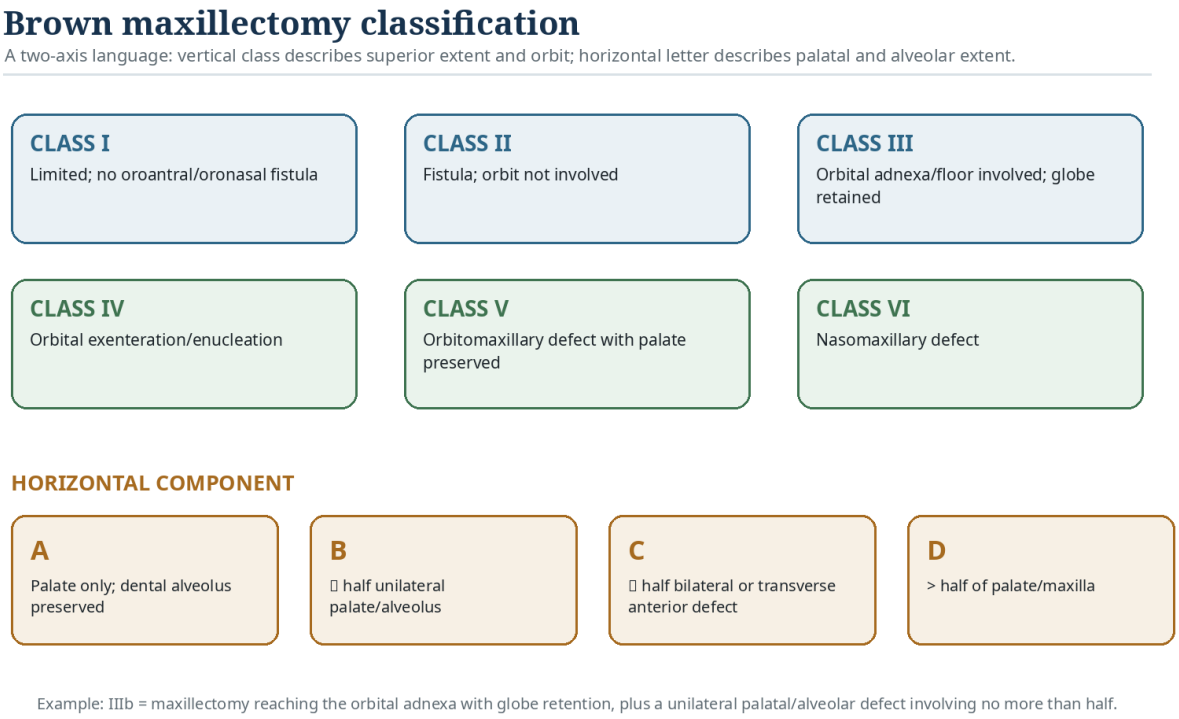



*Figure 12. Brown maxillectomy classification. The vertical class describes superior extent and orbital involvement; the horizontal letter describes palatal and alveolar extent. Original redraw based on Brown and Shaw.*

## Read the Brown classification clinically

Brown class I defects are limited and do not create a typical oroantral or oronasal fistula. Class II defects create a fistula but spare the orbit. Class III reaches the orbital adnexa or floor while retaining the globe. Class IV includes orbital exenteration or enucleation. Class V describes an orbitomaxillary defect with palate preserved, and class VI a nasomaxillary defect. The horizontal letters describe palatal and alveolar extent. The notation is useful because vertical extent predicts orbital and volume needs while horizontal extent predicts oral-nasal separation, dental support, and obturator retention.

No classification captures every relevant feature. The final description should also state facial skin, soft palate, zygoma, skull base, nasal lining, and dentition. A class II defect can be a small unilateral infrastructure defect or a broad anterior defect with devastating loss of lip support and prosthetic retention. Classification is a shared language, not an automatic flap prescription.

## What must be reconstructed?

Four functions should be considered separately: separation of oral and nasal cavities, support of the globe, restoration of midfacial projection, and rehabilitation of the dental arch. Not every wall of the maxilla requires exact replacement. Soft tissue can obliterate the sinus and close the palate effectively when orbital support and dental bone are preserved. Bone becomes more valuable when the orbital rim/floor, zygomatic projection, premaxilla, or implant-bearing alveolus is lost.

## Obturator or flap

Limited, unilateral defects with preserved teeth and no orbital or skin component remain strong obturator candidates. Flaps are favored as defects become larger, anterior, bilateral, or vertically extensive; when prosthetic retention is poor; when the patient cannot manage a removable device; or when the defect also requires orbital support, facial contour, external skin, or skull-base separation. Prior radiation and severe xerostomia can make obturation less tolerable, although free-flap surgery also carries greater perioperative burden.

*Table 8. Factors that shift maxillectomy reconstruction toward obturation or free tissue.*

| Feature | Favors obturator | Favors free tissue |
|---|---|---|
| Palatal extent | Small, unilateral, favorable undercut | Large, > half palate, anterior or bilateral |
| Dentition | Multiple stable teeth/canines remain | Poor dentition or loss of key abutments |
| Vertical extent | Orbit and facial skin preserved | Orbital floor/rim, skin, skull base, or major volume loss |
| Patient factors | Good dexterity, access, hygiene, and follow-up | Cannot insert/clean prosthesis; severe trismus or poor retention |
| Oncologic surveillance | Direct cavity inspection valued | Permanent separation and wound durability prioritized |
| Dental goal | Prosthesis can restore teeth | Vascularized bone needed for implants or arch support |

**COMMON MISTAKE** Selecting a maxillary flap from the size of the palatal hole alone. The orbit, zygomatic projection, anterior dental arch, nasal lining, facial skin, and skull base may dominate the reconstruction.

CHAPTER 9

# Complex Maxillary and Orbital Reconstruction

Restore the platform, buttresses, and facial volume that keep the globe and midface in position

When the orbital floor, rim, zygoma, or premaxilla is removed, soft-tissue closure alone may separate compartments but fail to preserve facial form and ocular function.

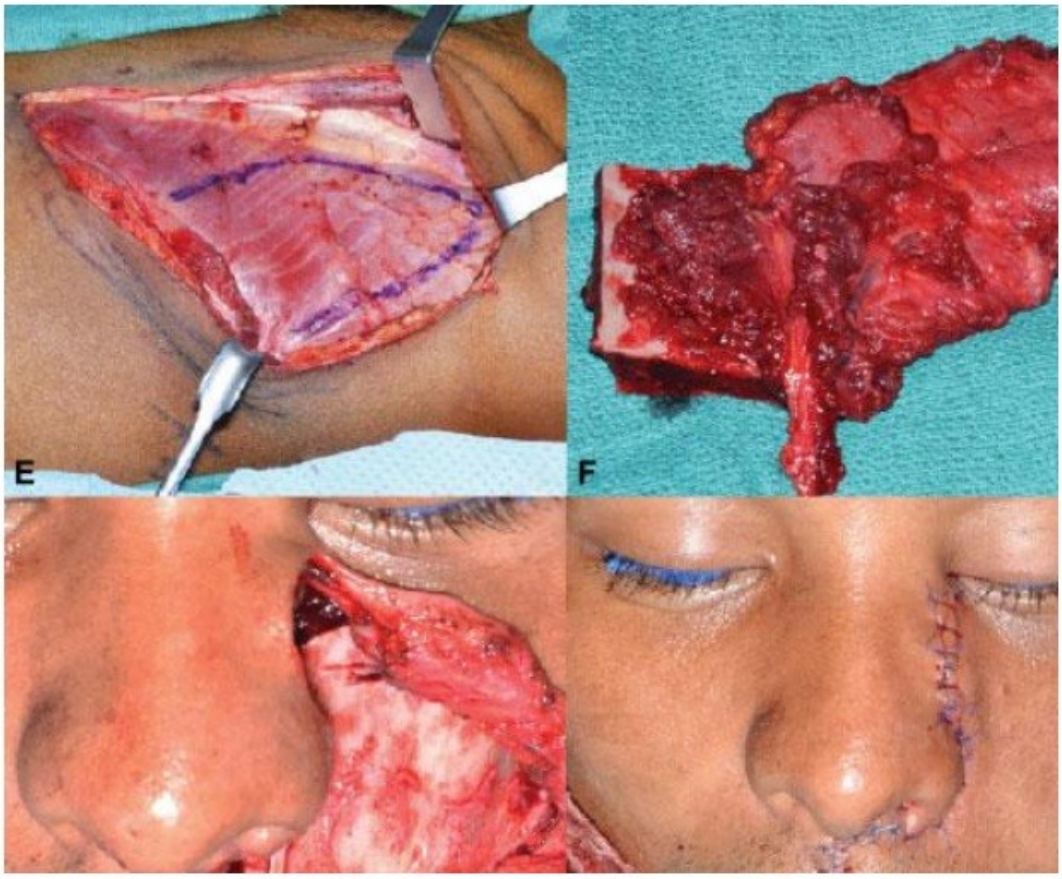



*Figure 13. DCIA-based osteomusculocutaneous reconstruction of a maxillary defect. Iliac bone provides height and contour while internal oblique supplies vascularized lining. Vincent et al., 2019.*

## Orbital support

The globe depends on the orbital floor and rim for vertical position and on the surrounding soft-tissue cone for stable alignment. Large oncologic floor defects can produce hypoglobus, enophthalmos, diplopia, and lower-lid malposition. Reconstruction may use vascularized bone, nonvascularized graft, titanium mesh, patient-specific implant, or a combination covered by vascularized tissue. The choice depends on defect size, contamination, radiation, anticipated surveillance imaging, and whether the zygomatic rim and facial buttresses are also absent.

Rigid material should not lie exposed to the sinonasal cavity or poorly vascularized irradiated tissue. Vascularized coverage separates hardware from saliva and supports healing. Exact recreation of

every orbital contour is difficult; restoration of rim position, floor height, and adequate volume is more important than an anatomically perfect sinus wall.

## Choosing osseous tissue for the maxilla

Fibula provides length and can reconstruct the alveolar arch, orbital rim, or zygomatic bar through multiple osteotomies. Its relatively narrow height can be a limitation for vertical midfacial reconstruction. Scapular tip has a natural triangular shape, abundant associated soft tissue, and independent components that can reconstruct palate, orbit, and external skin. DCIA provides substantial height and curvature, making it useful for alveolar and anterior maxillary support. Radial forearm bone is generally too limited for major midface structure but can address selected small defects.

The best flap often depends on the most difficult component rather than the largest component. A defect with modest bone loss but extensive skin, orbital exenteration cavity, and skull-base dead space may be better served by a soft-tissue-rich subscapular or ALT construct than by maximizing bone length. Conversely, a patient whose main goal is implant-supported dentition may justify a bone-focused reconstruction even when soft-tissue closure could be achieved more simply.

*Table 9. Complex maxillary and orbital requirements.*

| Defect need | Common reconstructive options | Decision point |
|---|---|---|
| Palatal separation only | Obturator, RFFF, ALT, local tissue | Retention, surface area, and patient ability to manage prosthesis. |
| Alveolar arch / dental platform | Fibula, DCIA, scapular bone | Bone position and height for implants, not just inferior border contour. |
| Orbital floor / rim | Vascularized bone, graft, mesh or patient-specific implant with vascularized cover | Globe retention, contamination, radiation, and rim loss. |
| Large exenteration cavity | ALT, latissimus, rectus, subscapular system | Need for volume versus future prosthetic space. |
| Multiple separated surfaces | Chimeric subscapular system, multi-paddle ALT, or two flaps | Independent geometry may be more important than total tissue volume. |

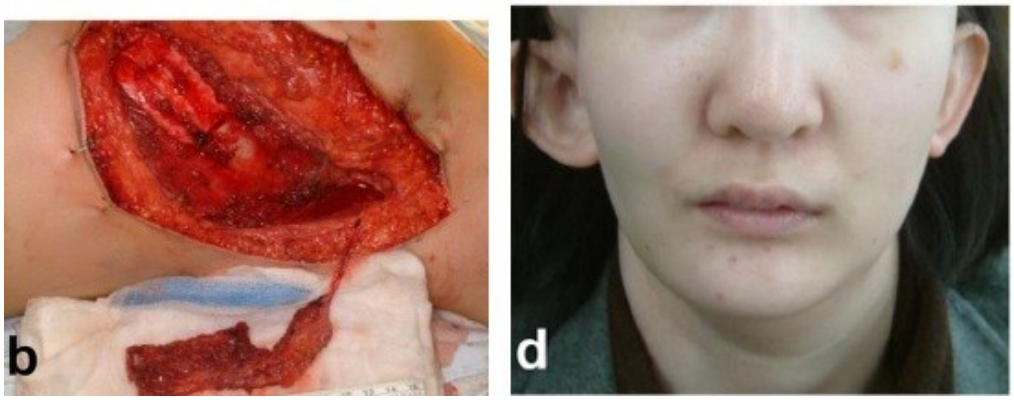



*Figure 14. Serratus anterior with rib component used in a complex maxillofacial reconstruction, providing thin vascularized tissue with limited bone. Kim et al., 2020; CC BY 4.0.*

## Orbital exenteration and facial skin

After exenteration, the goals change from globe support to durable cavity obliteration, separation from sinonasal or intracranial spaces, and external contour or prosthetic retention. A skin paddle can line or cover the cavity, but excessive bulk may prevent an orbital prosthesis. When facial skin is removed, paddle design should respect eyelid, nasal, and cheek aesthetic boundaries. Secondary debulking is common and should be anticipated rather than viewed as failure.

## Define the endpoint before reconstruction

“Close the orbit” is not a complete plan. The team should decide whether the patient needs a shallow stable bed for an adhesive prosthesis, complete obliteration of a contaminated or skull-base cavity, or restoration of facial skin and contour without prosthetic rehabilitation. These goals require different amounts and arrangements of tissue.

*Table 10. Exenteration reconstruction begins with the intended long-term endpoint.*

| Desired endpoint | Construct behavior | Avoid |
|---|---|---|
| Orbital prosthesis | Thin stable lining, preserved rim landmarks, predictable cavity depth | Excessive bulk that eliminates prosthetic space |
| Complete obliteration | Conformable vascularized volume that seals sinus or skull-base communication | Residual dependent cavity or poorly vascularized hardware exposure |
| External facial contour | Independent skin surface with structural eyelid/nasal support when needed | Treating skin replacement as sufficient when deep support is absent |

CHAPTER 10

# Oropharyngeal and Base-of-Tongue Defects

Preserve pressure generation, sensate airway protection, and a patent lateral channel

The oropharynx is a dynamic pressure chamber. Reconstruction must allow the remaining tongue base and pharyngeal constrictors to contact one another while avoiding circumferential scar or excessive bulk.

## Base of tongue versus oral tongue

Oral tongue reconstruction emphasizes articulation and oral bolus control. Base-of-tongue reconstruction emphasizes pharyngeal propulsion and airway protection. A posterior defect can be functionally severe despite modest visible surface area because the tongue base contributes to pressure generation, epiglottic inversion, and clearance of the vallecula.

Thin fasciocutaneous tissue can line a lateral tongue-base or tonsillar defect while preserving the movement of residual muscle. Larger posterior defects may need additional bulk to contact the posterior pharyngeal wall. The flap should not create a rigid shelf that diverts the bolus or obstructs the airway. Inset should preserve the lateral food channel and avoid narrowing the oropharyngeal inlet.

## Lateral pharyngeal wall and tonsillar fossa

A lateral oropharyngeal defect often communicates with the neck and exposes the carotid sheath. The immediate goals are watertight closure, vascularized carotid coverage, and preservation of lumen diameter. A radial forearm flap is useful for thin lining and a long reach; an ALT provides more volume when the defect extends into tongue base, mandible, or external skin. Local and regional flaps may be adequate for smaller defects, especially after transoral resection, but prior radiation and exposed vessels lower the threshold for robust vascularized tissue.

The superior extent near the nasopharynx and soft palate matters. Failure to reconstruct the lateral soft palate can worsen velopharyngeal insufficiency. Inferior extension toward the hypopharynx changes the problem from a wall defect to a conduit problem. The resident should describe the longitudinal and circumferential extent rather than using “oropharyngeal defect” as a single category.

## Sensory and cranial-nerve considerations

Preservation of the superior laryngeal nerve, lingual nerve, hypoglossal nerve, and functional pharyngeal musculature often has greater effect on swallowing than flap identity. Sensate flaps may improve awareness, but evidence is heterogeneous. The reconstructive plan cannot restore oncologically sacrificed laryngeal sensation. Patients with extensive tongue base, bilateral hypoglossal, or vagal deficits require particularly cautious expectations and may need prolonged enteral support.

*Table 10. Oropharyngeal defect patterns.*

| Oropharyngeal pattern | Reconstructive priority | Pitfall |
|---|---|---|
| Lateral tonsillar fossa; carotid exposed | Thin watertight lining and vascularized vessel coverage | Leaving a thin scarred suture line directly on carotid |
| Base-of-tongue surface defect with substantial muscle preserved | Pliable lining that preserves residual contraction | Overbulking and narrowing airway |
| Large tongue-base volume loss | Posterior bulk and contact with pharyngeal wall | Underfilling vallecular defect and losing pressure generation |
| Soft palate plus lateral wall | Narrow velopharyngeal port without rigid obstruction | Closing the surface but ignoring valve function |
| Oropharynx plus mandible/skin | Composite or multi-paddle construct | Forcing one paddle into incompatible surfaces |

**BOARDS PEARL** In the oropharynx, think “pressure chamber and protected carotid.” Thin tissue preserves residual motion; selected bulk restores contact. A watertight suture line and vascularized vessel coverage are mandatory.

CHAPTER 11

# Hypopharyngeal and Pharyngoesophageal Defects

Choose primary closure, patch augmentation, or complete conduit replacement

The key variable is circumference. If enough well-vascularized native mucosa remains for a tension-free lumen, primary closure may be appropriate. As native circumference decreases, the reconstruction progresses from patch to tube or enteric conduit.

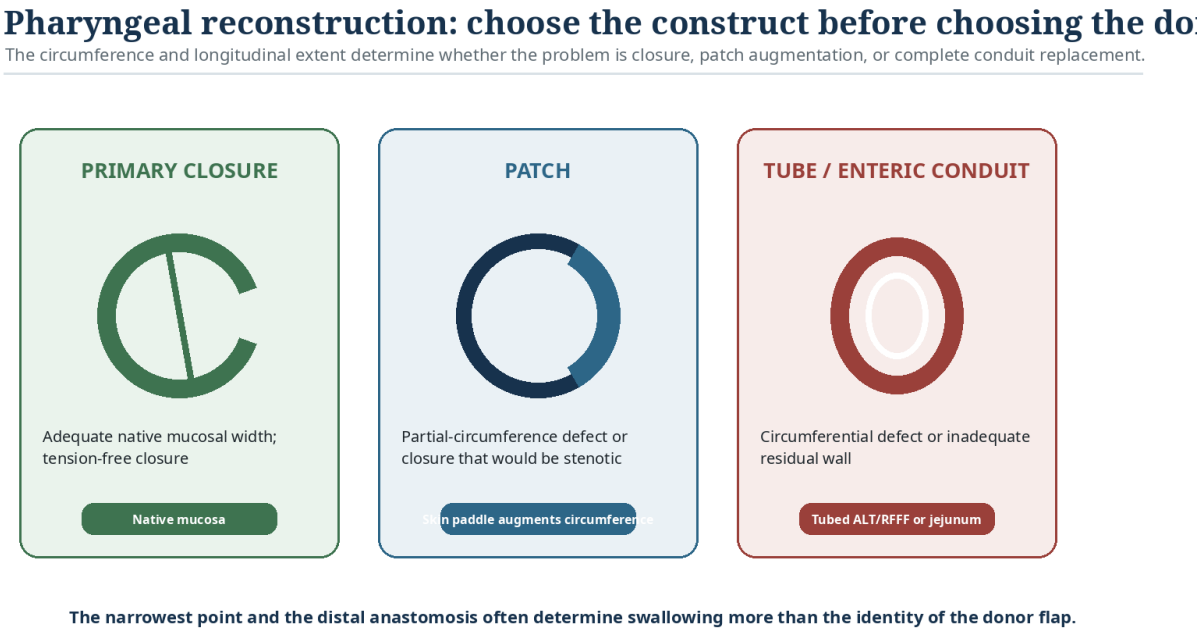



*Figure 15. Primary closure, patch reconstruction, and circumferential conduit replacement solve different pharyngeal geometries. Original synthesis diagram created for this guide.*

## Primary closure

Primary closure preserves native mucosa and avoids an additional epithelial interface, but only if it can be performed without excessive tension or stenosis. The residual pharyngeal strip must be judged after the specimen is removed and the constrictors relax. A lumen that appears adequate around an endotracheal tube may become narrow after scar and radiation. The closure orientation and the narrowest distal point deserve particular attention.

## Patch reconstruction

A partial-circumference defect can be augmented with a fasciocutaneous patch. The patch increases lumen circumference and replaces mucosa while retaining the native posterior or contralateral wall. RFFF provides a thin, easy-to-tube skin paddle; ALT provides more tissue and a concealed donor site. The patch should be inset without redundant folds that trap food and without a tight distal transition that becomes the site of stricture.

## Circumferential reconstruction

When the native pharynx is removed circumferentially, the options include tubed RFFF, tubed ALT, and free jejunum, with gastric pull-up or colon interposition reserved for defects extending farther into the esophagus. A tubed fasciocutaneous flap offers flexible length, permits simultaneous two-team harvest, and generally supports tracheoesophageal speech well. It has a longitudinal seam and two mucocutaneous anastomoses that can fistulize or stenose.

Free jejunum provides a native tubular mucosal conduit of similar caliber and often excellent swallowing. It requires abdominal harvest, has high metabolic sensitivity to ischemia, and its peristalsis is not coordinated with the pharyngeal swallow. Voice after tracheoesophageal puncture may be more “wet” or less fluent because the jejunal segment vibrates differently. Center experience and patient abdominal history strongly influence selection.

## Distal extension and the thoracic inlet

Defects extending below the thoracic inlet or involving substantial cervical esophagus require coordination with thoracic or gastrointestinal surgeons. Pedicle reach, distal anastomotic exposure, conduit length, and mediastinal contamination become limiting factors. A flap that is ideal for a short cervical segment may be inadequate for a long esophageal replacement. The resident should explicitly state the proximal and distal levels of the defect.

*Table 11. Pharyngoesophageal reconstructive options.*

| Option | Advantages | Tradeoffs |
|---|---|---|
| Primary closure | Native mucosa; no donor site; shortest operation | Only appropriate when tension-free and nonstenotic. |
| RFFF patch/tube | Thin, pliable, reliable, long pedicle, easy tube formation | Forearm donor site; seam; limited bulk. |
| ALT patch/tube | Large paddle, adjustable thickness, possible chimeric components | May be thick; perforator variability; seam. |
| Free jejunum | Native mucosal tube, matched caliber, strong swallowing outcomes | Abdominal operation, ischemia sensitivity, different voice quality. |
| Gastric pull-up / colon | Long-segment replacement beyond cervical esophagus | Major visceral operation and systemic morbidity. |

**CALL-ROOM TRANSLATION** When a postoperative note says “pharyngeal free flap,” determine whether it was an onlay, interposition, patch, or circumferential tube. The expected leak, stricture, monitoring, and swallowing problems are different.

CHAPTER 12

# Salvage Laryngectomy

Import nonirradiated vascularized tissue and use precise closure language

Salvage total laryngectomy after radiation or chemoradiation is a wound-healing operation performed in fibrotic, hypovascular tissue exposed to saliva. The reconstructive strategy should be planned before the pharynx is opened.

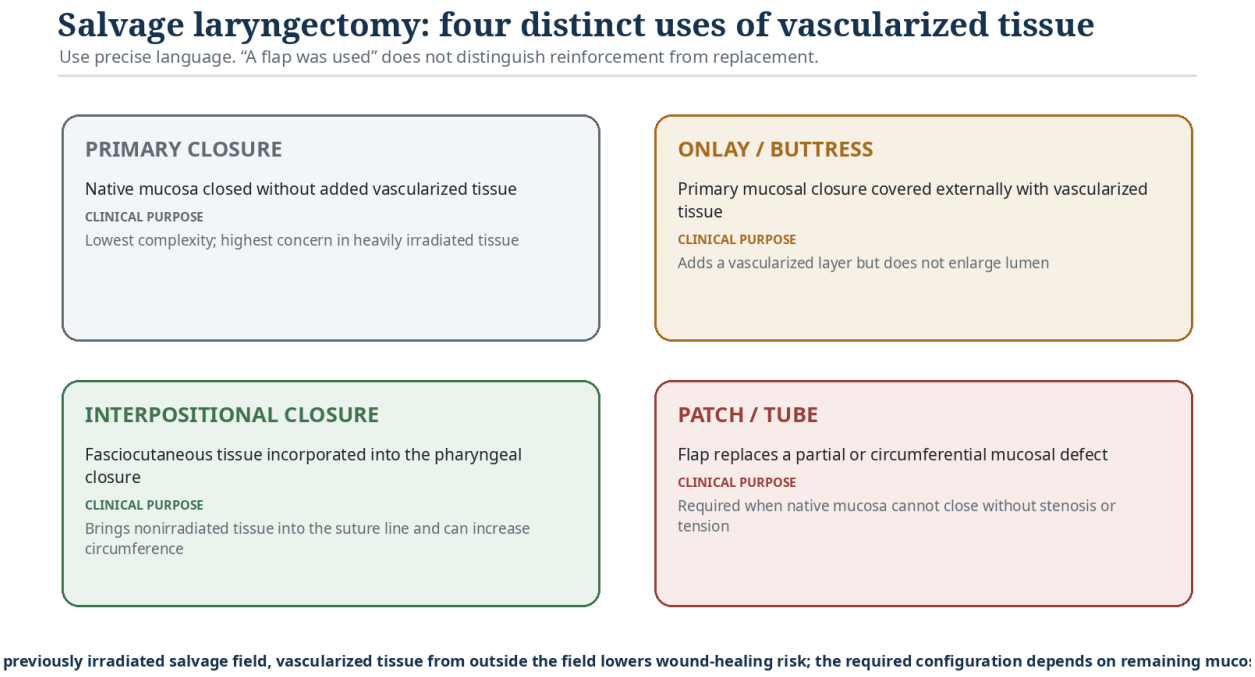



*Figure 16. Four distinct closure strategies after salvage laryngectomy. Onlay reinforcement, interpositional closure, patch replacement, and circumferential reconstruction should not be conflated. Original synthesis diagram created for this guide.*

## Why vascularized tissue helps

Radiation injures small vessels, fibroblasts, and tissue compliance. The pharyngeal closure is exposed to high bacterial load, repetitive swallowing forces, and salivary enzymes. Importing tissue from outside the radiation field provides a better-vascularized layer and can replace scarred mucosa. Contemporary multi-institutional evidence associates elective fasciocutaneous free-flap reconstruction with lower pharyngocutaneous fistula rates in salvage laryngectomy with limited pharyngectomy, although exact practice remains institution-dependent.

## Onlay, interposition, patch, and tube

An onlay or buttress covers a primary mucosal closure externally. It adds vascularized tissue between the pharynx and neck skin but does not enlarge the lumen or replace the irradiated suture line. An interpositional fasciocutaneous flap is incorporated into the pharyngeal closure, bringing nonirradiated tissue into the suture line and increasing circumference. A patch replaces a partial

mucosal defect, and a tube replaces the entire circumference. These are different operations with different indications.

If adequate mucosa remains for a broad closure, interpositional tissue may reduce tension and stenosis while reinforcing the field. If partial pharyngectomy leaves insufficient width, a patch is necessary. If the defect is circumferential, a tubed flap or jejunum is required. A pectoralis major onlay remains a reliable regional option, particularly when microsurgery is contraindicated or as backup, but it can add neck bulk and does not offer the same pliable mucosal replacement as a fasciocutaneous flap.

## Additional decisions

A salivary bypass tube may protect the distal anastomosis and direct saliva away from the suture line, but protocols vary. Primary versus delayed tracheoesophageal puncture depends on institutional practice, tissue quality, reconstruction type, and anticipated complications. The reconstructive plan should also cover the carotid arteries, separate the tracheostoma from the pharyngeal closure, and preserve sufficient neck skin for a tension-free stoma.

*Table 12. Salvage laryngectomy defect-to-construct logic.*

| Situation | Construct logic |
|---|---|
| Salvage laryngectomy; broad healthy mucosal strip | Primary closure plus vascularized onlay or interposition according to local protocol and risk. |
| Closure possible but narrow or high tension | Interpositional fasciocutaneous tissue to enlarge circumference and import nonirradiated tissue. |
| Partial pharyngeal wall removed | Patch reconstruction. |
| Circumferential pharyngectomy | Tubed ALT/RFFF or free jejunum; consider distal extent. |
| Microsurgery not feasible | Pectoralis major or other regional flap for reinforcement/replacement as anatomy permits. |

**BOARDS PEARL** Previously irradiated salvage laryngectomy is a classic indication for prophylactic vascularized tissue. State whether the flap reinforces a primary closure or replaces part of the pharyngeal circumference.

CHAPTER 13

# Cutaneous, Scalp, and Calvarial Defects

Replace external cover while controlling contour, dead space, and exposed bone or hardware

Cutaneous reconstruction is not merely about closing skin. The underlying parotid, facial nerve, muscle, calvarium, orbit, temporal bone, or carotid exposure often determines the flap.

## Large facial skin defects

Small facial defects are usually better served by local flaps because they replace like with like and preserve color, thickness, and aesthetic units. Free tissue becomes appropriate when the defect is too large for local recruitment, local tissue has been irradiated or previously used, or deep structures require simultaneous volume and coverage. ALT, radial forearm, scapular/parascapular, and latissimus flaps offer different combinations of skin thickness and bulk.

The skin paddle should be designed around landmarks rather than around the easiest donor ellipse. Eyelid, nasal ala, lip, and commissure losses require specialized support and often staged refinement. A free flap can establish a healthy platform, but secondary debulking, scar revision, static suspension, or prosthetic rehabilitation may be necessary for a natural contour.

## Scalp defects

The scalp has limited laxity and a convex surface. Primary closure and local rotational flaps are preferred when feasible because they provide hair-bearing tissue. Skin grafts require a vascular bed; bare calvarium without pericranium may need burring to diploë, a local flap, or vascularized tissue. Large irradiated defects, exposed hardware, chronic infection, or composite calvarial loss often require free tissue.

Latissimus dorsi provides broad, well-vascularized muscle that conforms to the calvarium and can accept a skin graft. ALT provides skin and adjustable volume with supine harvest. Scapular/parascapular flaps provide durable skin and can include bone. Muscle flaps atrophy and can improve contour over time, but early bulk may be substantial. Fasciocutaneous flaps preserve their skin paddle and may be easier to monitor.

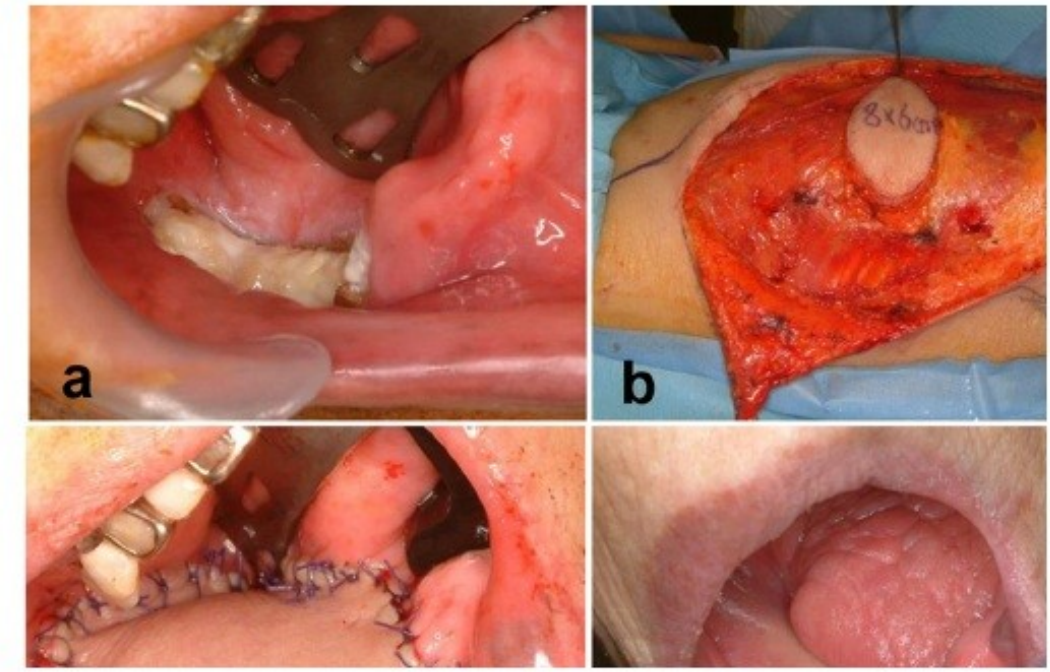



*Figure 17. Latissimus dorsi free flap used for a large oral and maxillofacial defect. The same broad vascularized muscle properties make latissimus useful for extensive scalp and skull-base dead space. Kim et al., 2020; CC BY 4.0.*

## Calvarial reconstruction

Not every calvarial defect requires immediate rigid cranioplasty. The decision depends on size, location, brain protection, contour, contamination, infection, and adjuvant therapy. In a contaminated or infected field, durable vascularized soft-tissue coverage may take priority, with delayed cranioplasty after infection control. When rigid reconstruction is performed, titanium mesh or patient-specific implants should be covered by healthy vascularized tissue.

*Table 13. Cutaneous, scalp, and calvarial scenarios.*

| Defect | Preferred rung or tissue | Key caveat |
|---|---|---|
| Small nonirradiated scalp with laxity | Primary closure or local rotation | Avoid excessive tension and alopecia. |
| Skin loss with intact vascular pericranium | Skin graft or local flap | Graft will not reliably take on avascular bare cortex. |
| Large scalp/calvarium; irradiated or infected | Latissimus, ALT, scapular/parascapular free flap | Dead space and hardware coverage dominate. |
| Calvarial defect with contamination | Vascularized soft tissue; consider delayed cranioplasty | Rigid implant in infection-prone bed may fail. |
| Facial skin plus deep volume/nerve loss | Composite or chimeric free flap plus reanimation plan | Skin closure alone does not restore contour or movement. |

CHAPTER 14

# Temporal Bone, Orbit, and Skull Base

Build a vascularized barrier around dura, carotid artery, contaminated cavities, and complex dead space

Skull-base reconstruction is layered barrier engineering. The reconstruction must separate intracranial contents from the aerodigestive tract, obliterate irregular cavities, protect vessels and hardware, and sometimes replace external skin.

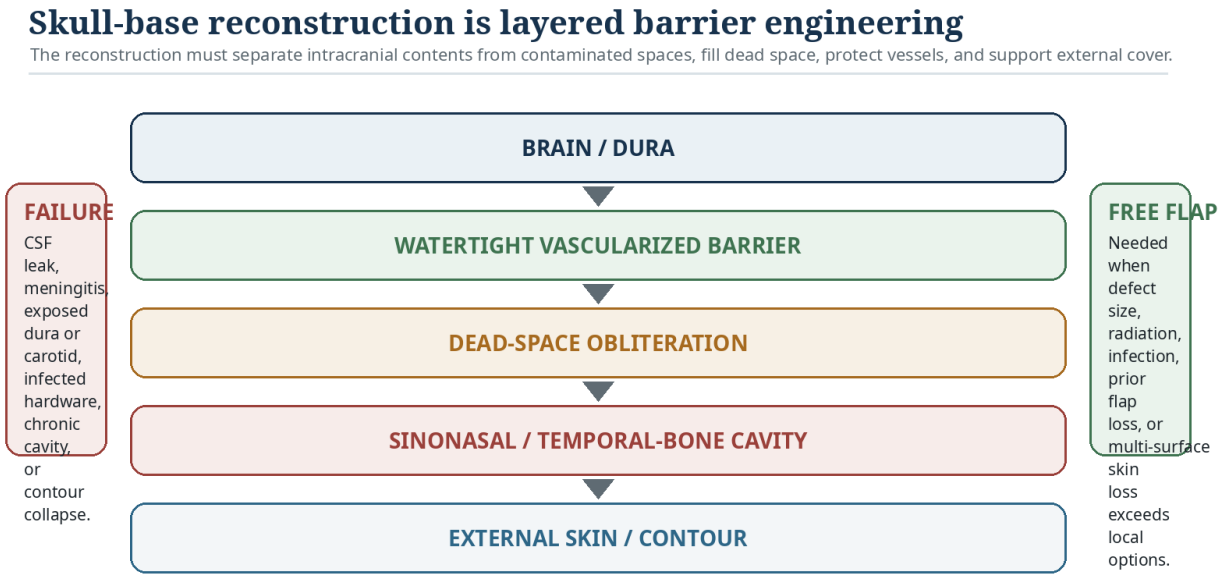



*Figure 18. Layered goals of skull-base reconstruction: dural protection, watertight vascularized separation, dead-space obliteration, cavity management, and external cover. Original synthesis diagram created for this guide.*

## Lateral temporal-bone defects

Lateral temporal-bone resection can expose dura, sigmoid sinus, carotid artery, facial nerve, temporomandibular joint, parotid bed, and external auditory canal. The cavity may be deep and irregular, and prior radiation is common. Small defects may be managed with temporalis or other regional tissue. Large subtotal or total temporal-bone defects, external skin loss, prior flap failure, or extensive irradiated dead space favor free tissue.

ALT and latissimus provide substantial volume; radial forearm provides thin pliable tissue and a long pedicle for selected defects; subscapular constructs can provide skin, muscle, and bone. The flap should separate any dural repair from the mastoid or pharyngeal space, cover exposed vessels, and fill the cavity enough to prevent chronic fluid collection without producing excessive facial bulk.

## Anterior skull base

For most endoscopic defects, a vascularized nasoseptal flap, pericranial flap, or other local option is preferred. Free tissue is reserved for unusually large open craniofacial defects, prior local-flap failure, radiation, osteomyelitis, recurrent CSF leak, or simultaneous orbital/facial skin loss. The dominant goal is durable separation of the sinonasal tract from the intracranial space. Thin radial forearm tissue can reach and line the defect; ALT or latissimus provides more volume for large cavities.

## Carotid coverage and the vessel-depleted neck

Exposed carotid artery is a reconstructive emergency even when the flap itself is viable. Saliva, infection, radiation, and desiccation increase the risk of blowout. Robust vascularized tissue should separate the artery from the pharyngeal or skin suture line. In a vessel-depleted neck, the required pedicle length and route may influence donor selection, but recipient-vessel strategy is addressed in Volume IV. The defect-specific point is that carotid coverage is a primary requirement, not an incidental benefit.

## Orbit and exenteration cavity

An exenteration defect may communicate with the nose, sinuses, skull base, or temporal fossa. The reconstruction must define whether the goal is complete obliteration, a shallow socket for prosthesis, external skin coverage, or support of adjacent eyelids and nasal sidewall. A bulky flap that seals the skull base may compromise prosthetic depth; a thin flap may leave dead space. The desired endpoint should be agreed upon with oculoplastics and prosthetics before inset.

*Table 14. Layered skull-base requirements.*

| Skull-base feature | Reconstructive response |
|---|---|
| Dural violation / CSF pathway | Watertight dural repair plus vascularized separation from sinonasal or temporal-bone cavity. |
| Large irregular dead space | Conformable muscle or adipofascial volume; secure fixation to prevent migration. |
| Exposed carotid or major vessels | Thick, well-vascularized coverage isolated from saliva and skin breakdown. |
| External skin loss | Independent skin paddle or second flap if internal geometry is incompatible. |
| Prior radiation / osteomyelitis / local-flap failure | Import nonirradiated free tissue and remove nonviable material. |
| Future orbital prosthesis | Control cavity depth and avoid unnecessary bulk at the prosthetic interface. |

**BOARDS PEARL** Local vascularized flaps are first-line for many endoscopic skull-base defects. Free tissue is reserved for large, composite, irradiated, infected, or previously failed defects that exceed local options.

CHAPTER 15

# Integrated Algorithms and Cases

Practice selecting a construct without reducing reconstruction to slogans

The following algorithm and cases are designed to make the resident state the defect, dominant failure mode, tissue requirements, and a reasonable construct. More than one flap can be correct when the reasoning is coherent.

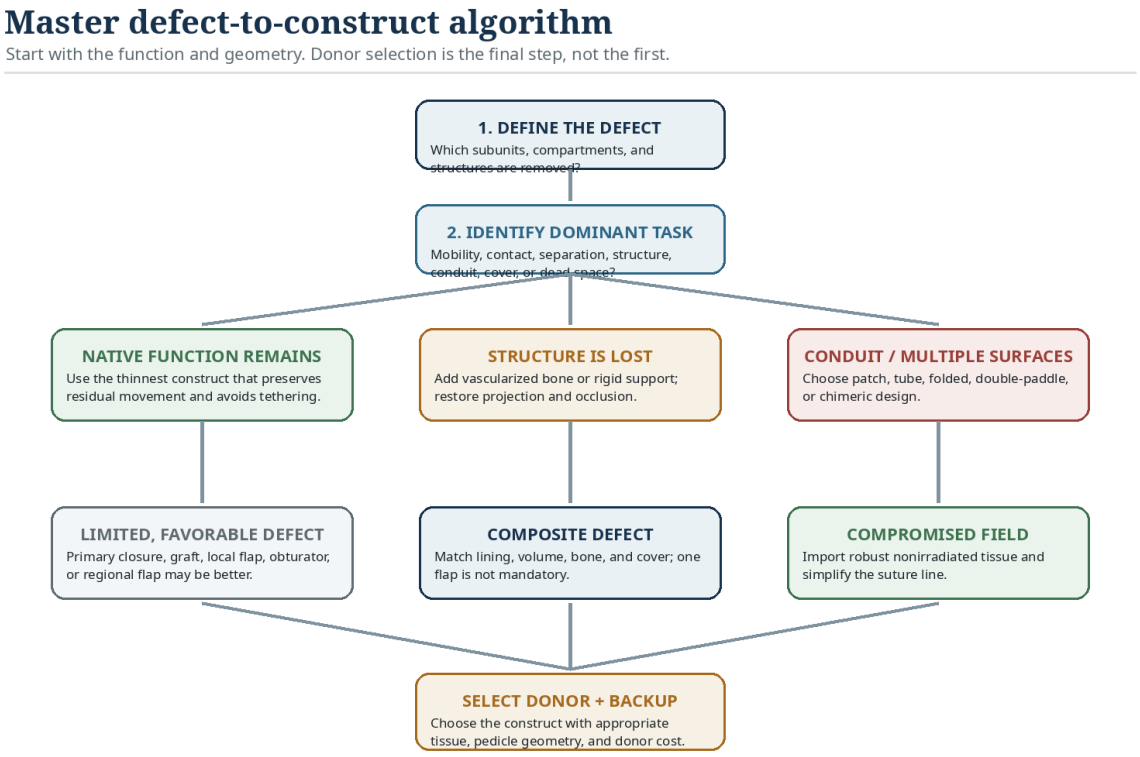



*Figure 19. Master defect-to-construct algorithm. Donor selection follows definition of residual function, structural loss, conduit geometry, and field quality. Original synthesis diagram created for this guide.*

## Case 1: mobile partial tongue

A 52-year-old undergoes resection of the lateral third of the oral tongue and a small adjacent floor-of-mouth segment. The tip, tongue base, contralateral musculature, mandible, and mylohyoid are preserved. The defect cannot close without pulling the tongue toward the alveolus.

**ANSWER** This is a lining and mobility-preservation problem. A thin pliable RFFF or thin ALT is appropriate; the inset should preserve lingual sulcus depth and avoid tethering. A bulky flap would sacrifice the main remaining advantage: native tongue motion.

## Case 2: near-total tongue with larynx preservation

A 64-year-old undergoes near-total glossectomy with preservation of a small posterior tongue-base remnant and the larynx. The mandible is intact. The patient has good pulmonary reserve and intact preoperative laryngeal sensation.

**ANSWER** The construct must create a broad convex neotongue with palatal contact and posterior volume while avoiding airway obstruction. A moderate-to-bulky ALT, musculocutaneous ALT, PAP, or rectus-type construct is more defensible than a thin forearm flap. Functional outcome also depends on the preserved tongue base, sensation, and rehabilitation.

## Case 3: anterior mandible plus floor of mouth

A 45-year-old loses the mandibular segment between both canines, floor-of-mouth mucosa, and genioglossus attachments. External chin skin is preserved. Dental rehabilitation is a priority.

**ANSWER** This is a central C-type structural defect with loss of projection and tongue support. Vascularized bone is required; fibula is the classic choice because it permits multiple osteotomies and implants. The plan must position bone for the dental arch and recreate floor-of-mouth lining, not simply bridge the inferior border.

## Case 4: lateral mandible plus large cheek skin

A 72-year-old has a lateral mandibular body/angle defect, buccal mucosal loss, and a 10-cm external cheek defect after resection in a previously irradiated field.

**ANSWER** The soft-tissue geometry may dominate. Options include a subscapular chimeric construct with bone and independent skin/muscle components, fibula plus a second ALT, or a carefully designed multi-paddle construct. A single small fibula paddle is unlikely to replace both large surfaces reliably.

## Case 5: limited maxillectomy

A dentate 58-year-old has a unilateral posterior hard-palate and alveolar defect that spares the orbital floor, premaxilla, facial skin, and soft palate. The patient has good dexterity and access to prosthodontics.

**ANSWER** An obturator is a strong first consideration because the defect is limited and retention is favorable. Free-flap surgery is not mandatory simply because it is available. The decision should incorporate patient preference, expected radiation, and prosthetic assessment.

## Case 6: total maxillectomy with globe retention

A 60-year-old has a total maxillectomy including the orbital floor and anterior maxillary arch, with globe retention and no external skin loss.

**ANSWER** The reconstruction needs palatal separation, orbital support, midfacial projection, and an alveolar/dental plan. Fibula, scapular tip/subscapular system, or DCIA can be appropriate depending on the geometry and soft-tissue needs. Soft tissue alone may close the palate but risks globe and facial support failure.

## Case 7: salvage laryngectomy with narrow residual mucosa

After chemoradiation, a patient undergoes salvage laryngectomy and limited pharyngectomy. Primary closure is technically possible but would be narrow and under tension.

**ANSWER** This is not merely a buttress problem. Interpositional fasciocutaneous tissue can enlarge the circumference and import nonirradiated tissue into the suture line. If a true mucosal segment is absent, use a patch; if circumferential, use a tube or jejunum.

## Case 8: circumferential pharyngoesophageal defect

A patient undergoes total laryngopharyngectomy with a circumferential defect from tongue base to cervical esophagus above the thoracic inlet. Abdomen is unoperated; the thigh is thin.

**ANSWER** Tubed ALT, tubed RFFF, and free jejunum are all reasonable. Compare donor morbidity, conduit length, center experience, swallowing goals, and voice rehabilitation. State the distal level and ensure the chosen conduit reaches without tension.

## Case 9: irradiated scalp and calvarium

A patient has recurrent scalp cancer with a 16-cm irradiated scalp defect, exposed titanium mesh, and chronic drainage. Dura is intact.

**ANSWER** Remove infected/nonviable material and provide broad vascularized tissue. Latissimus or ALT are common free-flap choices. Immediate repeat cranioplasty may be inappropriate in a contaminated field; durable soft-tissue coverage can precede delayed rigid reconstruction.

## Case 10: temporal bone and carotid exposure

After subtotal temporal-bone resection, the defect includes external skin, a deep mastoid/infratemporal cavity, exposed dura, and a skeletonized petrous carotid. The patient previously received radiation.

**ANSWER** The dominant tasks are watertight skull-base separation, dead-space obliteration, carotid coverage, and external cover. A high-volume ALT, latissimus, or subscapular construct with an independent skin paddle is appropriate; a thin surface-only flap is inadequate.

CHAPTER A

# Defect-Specific Checklists

A one-page framework for preoperative conference, operating room, and oral boards

For oral boards, name the defect, then the function, then the tissue; justify each component and state a backup donor or regional option rather than naming a favorite flap.

## Oral cavity

*Table A1. Oral-cavity defect card.*

| Prompt | Document |
|---|---|
| Tongue | Oral versus base; percentage and shape; tip; contralateral mobility; hypoglossal/lingual nerve status. |
| Floor of mouth | Mylohyoid intact? Oral-neck communication? Sulcus depth? Genioglossus/geniohyoid attachments? |
| Mandible | Marginal or segmental; central/lateral/condyle; dentition; occlusion; plate/hardware. |
| Mucosal surfaces | Single, folded, or spatially independent? Total surface area? |
| External skin | Size, landmarks, commissure/lip/eyelid involvement. |
| Dominant functional goal | Mobility, volume, palatal contact, oral competence, mastication, airway protection. |

## Maxilla and midface

*Table A2. Maxillary defect card.*

| Prompt | Document |
|---|---|
| Brown class | Vertical class and horizontal letter; also describe features the classification misses. |
| Palate/dentition | Hard versus soft palate; premaxilla; remaining canines/teeth; obturator retention. |
| Orbit | Globe retained? Floor/rim/periorbita involved? Need rigid support? |
| Buttresses | Alveolar arch, zygoma, nasomaxillary, frontomaxillary support. |
| Compartments | Oral-nasal, orbit-sinus, skull-base communication. |
| Skin/volume | Facial skin, exenteration cavity, nasal lining, dead space. |

## Pharynx and skull base

*Table A3. Pharynx and skull-base defect card.*

| Prompt | Document |
|---|---|
| Pharyngeal circumference | Enough native mucosa for tension-free closure? Patch or tube? |
| Longitudinal extent | Tongue base, hypopharynx, cervical esophagus, thoracic inlet. |
| Field quality / critical layers | Primary versus salvage; radiation, infection, and nutrition; carotid, dura, hardware, barrier closure, dead space, contaminated cavity, and external cover. |

CHAPTER B

# Boards Review Tables

Classic comparisons that should remain connected to clinical reasoning

## Defect-to-flap shorthand

*Table B1. High-yield shorthand with the nuance that prevents rote errors.*

| Defect | Classic boards answer | Important nuance |
|---|---|---|
| Partial mobile tongue | RFFF or thin ALT | Preserve sulci and residual motion; primary closure may be better for small defects. |
| Subtotal/total tongue | Bulky ALT, musculocutaneous ALT, rectus/PAP | Shape and palatal contact matter more than donor name. |
| Long segmental mandible | Fibula | Soft-tissue complexity may favor subscapular or double-flap plan. |
| Complex maxilla/orbit | Scapular tip, fibula, DCIA with soft tissue | Classify orbit, palate, skin, and dental goals separately. |
| Circumferential pharynx | Tubed ALT/RFFF or free jejunum | Distal extent and center experience drive selection. |
| Large irradiated scalp/skull base | ALT or latissimus | Need for skin paddle, volume, and future cranioplasty changes choice. |
| Salvage laryngectomy | Vascularized nonirradiated tissue | Specify onlay versus interposition versus patch/tube. |

## Common failure modes

*Table B2. Functional failure despite flap survival.*

| Defect | Technically successful but functionally poor reconstruction |
|---|---|
| Partial tongue | Bulky flap immobilizes remaining tongue or obliterates lingual sulcus. |
| Total tongue | Flat flap cannot contact palate; central trough traps residue. |
| Anterior mandible | Continuity restored but chin retruded and tongue unsupported. |
| Maxilla with orbital floor loss | Palate closed but globe develops hypoglobus/diplopia. |
| Soft palate | Hole closed but velopharyngeal port remains incompetent or obstructed. |
| Pharynx | Flap survives but distal transition stenoses. |
| Cheek | Skin and mucosa closed but middle volume collapses and commissure descends. |
| Skull base | Skin heals while deep dead space, CSF pathway, or carotid exposure persists. |

CHAPTER C

# Last-Minute Boards Pearls

A rapid review before conference, call, or the in-service examination

- Describe the defect before naming the flap.
- Partial tongue: preserve motion. Total tongue: create bulk and palatal contact.
- Floor-of-mouth inset must preserve the lingual sulcus and avoid tongue-alveolus tethering.
- Anterior mandibular defects are disproportionately important because they control projection and tongue support.
- Jewer C = central including both canines; L = lateral excluding condyle; H = hemimandibular including condyle.
- Fibula is the long-bone workhorse; scapular system excels when soft-tissue components are complex and independent.
- Maxillary classification must be supplemented with orbit, skin, soft palate, skull base, and dentition.
- Obturators are excellent for selected limited defects; they are not an inferior historical option.
- Orbital floor/rim loss requires a support plan, not only palatal closure.
- Primary pharyngeal closure, patch, tube, onlay, and interposition are different constructs.
- Previously irradiated salvage laryngectomy is a classic setting for prophylactic vascularized tissue.
- Circumferential pharynx: tubed ALT/RFFF or free jejunum; consider distal extent and voice goals.
- Large scalp/skull-base defects require management of dead space, dura, vessels, hardware, and external cover.
- Local vascularized flaps remain first-line for most routine endoscopic skull-base defects; free tissue is for large or compromised cases.
- A living flap is not a substitute for missing cranial-nerve function; preserve native motor and sensory structures when oncologically safe.
- Plan for radiation-related contraction, denervation atrophy, dental access, and secondary revision.
- One flap is not mandatory. Two flaps can be simpler and safer for incompatible tissue geometries.

**FINAL MENTAL MODEL** Native function → dominant failure mode → tissue requirement → construct geometry → donor choice → backup. Reversing that order is the most common reasoning error.

CHAPTER D

# References and Figure Credits

Core reviews, classification systems, outcome studies, and open-access teaching figures

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