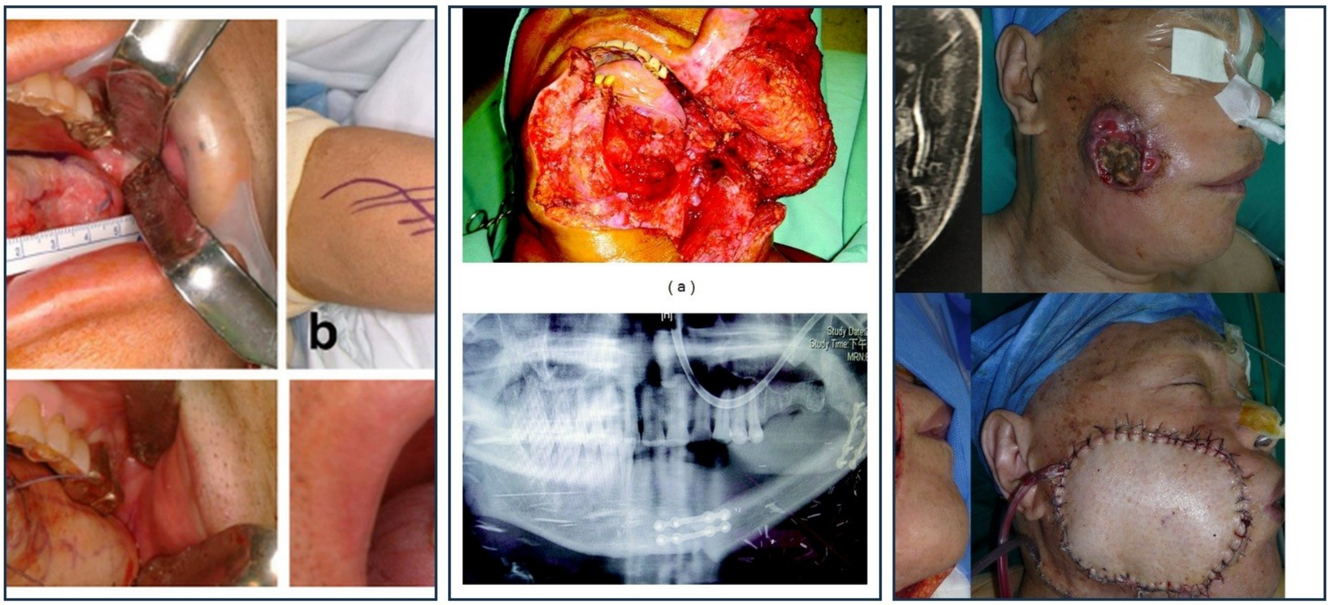
FREE-FLAP RECONSTRUCTION FOR HEAD AND NECK CANCER

VOLUME I

Reconstructive Thinking

From oncologic defect to a defensible reconstructive plan



Cover montage. *Representative tongue, mandibular, and through-and-through composite reconstructions. Open-access images adapted from Kim et al., Zhang et al., and Wang et al.; full credits in Appendix D.*

A first-principles guide for otolaryngology residents

Resident study guide • July 2026

CHAPTER 0

Orientation

How this volume is organized, what it teaches, and how to reason through the defect before naming a flap

THE CENTRAL QUESTION

What tissue is missing, what function must be preserved, and what is the simplest reliable construct that will still work after healing, atrophy, scar, and adjuvant therapy?

Free-flap reconstruction is often taught as a list of donor sites: radial forearm for thin lining, anterolateral thigh for soft-tissue volume, fibula for bone, scapula for complex composite tissue, and jejunum for a circumferential conduit. Those associations are useful, but they are not a reconstructive method. A resident who starts with the flap tends to force the defect into a familiar solution. A resident who starts with the defect can explain why a particular construct is appropriate, identify when it will fail functionally, and generate a backup plan.

This volume therefore follows the reasoning sequence used in actual head and neck oncologic reconstruction. It begins with the goals of reconstruction, then examines the patient and the ablative plan, builds a systematic defect audit, translates that audit into tissue requirements, reviews the physiology that makes free tissue transfer possible, and finally applies the framework to the common defect families encountered on service and on boards. Detailed donor anatomy and harvest technique are intentionally reserved for Volume II.

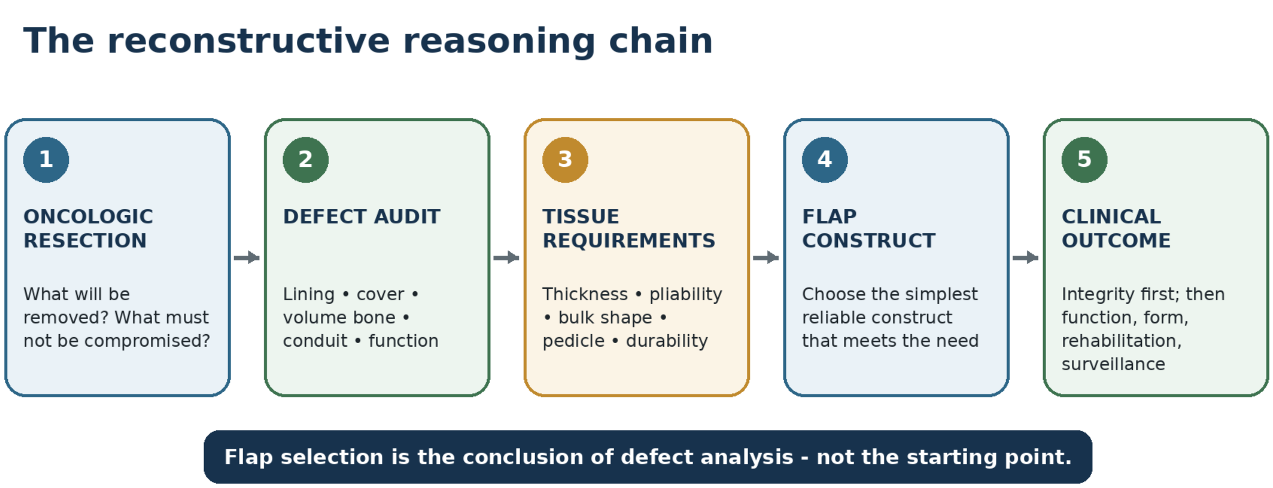


Figure 1. The reconstructive reasoning chain. The flap is selected only after the oncologic resection and resulting tissue requirements are understood. Original schematic created for this guide.

Learning objectives

After working through Volume I, the resident should be able to:

1. Describe a head and neck defect in terms of lining, external cover, volume, structural support, conduit or barrier requirements, and dynamic function.

2. Distinguish immediate priorities - wound integrity, compartment separation, vessel protection, and durable closure - from longer-term goals such as speech, swallowing, mastication, dental rehabilitation, and facial form.
3. Explain why the same named ablation can create very different reconstructive problems.
4. Match tissue characteristics rather than flap names to the defect, including thickness, pliability, bulk, bone geometry, pedicle requirements, and donor-site cost.
5. Explain the basic hemodynamics of a free flap and recognize the bedside pattern of arterial insufficiency versus venous congestion.
6. Generate a primary plan and a credible backup plan for common oral cavity, mandibular, maxillary, pharyngeal, cutaneous, and skull-base defects.
7. Answer boards-style questions that test classic workhorse flap characteristics without losing the more important defect-first framework.

Scope of the five-volume series

Table 1. *Architecture of the complete study-guide series.*

Volume	Core question	Major content
I. Reconstructive Thinking	What does the defect require?	Goals, patient selection, defect audit, tissue matching, physiology, master algorithms.
II. The Free-Flap Toolkit	What tissue can each donor site provide?	Anatomy, harvest concepts, pedicles, skin paddles, bone, donor morbidity, workhorse and rescue flaps.
III. Reconstruction by Defect	How is the flap shaped and inset for a specific resection?	Oral cavity, mandible, maxilla, pharynx, skin, scalp, skull base, vessel-depleted neck.
IV. Building the Reconstruction	How does the operation work?	Two-team workflow, recipient vessels, microvascular concepts, inset, perioperative execution.
V. The Postoperative Flap	How is the result protected and salvaged?	Monitoring, vascular compromise, fistula, wound complications, salvage, rehabilitation.

Contents of Volume I

Table 2. *Road map for Volume I.*

Chapter	Theme
1	Reconstruction begins with the defect
2	The patient and the oncologic plan
3	The six-domain defect audit
4	Tissue matching from first principles
5	Free-flap physiology
6	The reconstructive toolbox

Chapter	Theme
7	Functional subunits and recurring defect logic
8	Master algorithm and clinical cases
9	Resident workflow and boards review
Appendices	Defect card, preoperative checklist, glossary, references, and figure credits

HOW TO STUDY THIS VOLUME

On the first pass, follow the prose and figures. On the second pass, cover the decision tables and try to reconstruct them from memory. On the third pass, work through the cases without reading the answers. The goal is not to memorize every possible flap; it is to make your reasoning explicit enough that another surgeon can challenge or defend it.

CHAPTER 1

Reconstruction Begins with the Defect

Why flap survival is necessary but insufficient, and why integrity, function, and form must be considered in that order

OPENING CASE

A 61-year-old patient has a lateral oral tongue squamous cell carcinoma extending into the floor of mouth and mandibular body, with involved overlying cheek skin. The planned resection includes partial glossectomy, floor-of-mouth resection, segmental mandibulectomy, and a through-and-through cheek defect. Asking “Which flap is used for a mandibulectomy?” misses most of the problem.

The named ablative procedure is only a starting label. The true defect contains several independent tasks: restore mandibular continuity and contour; replace oral lining without tethering the residual tongue; supply enough volume to fill the floor of mouth; replace external skin; separate saliva from the neck; cover hardware and cervical vessels; and provide a pedicle that reaches healthy recipient vessels without compression. Depending on how these components are distributed, a single osteocutaneous flap may be adequate, a chimeric design may be preferable, or two tissue transfers may be required. The operative name does not tell you which of those statements is true.

Reconstruction is part of oncologic treatment

Head and neck reconstruction is not cosmetic closure after the “real” cancer operation. It is what allows the ablative surgeon to resect the disease with appropriate margins while preserving a route to speech, swallowing, alimentation, airway safety, and adjuvant therapy. Modern free tissue transfer expanded the range of defects that can be reconstructed reliably, but the reconstructive plan must remain subordinate to oncologic clearance. Useful vessels, nerves, mucosa, and bone should be preserved only when doing so is oncologically safe. The flap must adapt to the resection; the resection must not be compromised to simplify the flap.[1-3]

The best plan is therefore built jointly. The ablative surgeon communicates the anticipated margins, likely structures sacrificed, possible extension of resection, neck dissection, tracheostomy plan, and expected recipient vessels. The reconstructive surgeon converts that forecast into tissue requirements and prepares contingencies. After the specimen is removed, the team reassesses the actual defect because frozen sections, unexpected bone involvement, vessel sacrifice, or an altered external skin resection can change the plan materially.

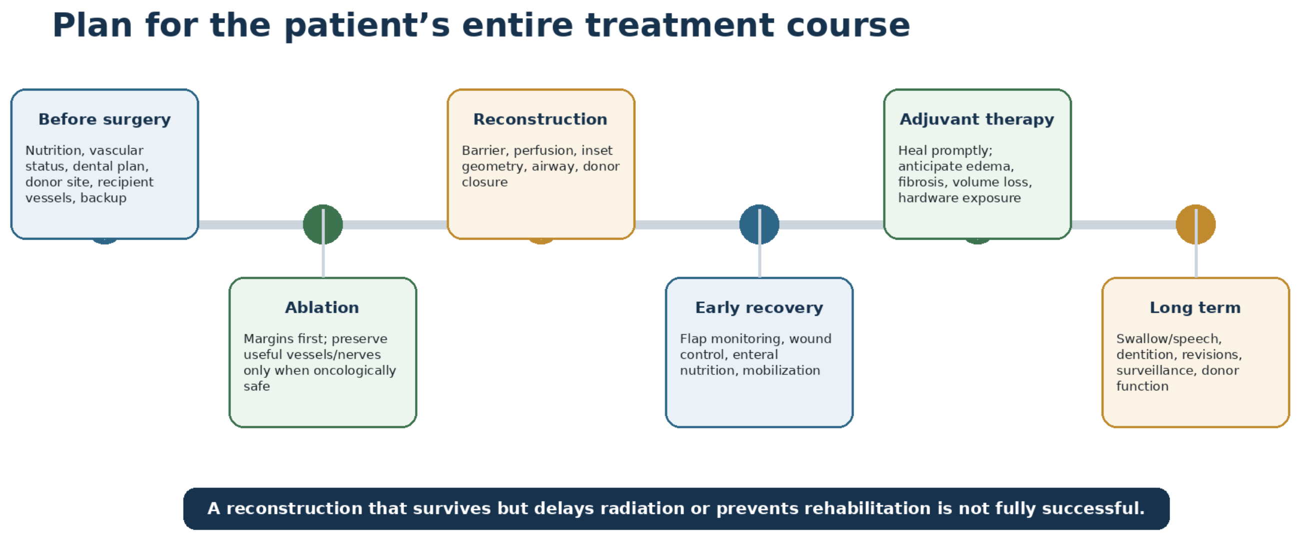


Figure 2. *The reconstruction should be designed for the entire oncologic course, not merely for skin closure at the end of the operation. Original schematic created for this guide.*

Three dimensions of success: integrity, function, and form

A useful hierarchy is integrity first, function second, and form third. The hierarchy does not imply that appearance is unimportant. It means that a reconstruction that looks excellent but leaks saliva onto the carotid artery is a failure, and a viable flap that seals the wound but prevents the residual tongue from moving is also incomplete.

Integrity

Integrity means durable separation of spaces, coverage of vulnerable structures, elimination of clinically important dead space, and creation of a wound that can heal through contamination and subsequent radiation. In the acute setting, the reconstruction may need to separate the oral cavity or pharynx from the neck, the sinonasal tract from the intracranial space, or the external skin from exposed hardware and great vessels. The tissue should be vascularized, placed without excessive tension, and oriented so that the pedicle is protected from saliva, compression, and sharp turns.

Function

Function is usually generated by the interaction between the reconstruction and the remaining native anatomy. A fasciocutaneous flap in a partial tongue defect is not a contractile tongue. It succeeds when it provides a thin, stable, non-tethering surface that permits residual tongue excursion. A bulky flap after subtotal glossectomy succeeds when it provides palatal contact and channels a bolus even if it has little intrinsic motion. A reconstructed mandibular arch succeeds when it restores continuity, lower facial projection, soft-tissue support, and a platform for dental rehabilitation. The functional target changes with the defect.

Form

Form matters because facial width, chin projection, midfacial buttresses, orbital position, lip support, and cervical contour affect both appearance and function. Loss of mandibular projection alters oral competence and tongue position. Loss of orbital support causes globe malposition and diplopia. Excessive soft-tissue bulk can obscure a sulcus or limit motion; inadequate bulk can produce contour collapse and expose hardware. Form is therefore not merely aesthetic. It is geometry in service of function.

Table 3. *Integrity, function, and form as linked reconstructive endpoints.*

Goal	Immediate question	Long-term question
Integrity	Are contaminated compartments separated? Are carotid, dura, bone, and hardware covered?	Will closure remain durable through edema, contraction, atrophy, and radiotherapy?
Function	Can the patient protect the airway and begin a path toward speech and swallowing?	Will residual tongue, palate, pharynx, lips, jaw, and dentition work together?
Form	Are skeletal continuity and major soft-tissue contours restored?	Will facial projection, orbital position, oral competence, and donor-site function remain acceptable?

Think in barriers, platforms, and scaffolds

Many apparently different reconstructions become easier to understand when reduced to three roles. A barrier separates spaces: oral cavity from neck, nose from brain, pharynx from carotid. A platform allows remaining anatomy to work: a thin tongue flap permits mobility; a bulky neotongue reaches the palate; a palatal reconstruction supports speech and swallowing. A scaffold restores structural geometry: vascularized bone re-establishes mandibular continuity, orbital support, or the maxillary arch. A single flap may serve all three roles, but the resident should name each role separately.

BOARDS PEARL

"Flap survival" is not synonymous with "reconstructive success." Boards questions often ask which flap best restores a specific function. Identify the missing tissue and functional target before choosing the donor site.

What free tissue transfer actually buys

A free flap transfers tissue with its own arterial inflow and venous outflow, which are re-established in the recipient site by microvascular anastomosis. This independence permits tissue to be chosen for its properties rather than its geographic proximity. The surgeon can bring thin skin, bulky soft tissue, vascularized bone, muscle, fascia, or intestine into an irradiated or contaminated field and tailor it to a complex three-dimensional defect. The tradeoff is a longer, more complex operation with a second operative site, microvascular risk, donor morbidity, and the need for coordinated postoperative monitoring.

Free tissue transfer is not automatically superior to every local or regional option. A small, well-vascularized mucosal defect may heal by primary closure or secondary intention. A pectoralis major flap may be the most reliable rescue when the neck is infected and the patient cannot tolerate a prolonged operation. A prosthetic obturator may provide excellent function for a selected limited maxillectomy. The correct question is not “Can a free flap be done?” but “What option most reliably accomplishes the full set of goals for this patient?”

COMMON ERROR

Equating technical sophistication with better care. A reconstruction is appropriately complex only when the added complexity buys a meaningful improvement in integrity, function, form, total morbidity, or reliability.

CHAPTER 2

The Patient and the Oncologic Plan

How host physiology, prior treatment, donor anatomy, rehabilitation goals, and the anticipated resection modify the ideal flap

Defect matching identifies what tissue would be ideal in a vacuum. The patient determines what is safe, what is available, and what outcome matters. Two patients with the same defect may reasonably receive different reconstructions because one has severe peripheral arterial disease, another has a previously operated thigh, another requires rapid recovery for adjuvant therapy, and another prioritizes dental rehabilitation. Patient selection is not a binary determination of “free-flap candidate” versus “not a candidate.” It is an effort to choose the reconstructive strategy with the best total risk-benefit profile.

Start with the anticipated ablation

Before entering the operating room, the resident should be able to state the likely mucosal, soft-tissue, skeletal, cutaneous, neural, and vascular components of the resection. Review the examination, cross-sectional imaging, dental status, and the ablative surgeon’s plan. Ask where the tumor crosses subunits, whether the mandible is undergoing marginal or segmental resection, whether the orbital floor or contents are involved, whether the pharyngeal defect will be partial or circumferential, and whether external skin is likely to be sacrificed. These details change the reconstruction more than the T category alone.

The predicted defect should be described as a range. For example: “At minimum, a 6-by-4-cm lateral tongue and floor-of-mouth lining defect; if mandibular marrow or cheek skin margins are positive, possible segmental bone and through-and-through skin components.” This statement naturally generates a primary flap and a contingency. It is more useful than a single fixed plan that assumes the resection will not change.

Physiologic reserve and frailty

Chronologic age alone is not a contraindication to microvascular reconstruction. Contemporary series demonstrate high flap success in carefully selected older adults, although medical complications increase with frailty, comorbidity, and operative stress.[4,5] The relevant questions are whether the patient can tolerate a prolonged operation, fluid shifts, blood loss, airway management, immobilization, and rehabilitation; whether the donor site will preserve mobility; and whether the expected oncologic and functional benefit justifies the burden.

A frail patient may still benefit from a free flap if it offers the fastest route to a durable wound and oral alimentation. Conversely, an anatomically elegant reconstruction may be inappropriate when the procedure would impose disproportionate physiologic risk or delay palliative treatment. These decisions should incorporate patient goals, prognosis, anticipated adjuvant therapy, and realistic postoperative support.

Table 4. *Host factors that matter because they change the operation or recovery.*

Domain	Questions that change the reconstructive plan	Why it matters
Cardiopulmonary reserve	Heart failure, coronary disease, pulmonary disease, exercise tolerance, prior anesthetic problems?	Operative duration, fluid strategy, airway course, ICU needs, and suitability for simultaneous harvest.
Frailty and mobility	Baseline gait, falls, assistive devices, dominant upper extremity, occupation?	Lower-extremity and forearm donor morbidity may be more consequential than flap survival.
Nutrition and anemia	Weight loss, sarcopenia, albumin context, enteral access, hemoglobin?	Wound healing, infection, rehabilitation, and ability to tolerate adjuvant therapy.
Metabolic risk	Diabetes control, renal disease, vascular disease, thrombosis history?	Microvascular and systemic complication risk; donor-site selection and monitoring.
Substance exposure	Current tobacco or nicotine, alcohol dependence, other substances?	Wound healing, pulmonary risk, withdrawal, adherence, and long-term cancer outcomes.
Cognition and support	Delirium risk, health literacy, caregiver support, travel distance?	Tracheostomy care, feeding, donor-site restrictions, rehabilitation, and follow-up.

Nutrition, swallowing, and the airway

Many patients begin treatment with dysphagia, odynophagia, weight loss, sarcopenia, or aspiration. Reconstruction should be planned alongside the nutritional route. A nasogastric tube may be adequate for a limited oral cavity defect; a gastrostomy may be reasonable when prolonged dysphagia is expected, although institutional practice varies. The airway plan should account for tumor obstruction, resection extent, flap bulk, anticipated edema, prior radiation, and the ability to access the oral cavity for monitoring. A tracheostomy is not mandated by the presence of a free flap, but extensive tongue, floor-of-mouth, or pharyngeal reconstruction often lowers the threshold.

Prior surgery and radiation

Prior neck dissection and radiation alter both the wound bed and the recipient-vessel map. Fibrosis reduces tissue mobility, makes dissection more difficult, and may obscure or shorten useful vessels. Radiation produces long-term changes in soft tissue and vessels and increases the risk of wound complications, fistula, and hardware exposure even when flap survival remains high.[6-8] Previously treated tissue often benefits from replacement or reinforcement with well-vascularized, nonirradiated tissue.

Do not reduce the vessel-depleted neck to “no facial artery.” Review previous operative notes, radiation fields, imaging, and scars. Determine which external carotid branches and jugular systems remain, whether the contralateral neck is available, and whether transverse cervical, thoracoacromial, internal mammary, or other recipient options may be needed. The pedicle length and route become part of flap selection. Vein grafts and arteriovenous loops can solve reach problems but add anastomoses and potential failure points; a flap with a longer pedicle or a different recipient basin may be preferable.

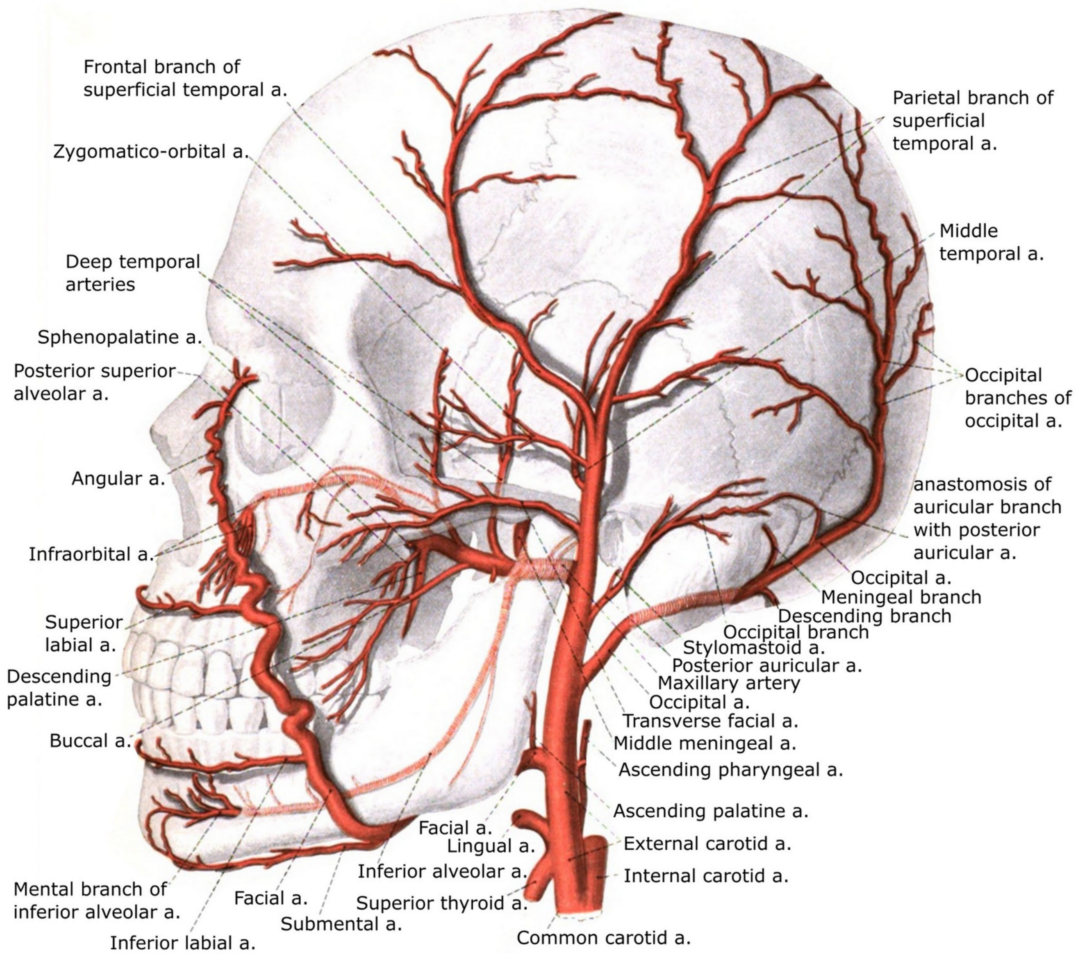


Figure 3. *Major branches of the external carotid artery. Common recipient arteries in the neck include the facial, superior thyroid, and lingual arteries; actual choice depends on the defect, pedicle geometry, vessel quality, and previous treatment. Public-domain anatomical plate adapted from Sobotta/Wikimedia Commons.*

Donor-site evaluation is part of patient selection

A donor site is not “available” merely because the tissue exists. Examine scars, vascular status, body habitus, prior trauma, range of motion, gait, and occupational demands. A thin patient may have an ideal ALT flap; an obese patient may have a flap too thick for a mobile tongue defect unless thinning is appropriate. A patient with peripheral arterial disease or abnormal lower-extremity anatomy may not be a fibula candidate. A patient who depends on a walker may experience meaningful morbidity from forearm or lower-extremity harvest. The chosen donor site must supply the needed tissue without creating a second disability.

RESIDENT PREOPERATIVE TASK

Document pulses and scars at the contemplated donor site, identify dominant hand and baseline mobility, review available vascular imaging, and know the backup donor site before the incision. “The attending checked it” is not a reconstructive assessment.

Dental rehabilitation and life after radiation

In mandibular and maxillary reconstruction, the desired endpoint may include implant-supported dentition, not simply bony continuity. The location, height, width, and orientation of vascularized bone, the relationship to the native occlusal plane, and the future radiation field all influence dental rehabilitation. Virtual surgical planning can improve the transfer of planned osteotomies and occlusion, but it does not replace intraoperative judgment when margins change. A patient who is unlikely to pursue implants may reasonably prioritize soft-tissue reliability and contour; another patient may accept a more complex osseous reconstruction to preserve an implant pathway.

Adjuvant therapy should be treated as part of the reconstructive environment. The wound must heal promptly enough to avoid unnecessary delay. Anticipate flap edema followed by remodeling, muscle atrophy, skin-paddle contraction, fibrosis, and volume loss. Hardware and bone require durable vascularized coverage. A flap that appears bulky on postoperative day 1 may be correctly overbuilt for its long-term task, particularly in subtotal or total tongue reconstruction, but excess bulk in a partial tongue defect can permanently impair mobility.

BOARDS PEARL

Age alone is not a contraindication to free tissue transfer. Boards questions are more likely to hinge on physiologic reserve, vascular disease, donor-site anatomy, prior radiation, and the functional consequence of donor morbidity.

Plan A, Plan B, and the conversion point

Every major reconstruction should have a primary plan, a backup donor site, alternative recipient vessels, and a defined point at which the team will convert. Examples include an inadequate ALT perforator, an abnormal fibular vascular study, a larger-than-expected skin defect, or recipient vessels that are unusable after neck dissection. A backup plan is credible only if the patient is positioned and prepared so it can actually be executed. For a fibula case, that may mean preparing another donor site or understanding whether the scapular system can be harvested without major repositioning. For a vessel-depleted neck, it means planning pedicle length and recipient options before ischemia begins.

CHAPTER 3

The Six-Domain Defect Audit

A reproducible way to describe complex defects before choosing a donor site

The defect audit prevents two common errors: overlooking a missing component and treating all tissue requirements as if they were equivalent. A useful audit asks six questions about lining, external cover, volume, structure, conduit or barrier function, and dynamic function. It then adds geometry, residual native tissue, contamination, pedicle route, and recipient vessels. The result should be a short reconstructive sentence that another surgeon can understand without seeing the wound.

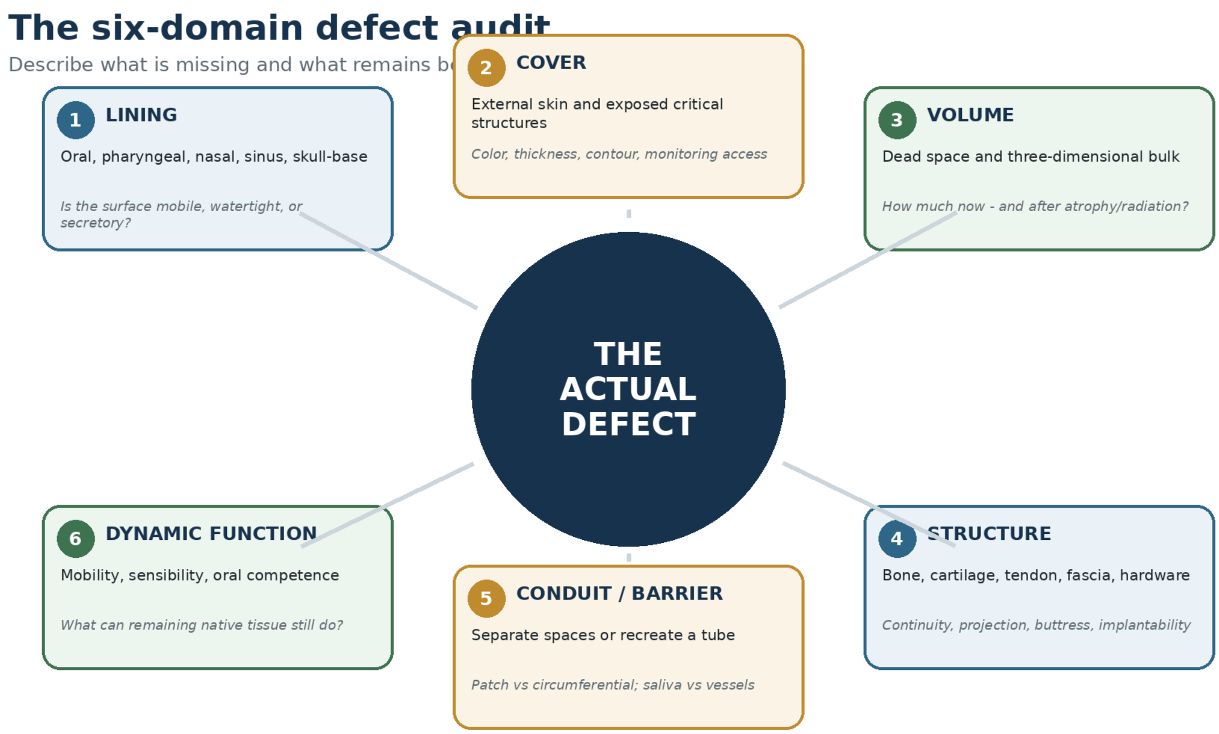


Figure 4. *The six-domain defect audit. Each domain asks what is missing, what remains, and what the replacement tissue must do. Original schematic created for this guide.*

Domain 1: lining

Lining is the internal surface of the oral cavity, pharynx, nasal cavity, sinus, or skull base. The required properties differ by location. Oral tongue lining should often be thin and pliable so residual muscle can move it. Buccal or floor-of-mouth lining should preserve the sulcus and avoid tethering. Pharyngeal lining must tolerate saliva and repeated bolus passage, and a circumferential defect must form a durable tube. Sinonasal and skull-base lining may need to create a watertight separation from the intracranial space.

Surface area alone is insufficient. Ask whether the lining must fold, whether it will be sutured to mucosa or skin, whether two epithelial surfaces are needed, and whether the flap will create a blind pocket. A single skin paddle can sometimes be folded for an intraoral and external surface, but the intervening bridge may be compressed or poorly positioned. Independent paddles based on separate perforators or branches may offer more freedom.

Domain 2: external cover

External cover replaces visible skin or covers a wound that cannot be closed safely. It must match the defect in area and thickness, permit tension-free closure, and preserve facial landmarks such as the oral commissure, eyelids, nasal base, or cervicomental angle. The skin paddle may also serve as a monitoring window. Hair-bearing skin, color mismatch, thickness, and future contraction matter, but durability and protection of underlying structures come first.

When external skin and internal lining are both absent, describe the defect as through-and-through. Do not assume one folded paddle is automatically sufficient. The distance between the two surfaces, intervening volume, required orientation, and pedicle path determine whether a folded, bilobed, chimeric, or double-flap solution is more reliable.

Figure 5. *A through-and-through cheek defect reconstructed with a perforator-based ALT flap. The case illustrates why "skin defect" is incomplete: external cover, internal lining, intermediate volume, and contour all require reconstruction. Wang et al., Scientific Reports 2020; CC BY 4.0. Image cropped from the open-access article.*

Domain 3: volume and dead space

Volume is three-dimensional, not merely the area of the skin paddle. It may be needed to recreate tongue bulk, restore facial contour, fill a maxillectomy cavity, obliterate a skull-base or parapharyngeal dead space, cushion hardware, or separate a vessel from saliva. The resident should estimate where bulk is needed and where it would be harmful. A flap can be too thin for the central tongue yet too thick along the gingivobuccal sulcus.

Dead space becomes clinically important when it can collect saliva, blood, or infected fluid; when it leaves exposed bone or hardware; or when it permits a skin paddle to sag away from the functional surface. Muscle can provide vascularized bulk and then atrophy, which may be desirable for obliteration but undesirable when permanent volume is required. Adipofascial and fasciocutaneous components maintain volume differently. Plan for the late result, not only the immediate inset.

Domain 4: structure

Structural loss may involve bone, cartilage, fascia, tendon, or the need to support hardware. Vascularized bone is indicated when durable skeletal continuity, height, projection, load-bearing, or implantability is required in a compromised field. The geometry of the missing bone matters as much as length. The fibula provides long, segmentable cortical bone; the scapular system offers flexible soft-tissue components and different bone shapes; the iliac crest offers height and a natural contour for selected mandibular or maxillary defects. These are not interchangeable simply because all contain bone.

Determine whether the defect includes the mandibular symphysis, lateral body, angle, ramus, condyle, orbital floor, maxillary alveolus, or key facial buttresses. An anterior mandibular defect threatens tongue support and lower facial projection more than a small posterior segment. A maxillary defect involving the orbital floor requires support of the globe in addition to oronasal separation. Structural analysis converts "bone needed" into a specific engineering problem.

Domain 5: conduit or barrier

A partial pharyngeal defect can often be reconstructed as a patch; a circumferential defect requires a tube. A patch must be wide enough to avoid narrowing but not so redundant that it creates a pouch. A tube must maintain lumen diameter, avoid a tight distal anastomosis, and permit a pedicle route without twisting. The same logic applies to the oral-nasal and sinonasal-intracranial barriers: the reconstruction must separate spaces throughout the expected pressure and contamination environment.

Barrier failure can be catastrophic when saliva reaches the carotid artery, hardware, mediastinum, or intracranial space. In previously irradiated salvage laryngectomy, vascularized tissue may be used to reinforce or replace pharyngeal closure even when primary closure is technically possible. The exact role - onlay reinforcement, interposition, patch, or tube - should be named rather than described generically as "a flap."

Domain 6: dynamic function

Most transferred tissue is static. Dynamic function therefore depends on what native motor and sensory structures remain and whether the reconstruction permits them to act. After partial glossectomy, preserve residual tongue mobility by avoiding excessive bulk and tethering. After subtotal glossectomy, create a stable mound that contacts the palate and directs the bolus. In facial defects, restore oral competence with structural support or fascial suspension when necessary. Sensate or motor-innervated flaps may offer theoretical or selected clinical advantages, but they do not compensate for poor geometry.

The audit should explicitly state what residual tissue remains. “Half the mobile tongue remains with an intact contralateral hypoglossal nerve” is more informative than “hemiglossectomy.” “Orbital contents preserved with loss of the floor and rim” differs fundamentally from orbital exenteration. Reconstruction is often the art of enabling remaining native tissue, not replacing everything that was removed.

Table 5. *The six domains translated into reconstructive consequences.*

Domain	Describe	Common reconstructive consequence
Lining	Surface, mobility, contamination, number of epithelial surfaces, patch versus tube	Thin pliable skin, folded or multiple paddles, watertight mucosal closure.
External cover	Skin area, landmark involvement, contour, monitoring need	Skin paddle design, color/thickness tradeoffs, independent external component.
Volume	Where bulk is required; dead space; expected atrophy	Adipofascial or muscle component, intentional overcorrection, chimeric design.
Structure	Bone/cartilage/fascia lost; geometry; load; implants	Osteocutaneous flap, osteotomies, hardware, fascial sling.
Conduit/barrier	Spaces to separate; lumen length and circumference	Patch, tube, onlay reinforcement, multilayer closure.
Dynamic function	Residual motor/sensory anatomy and required movement	Avoid tethering, restore palatal contact, consider nerve coaptation or suspension.

Add geometry, pedicle route, and contamination

After the six domains, add three modifiers. First, geometry: measure the defect in three dimensions, note the distance between surfaces, and anticipate how the flap will fold. Second, pedicle route: identify where the pedicle exits the inset, whether it crosses bone or hardware, and whether the neck position will kink it. Third, contamination: determine whether saliva, sinus flora, infected tissue, osteoradionecrosis, or an open tracheal stoma increases the need for robust vascularized coverage.

Pedicle geometry is part of the defect. A flap with excellent tissue characteristics may be wrong if its pedicle is too short, exits on the wrong side, or must make a sharp turn beneath the mandible. Likewise, recipient-vessel availability can transform a simple defect into a complex reconstruction. Flap design should place the pedicle in a broad, smooth, protected path before any sutures make that route irreversible.

Write the reconstructive sentence

DEFECT STATEMENT TEMPLATE

"This is a [location] defect requiring [lining/cover], [volume], and [structure], with a need to [separate spaces/recreate conduit/protect structure]. Residual [native tissue] remains functional. The pedicle must reach [recipient basin] through [route], in a [primary/irradiated/contaminated] field."

For the opening case, a useful statement is: "This is a right composite oromandibular and through-and-through cheek defect requiring vascularized mandibular bone, thin oral lining, external skin, and intermediate soft-tissue volume. The reconstruction must preserve residual tongue mobility, restore lower facial contour, separate saliva from the neck, and cover hardware. The pedicle must reach ipsilateral or contralateral neck vessels without crossing a sharp mandibular edge." Once stated this way, flap selection becomes a constrained problem rather than a memory test.

BOARDS PEARL

The distinction most often tested is not "which flap is popular?" but "what is the dominant tissue requirement?" Thin mobile lining favors a fasciocutaneous flap; substantial soft-tissue volume favors a bulkier flap; segmental mandibular continuity requires vascularized bone in most definitive oncologic reconstructions; circumferential pharyngeal loss requires a conduit.

CHAPTER 4

Tissue Matching from First Principles

How thickness, pliability, volume, skeletal geometry, pedicle design, and donor morbidity determine the construct

Once the defect has been audited, the next step is not yet to name a flap. Translate each missing component into a tissue property. The oral lining may require a thin, compliant skin paddle; the central neotongue may require persistent bulk; an exposed carotid may require robust vascularized soft tissue; a mandibular defect may require long bone that tolerates multiple osteotomies; a maxillary defect may require bone oriented to support the orbit and alveolus. Only after this translation should donor sites be compared.

Skin and fascia: surface without unnecessary mass

Fasciocutaneous tissue is useful when the central problem is surface replacement. Skin provides durable lining or cover; fascia can reinforce closure, suspend tissue, or provide a thin vascularized layer. The radial forearm flap is classically thin, pliable, and supplied by a long, reliable pedicle. The ALT can also provide skin and fascia, but its thickness varies substantially with body habitus and perforator anatomy. A thin flap that permits residual motion is often preferable for partial tongue and floor-of-mouth defects, whereas a larger tongue defect may need more bulk than a thin forearm flap naturally provides.

Pliability is not identical to thinness. A flap must bend and drape into the defect without creating tension at the mucosal suture line or compressing its own perforators. The subcutaneous layer can sometimes be customized, and some flaps can be thinned, but aggressive thinning may compromise perfusion if performed without respect for the perforator network. Design the flap around the required three-dimensional shape rather than trimming blindly after harvest.

Adipose and muscle: volume, separation, and dead-space control

Adipose tissue supplies soft, conformable volume that may be useful for facial contour, tongue bulk, and cavity obliteration. Muscle supplies highly vascular tissue and can fill irregular spaces, cover infected or irradiated structures, and reinforce a contaminated wound. Muscle also undergoes denervation atrophy, which can be advantageous when temporary bulk is needed but problematic when permanent projection or palatal contact is the goal. A myocutaneous or chimeric flap permits skin and muscle to be positioned somewhat independently.

The resident should ask whether the needed bulk is functional or disposable. Functional bulk must remain in a precise position: a neotongue mound should reach the palate and avoid a central trough. Disposable bulk simply obliterates dead space and may be allowed to atrophy. Confusing the two can produce either a late volume deficit or an unnecessarily obstructive reconstruction.

Vascularized bone: geometry, biology, and future dentition

Vascularized bone offers living tissue capable of healing osteotomies and integrating in an irradiated or contaminated field. The ideal osseous donor depends on defect length, required height and width, number and orientation of osteotomies, soft-tissue requirements, pedicle geometry, and dental plans. The fibula provides long, straight, segmentable bone and a skin paddle; the scapular system offers versatile composite tissue and bone shapes; the deep circumflex iliac artery flap provides substantial height and a contour useful in selected mandibular and maxillary defects. Osteocutaneous radial forearm bone is limited and carries fracture-related concerns, so it is reserved for selected defects.

Bone must be placed to restore more than continuity. In the mandible, the reconstruction should restore the arch, chin projection, lower facial width, and a stable relationship to the maxilla. In the maxilla, bony reconstruction may need to recreate the alveolar arch, orbital floor, zygomatic projection, and facial buttresses. A technically patent bone flap can still produce malocclusion, facial asymmetry, or an unusable implant position if geometry is neglected.

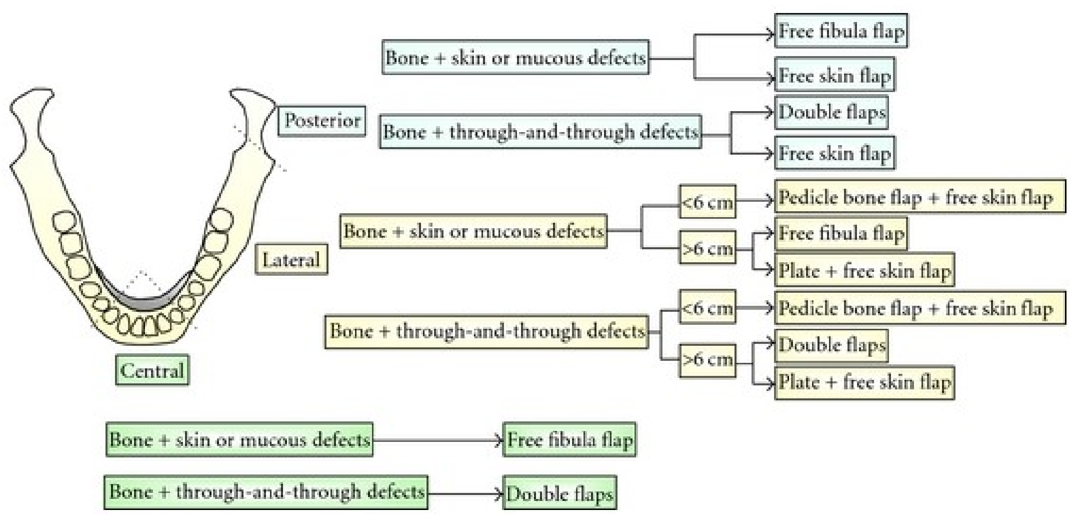


Figure 6. *Mandibular defects are commonly described by their relationship to the central segment and lateral or posterior components. Loss of the anterior arch has disproportionate effects on tongue support, projection, and oral competence. Adapted from Zhang et al., ISRN Surgery 2011; open-access article.*

Pedicle length, caliber, and orientation

Pedicle characteristics are functional properties of the flap. A long pedicle may avoid vein grafting or permit use of contralateral vessels. Adequate vessel caliber simplifies anastomosis and reduces mismatch. The point at which the pedicle enters the flap determines how the skin paddle can be inset. A flap may have ample nominal pedicle length yet lose reach after the tissue is folded or after the pedicle is routed around the mandible.

Design backward from the recipient vessels. Mark the side on which the pedicle should exit, estimate the distance in the final neck position, and leave enough freedom for a gentle curve. Do not allow the pedicle to lie beneath a reconstruction plate edge, cross a drain, or be compressed by a tight tunnel. In double-flap or chimeric reconstructions, confirm that movement of one component does not torque the shared source vessel.

One flap, chimeric flap, flow-through flap, or two flaps

A single flap is attractive because it requires one donor site and one set of microvascular anastomoses. It is appropriate when the components can be arranged without compromising perfusion or geometry. A chimeric flap contains separate tissue components supplied by branches of a common source vessel, allowing independent positioning while retaining one main pedicle. The subscapular system and selected ALT or fibula designs are particularly useful for this purpose. A flow-through flap can provide a distal recipient circuit for a second flap, although this increases complexity and demands careful hemodynamic planning.

Two free flaps may be justified when one flap cannot simultaneously provide the required bone, internal lining, external cover, and volume without major compromise. Examples include massive through-and-through oromandibular defects. The price is additional donor morbidity, ischemia management, and anastomoses. The decision should be driven by the independent spatial requirements, not by a desire to use a more elaborate technique.

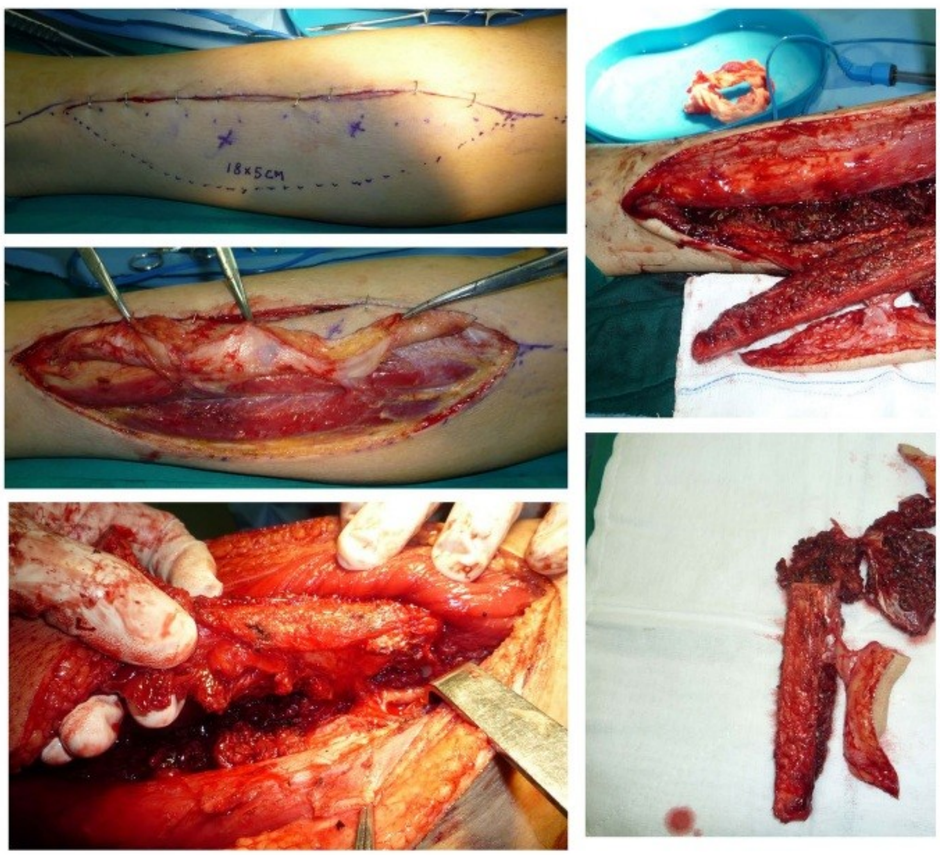


Figure 7. *A chimeric fibula construct can provide vascularized bone and multiple independently positioned soft-tissue components. This approach is useful when tissue components are separated in space but share a source pedicle. Wang et al., Scientific Reports 2020; CC BY 4.0. Image cropped from the open-access article.*

Sensation and motor reinnervation

Sensory nerve coaptation can be performed in selected fasciocutaneous flaps, commonly by connecting a donor cutaneous nerve to the lingual or another recipient sensory nerve. Some studies demonstrate improved sensory testing, but the functional benefit for speech and swallowing is variable and depends on defect size, rehabilitation, and residual anatomy. Motor-innervated muscle transfer is conceptually attractive for tongue or facial function, but it is not a substitute for appropriate bulk, shape, and fixation.

For boards, know that the lateral antebrachial cutaneous nerve can accompany the radial forearm flap and that the lateral femoral cutaneous nerve may be used with an ALT flap. In practice, nerve selection and expected benefit are individualized. A sensate flap that is too bulky or tethered will function poorly despite successful nerve coaptation.

Anticipate change over time

Flaps are not inert prostheses. Early edema subsides. Denervated muscle atrophies. Fat and skin may remodel. Radiation can cause fibrosis, contraction, edema, and later volume loss. A thin flap may become thinner; a bulky flap may lose projection; a skin paddle may contract and narrow a pharyngeal lumen or tether the tongue. Reconstruction should include a prediction of the late tissue state.

Intentional overcorrection is most defensible when the reconstruction requires long-term volume, such as subtotal or total tongue replacement. It is dangerous when mobility is the primary goal, such as a smaller partial glossectomy. There is no universal percentage of overcorrection. The amount depends on the tissue composition, anticipated radiation, defect, and institutional experience.

Table 6. *Tissue matching: the property is primary; the named donor site is secondary.*

Required property	Flap characteristics that help	Potential mismatch
Thin, mobile lining	Pliable fasciocutaneous tissue; long pedicle; reliable skin paddle	Excess adipose or muscle restricts residual tongue and sulcus motion.
Persistent soft-tissue bulk	ALT, scapular, latissimus, rectus, or tailored chimeric tissue	Thin flap forms a trough; denervated muscle atrophies more than expected.
Irregular dead-space obliteration	Muscle or conformable adipofascial component	Rigid or poorly positioned skin paddle leaves a cavity.
Long segment of bone	Fibula or selected scapular constructs	Insufficient length, poor osteotomy geometry, or pedicle limitation.
Bone height / curved contour	DCIA or selected scapular geometry	Long straight fibula may require multiple osteotomies or double-barrel design.
Independent tissue components	Chimeric or double-flap construct	Folded single paddle compresses the bridge or cannot reach both surfaces.
Vessel-depleted neck	Long pedicle, favorable caliber, alternative recipient basin	Short pedicle requires grafts or a high-risk route.

COMMON ERROR

Choosing a flap because its donor anatomy is familiar, then trying to make its thickness, geometry, or pedicle fit the defect. Familiarity improves safety, but it does not erase a fundamental tissue mismatch.

BOARDS PEARL

RFFF: classically thin, pliable, long pedicle, reliable anatomy, conspicuous donor site and skin-graft morbidity. ALT: versatile, potentially bulky, can include fascia or vastus lateralis and be chimeric, but perforator anatomy and thickness vary. Fibula: long segmentable bone with skin paddle and implant potential. Scapular system: exceptional composite versatility and useful bone shapes, traditionally limited by positioning and two-team logistics.

CHAPTER 5

Free-Flap Physiology

The hemodynamic system the resident is protecting before, during, and after transfer

A free flap is living tissue disconnected from its native circulation and revascularized at a distant site. Its survival depends on a patent arterial inflow, a low-resistance microcirculation, and unobstructed venous outflow. The anastomosis is only one point in the circuit. A perfect anastomosis can fail if the pedicle is twisted, the vein is compressed, the flap is under excessive tension, a hematoma raises external pressure, or systemic perfusion is inadequate.

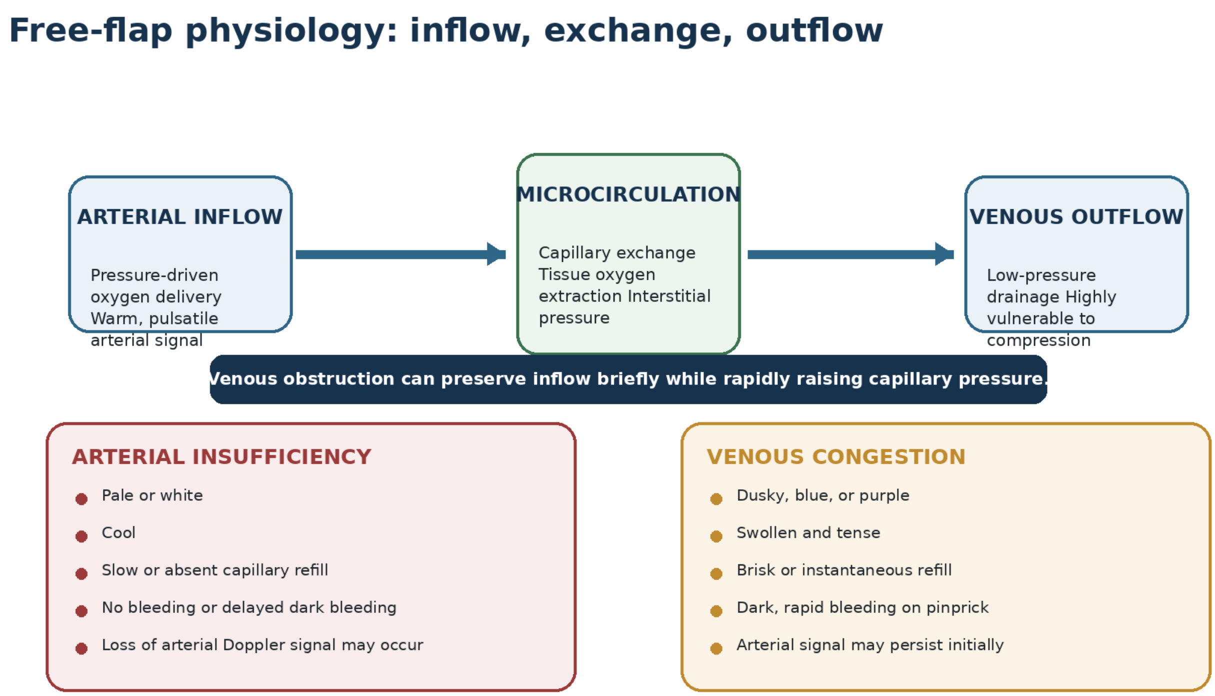


Figure 8. *The free flap as a circuit. Venous obstruction may preserve arterial inflow initially while capillary pressure rises, producing the classic congested appearance. Original schematic created for this guide.*

Macrocirculation and microcirculation

Arterial flow delivers oxygenated blood under pressure. Venous drainage occurs at lower pressure and is therefore especially vulnerable to compression, kinking, and unfavorable hydrostatic conditions. Within the flap, arterioles regulate resistance, capillaries permit exchange, and venules collect outflow. Tissue edema can increase interstitial pressure and impair capillary perfusion even when the main vessels remain patent.

Blood flow is influenced by perfusion pressure and vascular resistance. In clinical practice, the resident does not calculate a flap-specific flow equation at the bedside. The useful implication is that both severe hypotension and excessive resistance are harmful. Correct systemic causes such as hypovolemia, anemia when clinically significant, hypothermia, hypoxia, pain, and agitation, while looking urgently for a local mechanical cause when the flap examination changes.

Ischemia and reperfusion

During transfer, the flap experiences ischemia from pedicle division until reperfusion. Warm ischemia is generally more injurious than cold ischemia, and tissues differ in tolerance. Muscle is more metabolically active and less tolerant of prolonged warm ischemia than skin and fascia; bone and fat have different injury patterns. Prolonged ischemia increases endothelial injury, edema, inflammation, and thrombosis risk, although no single time threshold guarantees success or failure across all flaps.

The practical goals are to coordinate ablation, harvest, inset, and recipient-vessel preparation; avoid dividing the pedicle before the recipient site is ready; handle the pedicle gently; maintain appropriate temperature; and reperfuse efficiently without sacrificing anastomotic quality. "Ischemia time" should be documented, but the quality of the tissue and circuit matters as much as the clock.

Why thrombosis occurs

Virchow's triad is a useful organizing model: endothelial injury, abnormal flow, and hypercoagulability. Technical injury can result from rough handling, adventitia in the lumen, intimal damage, poor suture placement, size mismatch, or a narrowed anastomosis. Abnormal flow can arise from a kink, twist, tension, compression, hematoma, low-flow geometry, or competing venous pathways. Patient factors include malignancy, prior radiation, thrombophilia, severe inflammation, and systemic instability.

Venous thrombosis is commonly reported as the most frequent vascular crisis in head and neck free-flap series.[9,10] Venous outflow problems may be more salvageable when detected early because arterial inflow initially remains present, but the window closes as edema, microvascular thrombosis, and no-reflow develop. Arterial compromise can produce rapid ischemia. Both require urgent assessment and usually exploration when a mechanical or anastomotic problem is suspected.

Table 7. *Classic bedside patterns of arterial insufficiency and venous congestion. Findings are patterns, not isolated binary tests.*

Finding	Arterial insufficiency	Venous congestion
Color	Pale, white, or mottled	Dusky, violaceous, blue, or dark
Temperature	Cool	May be warm early, then cool
Turgor	Soft, flat, or poorly filled	Swollen, tense, edematous
Capillary refill	Slow or absent	Brisk, immediate, or "flash" refill
Pinprick	No bleeding or delayed scant dark blood	Rapid dark venous blood
Doppler	Arterial signal may diminish or disappear	Arterial signal can persist; venous signal may be lost
Common mechanisms	Arterial thrombosis, spasm, tension, hypotension, kink	Venous thrombosis, compression, twist, hematoma, tight tunnel

CLINICAL URGENCY

A new abnormal flap examination is a surgical problem until proven otherwise. Repeat the examination, remove obvious external compression, correct neck position and systemic derangements, notify the reconstructive team immediately, and prepare for exploration. Imaging should not delay return to the operating room when the clinical concern is high.

Spasm versus a mechanical problem

Arterial spasm is a diagnosis made in context, often intraoperatively. Warm irrigation, topical vasodilators according to local practice, correction of hypotension and hypothermia, and removal of traction may restore flow. Persistent poor perfusion should trigger inspection for twist, tension, intimal injury, thrombosis, or a technical anastomotic issue. Labeling a compromised flap as "spasm" without excluding mechanical causes can waste the salvage window.

Fluids, vasopressors, and blood pressure

Historic practice sometimes avoided vasopressors categorically out of concern for pedicle vasoconstriction. Contemporary anesthetic and reconstructive practice generally emphasizes euvolemia and appropriate systemic perfusion rather than indiscriminate crystalloid loading, and vasopressors may be used when clinically indicated within institutional protocols.[11,12] Excessive fluid can worsen flap and airway edema, pulmonary function, and wound complications. The resident should know the local hemodynamic targets and communicate whether a pressure problem is systemic, bleeding-related, or associated with an evolving neck hematoma.

Success rates and the meaning of salvage

Experienced centers commonly report overall free-flap success rates greater than 95%, but success is not automatic.[4,9,13] A large retrospective review of 866 head and neck free flaps reported vascular crisis in approximately 5% and overall flap survival of 97.6%; salvage succeeded in roughly half of compromised flaps, with outcome strongly influenced by early detection and re-exploration.[9] These figures should be used as orientation rather than a guarantee for an individual patient or institution.

The resident's contribution to flap survival is often temporal. A subtle change recognized and escalated at 2 AM may be more important than identifying the exact thrombotic mechanism at the bedside. Document the examination precisely: color, warmth, turgor, capillary refill, pinprick response when authorized, and arterial and venous Doppler signals at the marked sites. "Flap looks okay" cannot be compared with the next examination.

BOARDS PEARL

Venous congestion: dark, swollen, brisk refill, rapid dark bleeding; an arterial Doppler may remain audible. Arterial insufficiency: pale, cool, slow refill, absent or delayed bleeding. Venous problems are common and time sensitive.

CHAPTER 6

The Reconstructive Toolbox

Using the ladder, the elevator, and workhorse flap categories without letting the toolbox drive the diagnosis

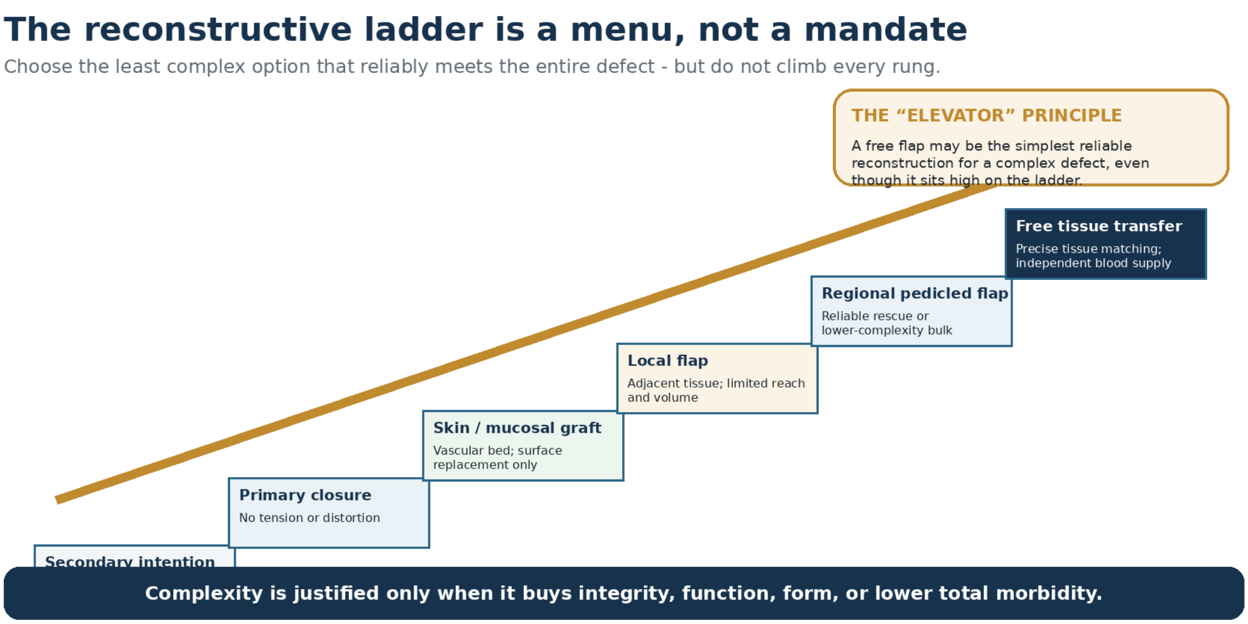


Figure 9. *The reconstructive ladder should be treated as a menu. A complex free flap can be the simplest reliable solution when lower rungs cannot meet the full defect. Original schematic created for this guide.*

The ladder and the elevator

The reconstructive ladder proceeds from secondary intention through primary closure, grafts, local flaps, regional pedicled flaps, and free tissue transfer. The traditional teaching is to choose the lowest rung that will succeed. The modern “elevator” concept emphasizes that a surgeon may move directly to the option that most reliably meets the defect. A free flap can therefore be the least burdensome total solution for a large composite defect, even though the operation itself is complex.[1,2]

The ladder remains useful because it forces the surgeon to ask whether tissue transfer is truly necessary. A small lateral tongue defect may be closed primarily or allowed to granulate; a limited palatal defect may be obturated; a superficial scalp defect with a vascular bed may accept a graft. The error is not using a lower rung. The error is using it when it cannot restore the required barrier, volume, structure, or function.

Primary closure, secondary intention, and grafts

Primary closure is appropriate when it does not distort a functional subunit, narrow a lumen, tether the tongue, or place the wound under tension. Secondary intention can produce excellent results in selected small mucosal defects but is inappropriate over exposed major vessels, hardware, poorly vascularized bone, or a large communication between compartments. Skin or mucosal grafts replace surface only and require a vascular recipient bed; they do not supply volume, independent blood flow, or structural support.

Local and regional flaps

Local flaps provide tissue with favorable color and thickness and avoid microvascular anastomosis, but reach and volume are limited and prior treatment may compromise the surrounding tissue. Regional pedicled flaps remain essential. The pectoralis major, supraclavicular, submental, temporalis, and other regional options can offer rapid, reliable coverage, particularly for salvage, vessel protection, or patients in whom a long microsurgical procedure is undesirable. Their arc of rotation, bulk, donor morbidity, and effect on future neck access must be considered.

A pedicled flap is not a “failed free flap choice.” It may be the optimal primary reconstruction or a lifesaving rescue. Conversely, selecting it solely because it is faster can create a poor functional result if the defect requires thin mobile lining or vascularized bone. Compare total morbidity, not only operative time.

Workhorse free-flap categories

Volume II will examine donor anatomy in detail. For Volume I, the goal is to recognize the dominant tissue profile of each workhorse. The table below is deliberately simplified; every flap can be modified, and institutional expertise matters.

Table 8. *Resident-level profile of major free-flap categories. Detailed anatomy and harvest are deferred to Volume II.*

Flap	Core tissue profile	Typical strengths	Important limitations / boards associations
Radial forearm	Thin fasciocutaneous; optional fascia, tendon, small bone segment	Pliable lining, long reliable pedicle, easy two-team harvest, sensory nerve option	Donor skin graft and conspicuous scar; tendon exposure; hand vascular assessment; limited bulk.
Anterolateral thigh	Fasciocutaneous or musculocutaneous; fascia lata; chimeric options	Large skin paddle, variable bulk, low donor morbidity, primary closure often possible, multiple components	Perforator anatomy and thickness vary; may be too bulky; pedicle usually shorter than RFFF.
Fibula osteocutaneous	Long segmentable bone, skin paddle, optional muscle	Mandibular reconstruction, multiple osteotomies, implant-bearing potential, long pedicle	Lower-extremity vascular assessment; skin paddle variability; ankle/gait morbidity; bone height may be limited.
Scapular / subscapular system	Multiple skin, muscle, and bone components on a branching system	Outstanding chimeric versatility, large soft-tissue needs, scapular tip/lateral border options	Positioning and two-team logistics; pedicle and bone length vary by component.

Flap	Core tissue profile	Typical strengths	Important limitations / boards associations
DCIA / iliac crest	High-volume curved bone with internal oblique or skin	Bone height and natural mandibular contour; implant platform	Shorter pedicle; abdominal wall, gait, and hernia morbidity; skin paddle less versatile.
Latissimus dorsi	Large muscle or myocutaneous flap; thoracodorsal system	Very large coverage and dead-space obliteration; reliable anatomy	Positioning; bulk; seroma and shoulder considerations; denervation atrophy.
Free jejunum	Vascularized intestinal tube	Circumferential pharyngoesophageal conduit; lubricated mucosa, peristalsis	Abdominal operation; ischemia sensitivity; monitoring and size mismatch; voice characteristics.
Rectus abdominis / other muscle	Large soft tissue with skin option	Bulk and complex dead-space filling; historical workhorse	Abdominal morbidity and volume change; often replaced by ALT in many centers.

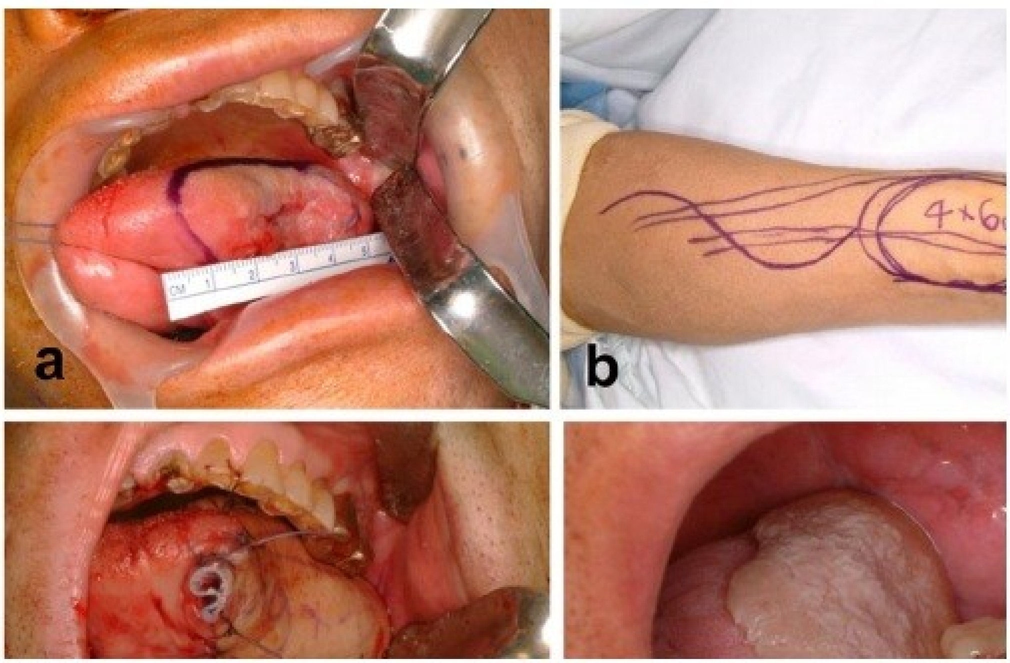


Figure 10. *Radial forearm flap used for lateral tongue reconstruction: defect, donor design, inset, and long-term appearance. The image illustrates the thin, pliable tissue profile of the flap. Kim et al., Maxillofacial Plastic and Reconstructive Surgery 2020; CC BY 4.0. Image cropped from the open-access article.*

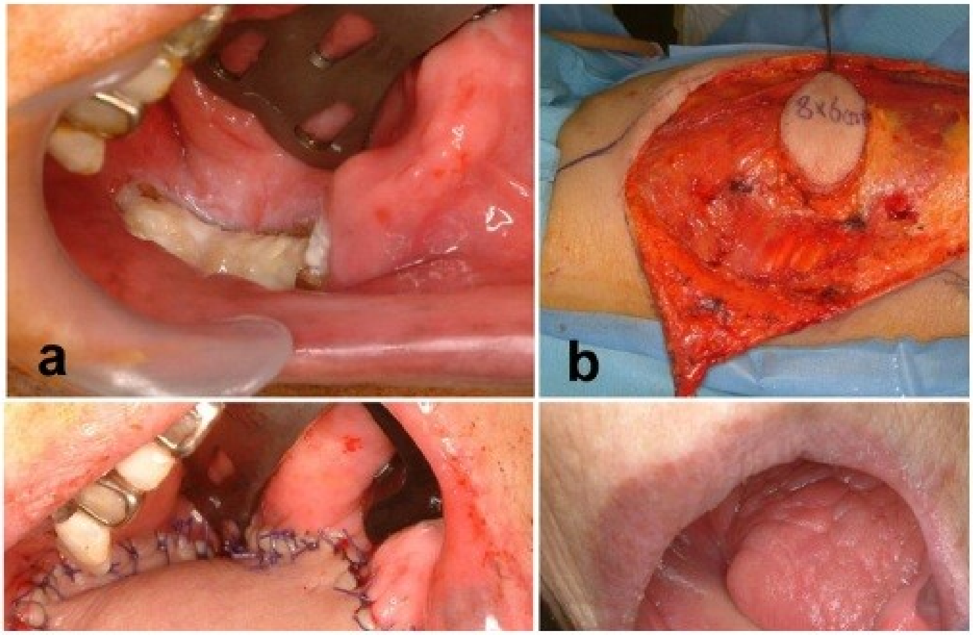


Figure 11. *Latissimus dorsi flap used for a large oral and maxillofacial defect. Large muscle-based flaps are useful when bulk and coverage dominate the problem. Kim et al., Maxillofacial Plastic and Reconstructive Surgery 2020; CC BY 4.0. Image cropped from the open-access article.*

Immediate versus delayed reconstruction

Immediate reconstruction usually offers unscarred tissue planes, known defect anatomy, a single anesthetic, and earlier rehabilitation. It also permits the ablative and reconstructive teams to coordinate vessel preservation. Delayed reconstruction may be appropriate when oncologic uncertainty, infection, severe physiologic instability, or a staged prosthetic plan makes immediate transfer undesirable. Secondary reconstruction is technically harder because of fibrosis, altered anatomy, vessel depletion, and contracture, but free tissue transfer remains a powerful method for restoring previously failed or irradiated defects.

Rescue principles

When a primary flap is lost, the defect must be re-audited rather than automatically reconstructed with the same flap. Determine why the first construct failed, whether the recipient vessels remain usable, whether infection or salivary contamination is controlled, and whether the tissue requirement has changed after debridement. A regional flap may be ideal for urgent carotid or hardware coverage; a second free flap may be required for definitive bone or conduit reconstruction. Never route a new pedicle through the same unresolved mechanical hazard.

BOARDS PEARL

The pectoralis major myocutaneous flap remains a key regional workhorse and rescue flap. Free flaps offer superior tissue matching for many complex defects, but regional flaps remain appropriate when rapid reliable coverage, vessel protection, salvage, or patient physiology dominates the decision.

CHAPTER 7

Functional Subunits and Recurring Defect Logic

How the same defect-audit framework changes across the oral cavity, mandible, maxilla, pharynx, skin, and skull base

The following sections are not complete defect-specific algorithms; those belong in Volume III. Their purpose is to show how the six-domain audit produces different functional priorities in common clinical scenarios. The workhorse flap associated with a defect is less important than understanding why that flap profile is useful.

Partial oral tongue and floor of mouth

For a limited lateral tongue defect, the native tongue is the motor. The reconstruction should preserve its excursion, avoid tethering the tip or floor of mouth, maintain a usable gingivolingual sulcus, and provide a durable surface. Primary closure is reasonable when it does not distort or restrict; a thin fasciocutaneous flap is favored as defect size and floor-of-mouth involvement increase. Excess volume can impair articulation and bolus manipulation more than it helps.

Floor-of-mouth involvement changes the problem because scar can anchor the residual tongue to the mandible. The inset should preserve mobility and prevent a dependent pocket. If the resection communicates with the neck, the flap also becomes a salivary barrier. Sensory reinnervation may be considered, but the dominant goals are geometry and residual motor function.

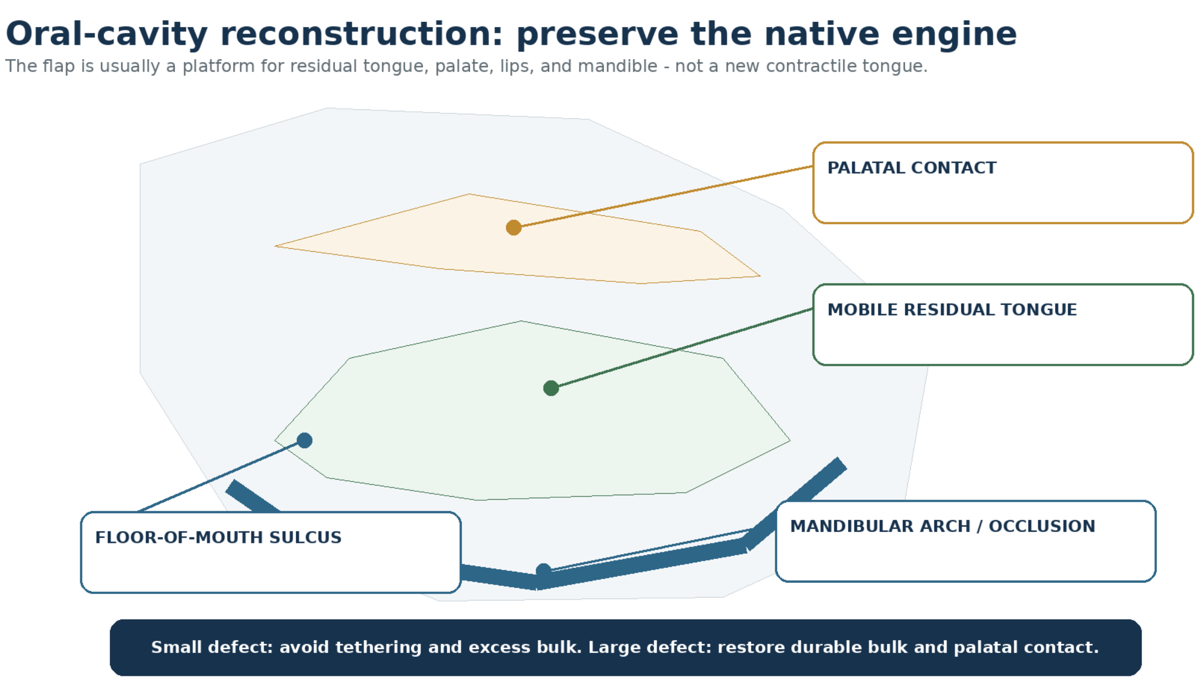


Figure 12. *In oral-cavity reconstruction, the flap typically supports the residual functional structures. Small defects prioritize mobility; larger defects prioritize bulk and palatal contact. Original schematic created for this guide.*

Subtotal and total glossectomy

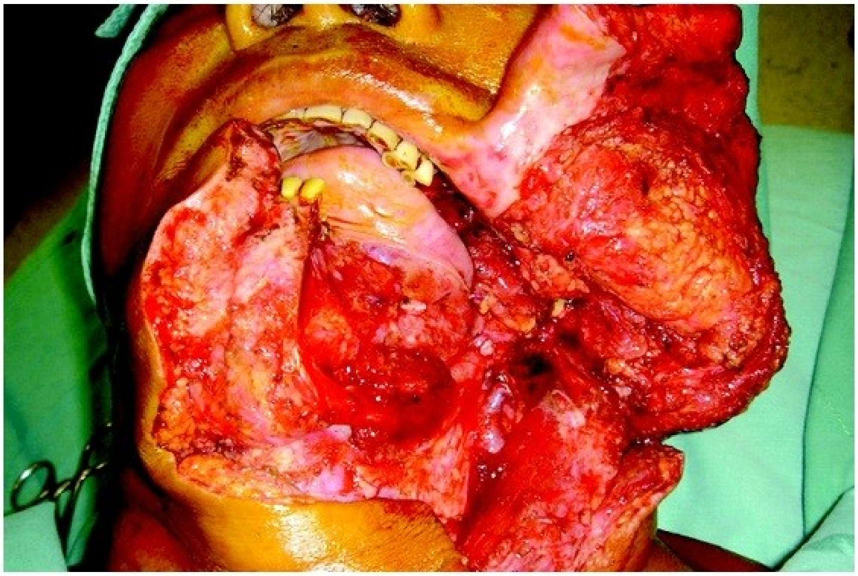
As more tongue is removed, the goal shifts from preserving mobility to restoring volume and shape. A subtotal or total neotongue should form a broad, convex mound that reaches the palate, avoids a central trough, and directs the bolus toward the pharynx. The flap is usually designed larger than the apparent immediate defect because edema resolves and long-term tissue loss may follow denervation and radiation. A bulky ALT, rectus, latissimus, or other tailored soft-tissue flap may be appropriate depending on body habitus and donor availability.[14]

Laryngeal preservation is an independent decision based on tumor extent, aspiration risk, pulmonary reserve, residual base-of-tongue and pharyngeal function, and the expected ability to rehabilitate. A large flap cannot compensate for absent pharyngeal drive or profound airway-protection deficits. Counseling should address likely tracheostomy and enteral feeding needs, not merely flap survival.

Segmental mandibular defects

The mandible is a curved load-bearing arch that supports dentition, tongue position, lower facial projection, and the suprahyoid musculature. Segmental loss generally requires vascularized bone for definitive reconstruction in patients expected to tolerate it, particularly in an irradiated or contaminated oncologic field. The defect should be described by location - anterior, lateral, ramus, condyle - and by its associated lining, skin, and soft-tissue components.

Anterior defects are functionally unforgiving. Loss of the symphysis can produce tongue prolapse, loss of chin projection, oral incompetence, and “Andy Gump” deformity if continuity is not restored. Lateral defects may tolerate simpler contouring but still affect occlusion and facial width. Condylar reconstruction raises questions about joint position, ramus height, deviation, and trismus. Bone choice and osteotomy pattern follow this geometry.



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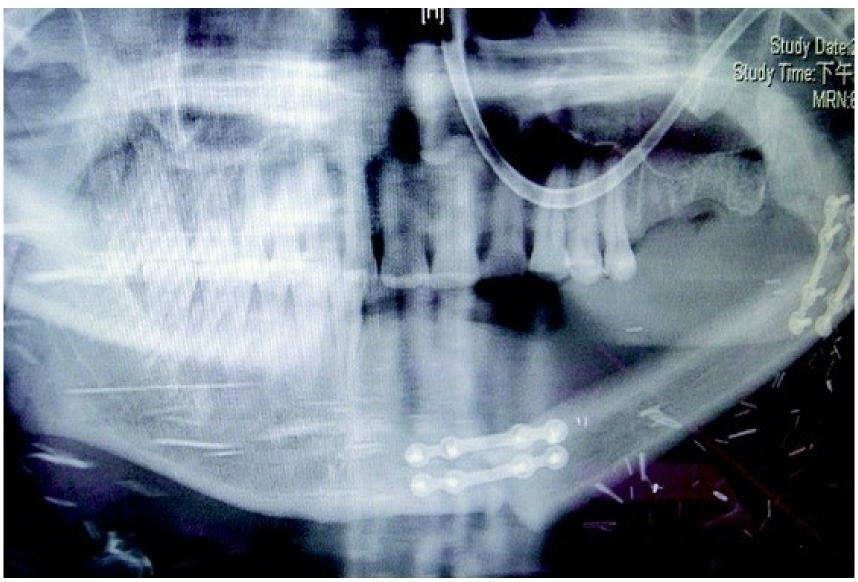

(b)

Figure 13. *Representative sequence of composite oromandibular reconstruction. Vascularized bone restores continuity while the skin paddle replaces mucosal or external soft tissue. Zhang et al., ISRN Surgery 2011; open-access article.*

The soft-tissue component is often the harder part. A fibula may restore bone perfectly yet provide an inadequate or poorly oriented skin paddle for a large through-and-through defect. Conversely, excessive soft tissue can bury the alveolar ridge and prevent dental rehabilitation. The resident should describe the bone and soft-tissue defects separately, then ask whether one source pedicle can serve both.

Maxilla, palate, and orbit

Maxillary defects are three-dimensional and may involve the palate, alveolus, maxillary sinus, facial skin, orbital floor or contents, nasal cavity, and skull base. The first question is whether a prosthetic obturator can provide reliable separation and function. Limited defects with preserved dentition and favorable geometry may be managed well prosthetically. Larger defects, loss of the premaxilla or key teeth, extensive soft-tissue loss, poor manual dexterity, or planned radiation may favor surgical reconstruction.[15-17]

If the orbital floor is removed but the globe is preserved, the reconstruction must support orbital contents and limit enophthalmos or vertical dystopia. If the alveolus is removed, the plan should consider maxillary arch and dental restoration. Soft tissue can seal the palate and fill the cavity but may not restore orbital support or an implant-bearing platform. Bony flaps are selected according to the buttresses and surfaces that must be recreated.

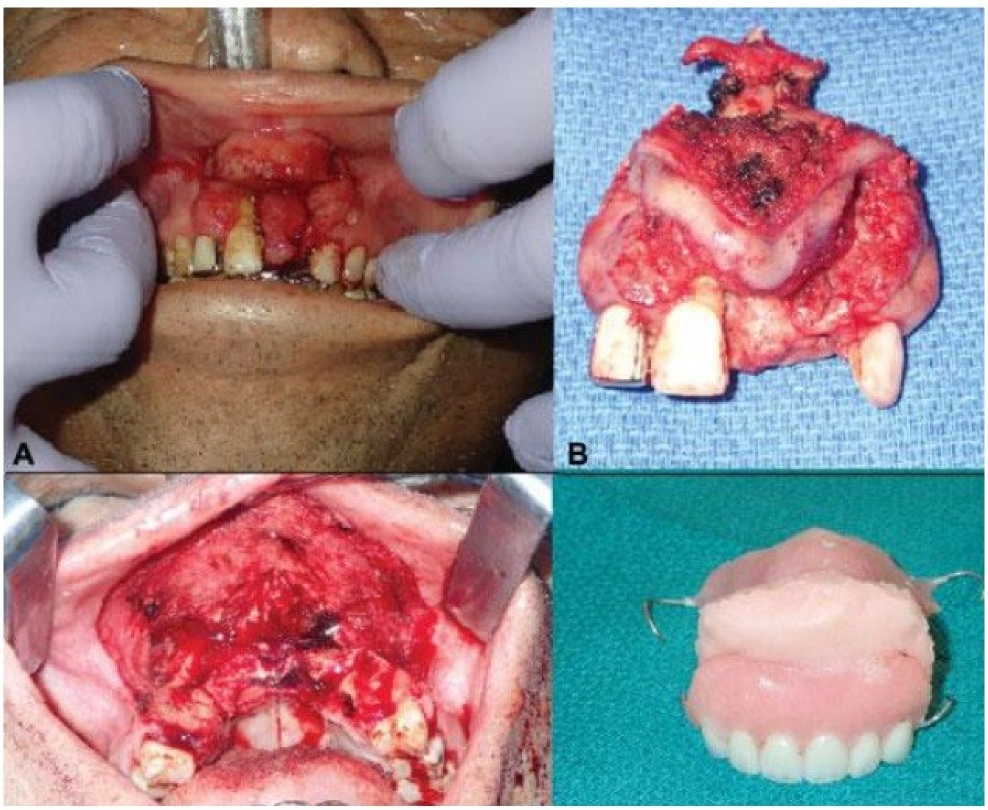

Figure 14. *A limited maxillary defect can sometimes be managed with an obturator when residual dentition and defect geometry provide retention and separation. Prosthetic and surgical options should be considered together. Vincent et al., Seminars in Plastic Surgery 2019. Cropped educational figure; source cited in Appendix D.*

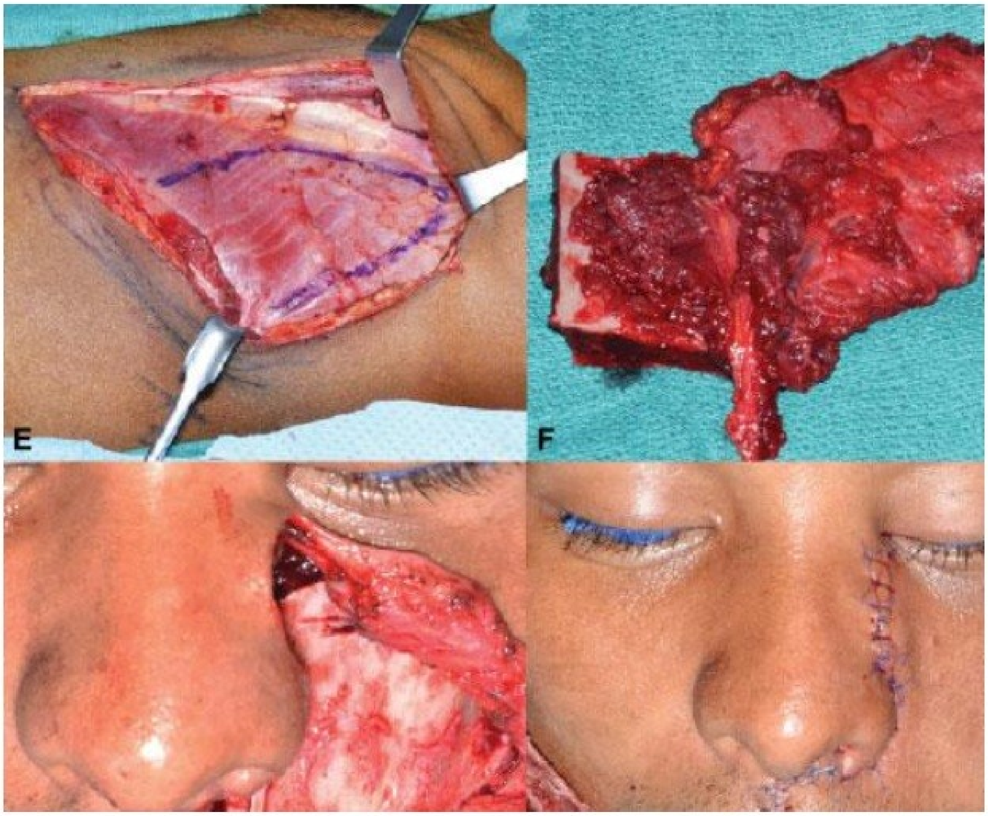

Figure 15. *An osteocutaneous iliac-crest reconstruction can provide bone height, palatal separation, and midfacial structure for selected maxillectomy defects. Vincent et al., Seminars in Plastic Surgery 2019. Cropped educational figure; source cited in Appendix D.*

Partial and circumferential pharyngeal defects

A partial pharyngeal defect is a patch problem; a circumferential defect is a conduit problem. Primary closure is appropriate only when it preserves an adequate lumen without tension. A patch should be designed wide enough to prevent stenosis and oriented to avoid a dependent pouch. A circumferential reconstruction may use a tubed radial forearm flap, tubed ALT, or free jejunum, each with distinct donor morbidity, fistula and stricture profiles, speech characteristics, and sensitivity to ischemia.[18-20]

The junctions are often the weak points. The distal anastomosis should not be narrowed, the tube should not twist, and the pedicle should leave the conduit without compression. In salvage laryngectomy, previously irradiated mucosa and skin increase fistula risk. Vascularized tissue may be used as an interposition patch or onlay even when the pharynx can be closed primarily. The resident should distinguish reinforcement from replacement.

Table 9. *Patch, tube, and reinforcement logic in pharyngeal reconstruction.*

Defect	Primary reconstructive task	Common options	Failure to anticipate
Small partial pharynx	Tension-free closure with adequate lumen	Primary closure; selected patch	Stenosis from tight closure; leak at high-tension corner.
Large partial defect	Replace wall without pouch or narrowing	RFFF/ALT patch; regional flap in selected cases	Redundant dependent segment; exposed carotid.
Circumferential hypopharynx	Create durable conduit from pharynx to esophagus	Tubed RFFF, tubed ALT, free jejunum	Tight distal lumen, twist, fistula, stricture, poor TEP voice.

Defect	Primary reconstructive task	Common options	Failure to anticipate
Salvage laryngectomy reinforcement	Bring vascularized tissue into irradiated closure	Fasciocutaneous interposition/onlay; pectoralis reinforcement	Treating technically closable mucosa as biologically normal tissue.

Cutaneous, scalp, and skull-base defects

Large cutaneous defects require durable cover and restoration of contour, but the deeper problem often determines flap choice. A parotid or lateral temporal-bone defect may require substantial volume to protect the facial nerve, carotid artery, or exposed bone. A scalp defect may require a broad skin paddle over calvarium, hardware, or dura. A skull-base defect requires separation of the intracranial space from the sinonasal tract and obliteration of dead space with vascularized tissue.

Muscle is useful for irregular dead space and infected or irradiated bone; fasciocutaneous tissue may be preferable when durable external cover and easier surveillance are central. The flap should not obscure oncologic surveillance unnecessarily, but reliable protection of dura, vessels, and hardware takes precedence. Pedicle length can be decisive because recipient vessels may be remote from the cranial defect.

Carotid and hardware protection

Exposed or threatened carotid artery is an urgent reconstructive problem. The goal is robust vascularized coverage that separates the vessel from saliva, infection, and skin breakdown. A thin skin graft is inadequate. Likewise, hardware should be covered with well-vascularized tissue, particularly after radiation. Persistent salivary leakage, infection, or nonviable bone must be addressed; adding a flap without source control may only delay failure.

The vessel-depleted neck

Prior neck dissection, radiation, recurrent tumor, infection, and prior flap harvest can eliminate the usual facial, superior thyroid, lingual, and jugular options. The reconstructive plan may use contralateral neck vessels, transverse cervical vessels, the thoracoacromial system, internal mammary vessels, cephalic-vein transposition, vein grafts, or other selected recipient sites.[7,21] The safest solution often begins with a flap whose pedicle naturally reaches the best available basin.

Recipient-vessel planning must be coordinated with pedicle orientation before harvest. The flap should not be committed to a short pedicle or wrong-sided skin paddle while the neck exploration remains uncertain. In recurrent cancer, vessel selection is also oncologic: do not preserve or use a vessel that compromises clearance or lies within gross disease.

BOARDS PEARL

Mandible: restore continuity, projection, and occlusion with vascularized bone when appropriate. Partial tongue: thin and mobile. Total tongue: bulk and palatal contact. Maxilla with orbital-floor loss: support the globe as well as separate oral and nasal spaces. Partial pharynx: patch; circumferential pharynx: tube or jejunal conduit.

CHAPTER 8

Master Algorithm and Clinical Cases

Applying the framework to the decisions residents are expected to explain on rounds, in the operating room, and on boards

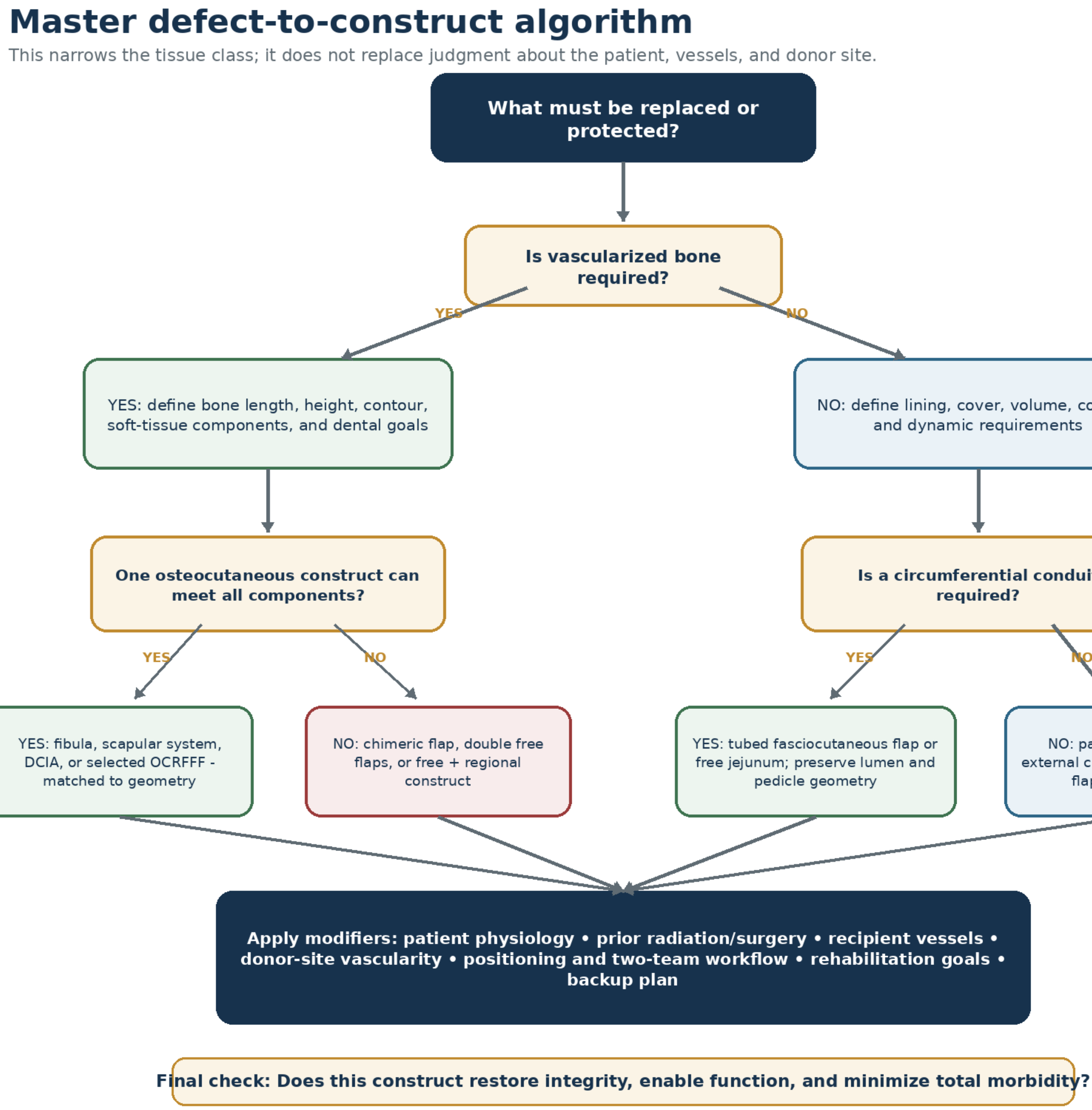

Figure 16. *Master defect-to-construct algorithm. It identifies the tissue class and complexity required; patient and recipient-vessel modifiers still determine the final flap. Original schematic created for this guide.*

The algorithm is intentionally defect based. First decide whether living bone is required. If yes, determine whether one osteocutaneous source can satisfy the soft-tissue components. If no bone is required, decide whether the central problem is a circumferential conduit, thin lining, bulk, external cover, or a combination. Only then apply patient, donor-site, and recipient-vessel modifiers. The cases below demonstrate how a defensible answer is constructed.

Case 1: Lateral oral tongue defect

CLINICAL VIGNETTE

A 54-year-old patient undergoes resection of approximately 40% of the mobile tongue with a small adjacent floor-of-mouth component. The mandible and base of tongue are preserved. The contralateral tongue and hypoglossal function are intact.

The dominant functional asset is the residual tongue. The reconstruction should provide a thin, pliable surface, preserve the tip and floor-of-mouth mobility, and avoid excess bulk. The need for a free flap depends on the actual defect and whether primary closure would tether or distort.

DEFENSIBLE RECONSTRUCTIVE PLAN

For a defect too large for tension-free closure, a thin fasciocutaneous flap such as RFFF or a suitably thin ALT is reasonable. Design the inset to preserve the sulcus and permit residual tongue excursion. A local or regional option may be appropriate in selected patients.

COMMON ERROR

Selecting a bulky flap because “tongue defects need volume.” That principle applies to subtotal and total defects, not automatically to a mobile residual tongue.

Case 2: Subtotal glossectomy with preserved larynx

CLINICAL VIGNETTE

A 63-year-old patient has an anterior subtotal glossectomy with bilateral tongue-base remnants and intact larynx. There is no mandibular defect.

The dominant problem is loss of bolus-propulsive volume rather than preservation of large residual mobile tongue. The neotongue must form a stable convex mound, reach the palate, and avoid a central trough. Long-term atrophy and radiotherapy are expected.

DEFENSIBLE RECONSTRUCTIVE PLAN

Use a bulky soft-tissue flap, commonly ALT or another musculocutaneous/fasciocutaneous option suited to the patient. Shape and anchor it to maintain palatal contact, and intentionally account for later volume loss. Evaluate aspiration risk and enteral-feeding expectations separately from flap choice.

COMMON ERROR

Using a very thin flap because it is easy to inset. A flat floor-of-mouth reconstruction leaves no palatal contact and may worsen swallowing.

Case 3: Lateral segmental mandibulectomy with small mucosal defect

CLINICAL VIGNETTE

A 58-year-old patient undergoes segmental resection of the mandibular body and angle with a 5-cm intraoral lining defect. External skin is preserved and the recipient neck is untreated.

Living bone is required to restore continuity and contour. The soft-tissue requirement is limited and contiguous with the bone. Future dental rehabilitation is possible.

DEFENSIBLE RECONSTRUCTIVE PLAN

A fibula osteocutaneous flap is a classic choice because it supplies adequate bone length, tolerates osteotomies, and can provide a mucosal skin paddle. Scapular or iliac-crest options may be appropriate depending on geometry, donor status, and institutional expertise.

COMMON ERROR

Answering “fibula” without evaluating lower-extremity vessels, bone height, skin-paddle requirement, or the position of the pedicle.

Case 4: Anterior mandible plus through-and-through lower lip and chin

CLINICAL VIGNETTE

A 67-year-old patient requires resection of the symphysis, floor of mouth, lower lip musculature, and external chin skin.

This is not merely a bone defect. It requires anterior arch and projection, oral lining, external cover, intermediate volume, and restoration of oral competence. The internal and external surfaces are spatially independent.

DEFENSIBLE RECONSTRUCTIVE PLAN

Consider a chimeric scapular or fibula-based construct, double-paddle osteocutaneous flap, or double free flaps depending on tissue distribution. A fascial sling or other static support may be needed for oral competence. The plan must protect the plate and restore the anterior soft-tissue envelope.

COMMON ERROR

Using a single narrow fibular skin paddle that can cover either the mouth or chin but not both without tension, compression, or loss of lip support.

Case 5: Total maxillectomy with orbital floor resection, globe preserved

CLINICAL VIGNETTE

A 49-year-old patient undergoes total maxillectomy including the orbital floor and maxillary alveolus, with preservation of the globe and external cheek skin.

The reconstruction must separate oral and nasal cavities, support the orbit, restore midfacial projection, fill the maxillary cavity appropriately, and consider dental rehabilitation. Soft tissue alone may seal the palate but can allow globe malposition and cannot provide an implant-bearing alveolus.

DEFENSIBLE RECONSTRUCTIVE PLAN

Use an osseous reconstruction whose geometry can restore key buttresses and orbital support, such as scapular, fibula, or iliac-crest based options, with prosthodontic and virtual-planning input. Mesh may supplement orbital support in selected constructs.

COMMON ERROR

Choosing the flap solely by the palatal surface area and forgetting the orbital floor and midfacial scaffold.

Case 6: Salvage laryngopharyngectomy with circumferential defect

CLINICAL VIGNETTE

A 66-year-old patient previously treated with chemoradiation undergoes salvage total laryngopharyngectomy, leaving a 10-cm circumferential defect from the oropharynx to cervical esophagus.

This is a conduit in a biologically compromised field. The reconstruction must provide a durable tube, protect neck vessels from saliva, minimize fistula and stricture risk, and permit future speech rehabilitation. Recipient vessels may be scarred.

DEFENSIBLE RECONSTRUCTIVE PLAN

A tubed ALT, tubed RFFF, or free jejunum may be selected according to lumen size, donor factors, recipient vessels, and institutional outcomes. Ensure a tension-free proximal and distal anastomosis, smooth pedicle exit, and a backup plan for vessel depletion.

COMMON ERROR

Calling any fasciocutaneous flap a “patch” despite a complete circumferential loss, or failing to anticipate the distal esophageal size mismatch.

How to present a plan on rounds

A concise resident presentation should contain five elements: the exact defect, the primary functional goal, the selected tissue profile, the planned recipient basin and pedicle route, and the backup. For example: “The expected defect is a lateral mandibular segment with a small floor-of-mouth lining component and no external skin loss. The goal is bony continuity and contour with thin mucosal coverage. We plan a fibula osteocutaneous flap to the ipsilateral facial or superior thyroid system, with scapular flap as backup if leg vascular imaging or skin-paddle perfusion is unfavorable.”

RESIDENT STANDARD

A flap name without a defect statement is an incomplete plan. A defect statement without a backup donor site and recipient-vessel strategy is an incomplete operative plan.

CHAPTER 9

Resident Workflow and Boards Review

What to know before the case, what to watch during the operation, and what distinctions are repeatedly tested

Before the case

Read the ablative and reconstructive notes, imaging, pathology, radiation history, and prior neck operations. Examine the oral cavity and external skin with the anticipated margins in mind. Know whether the operation includes marginal or segmental mandibulectomy, partial or circumferential pharyngectomy, orbital-floor removal, external skin sacrifice, or a planned tracheostomy. Review donor-site vascular studies and identify the backup.

8. State the anticipated defect in the six-domain format.
9. Name the dominant functional target and the tissue properties required.
10. Know the primary flap, tissue components, pedicle, patient position, and major donor-site risks.
11. Identify likely recipient arteries and veins and the effect of the neck dissection on them.
12. Know the backup donor site, alternate recipient basin, and conversion trigger.
13. Anticipate airway, enteral access, flap-monitoring method, and disposition.

What to watch during the operation

During ablation, watch which functional structures truly remain: tongue tip, contralateral hypoglossal nerve, mandibular periosteum, palatal arch, orbital contents, pharyngeal mucosa, and cervical vessels. During harvest, identify the pedicle and perforator anatomy rather than only the skin paddle. During inset, follow the pedicle in three dimensions. Ask where it enters the flap, where it exits the defect, whether any fold changes its length, and how the neck closure will affect it.

Before anastomosis, understand vessel preparation and orientation. After reperfusion, observe color, capillary refill, bleeding, Doppler signals, and the effect of final inset. A flap that appears healthy before closure can become compromised after hardware fixation, drain placement, tracheostomy ties, or skin closure. The final check should occur in the patient's neutral postoperative position.

Operative note elements the resident should understand

- **Defect:** dimensions and tissue components after final margins.
- **Flap:** side, tissue components, skin-paddle dimensions, pedicle, perforators, and any nerves.
- **Ischemia:** pedicle division, reperfusion, and total ischemia time according to local practice.
- **Recipient vessels:** artery and vein, end-to-end or end-to-side configuration, coupler size if used.
- **Inset:** orientation, osteotomies, plate/hardware, conduit or barrier created, pedicle route.
- **Perfusion:** clinical examination and Doppler signals after reperfusion and after closure.
- **Donor site:** closure method, graft, drains, immobilization, and neurovascular status.
- **Monitoring:** location of skin paddle or Doppler stitch and postoperative protocol.

Boards-relevant workhorse associations

Table 10. *High-yield associations. Use them only after identifying the tissue requirement.*

Question stem clue	Most likely concept	Why
Thin, pliable oral lining; long reliable pedicle	Radial forearm free flap	Classic surface-replacement workhorse; donor-site graft/scar tradeoff.
Large soft-tissue defect; variable thickness; low donor morbidity	ALT flap	Can be fasciocutaneous, musculocutaneous, or chimeric; perforator variability.
Long segmental mandibular defect; multiple osteotomies	Fibula osteocutaneous flap	Long bone stock, reliable segmental supply, implant potential.
Complex composite defect needing several independent components	Subscapular/scapular system	Branching system permits bone, muscle, and multiple skin paddles.
Need for substantial bone height / natural curved mandibular contour	DCIA flap	Iliac crest geometry and height; abdominal donor morbidity.
Circumferential pharyngoesophageal defect	Tubed RFFF/ALT or free jejunum	Conduit rather than patch; option depends on patient and center.
Previously irradiated salvage laryngectomy closure	Vascularized tissue reinforcement or replacement	Reduces reliance on poorly vascularized irradiated wound edges.
Pale, cool flap with delayed refill	Arterial insufficiency	Inadequate inflow.
Purple, swollen flap with brisk dark bleeding	Venous congestion	Outflow obstruction; arterial Doppler may remain.

Boards-style questions

1. A PATIENT HAS A 4-CM LATERAL TONGUE DEFECT AND INTACT RESIDUAL TONGUE MOTOR FUNCTION. WHICH RECONSTRUCTIVE FEATURE IS MOST IMPORTANT?

A thin, pliable inset that minimizes tethering and preserves residual mobility. Bulk is not the primary goal.

2. A FLAP IS PURPLE, SWOLLEN, AND HAS INSTANTANEOUS CAPILLARY REFILL. THE ARTERIAL DOPPLER IS STILL AUDIBLE. WHAT IS THE MOST LIKELY PROBLEM?

Venous outflow obstruction. An arterial signal can persist early because inflow continues into a congested flap.

3. WHICH FLAP CLASSICALLY SUPPLIES THE LONGEST SEGMENTABLE BONE FOR MANDIBULAR OSTEOTOMIES?

Fibula osteocutaneous free flap.

4. AFTER TOTAL GLOSSECTOMY, WHY IS A BULKY RECONSTRUCTION PREFERRED?

To restore a convex neotongue, palatal contact, and bolus propulsion while anticipating later volume loss.

5. WHAT ADDITIONAL REQUIREMENT APPEARS WHEN A MAXILLECTOMY INCLUDES THE ORBITAL FLOOR BUT PRESERVES THE GLOBE?

Structural support of the orbital contents to limit globe malposition and diplopia.

6. WHAT IS THE KEY DISTINCTION BETWEEN PARTIAL AND CIRCUMFERENTIAL PHARYNGEAL DEFECTS?

A partial defect is reconstructed as a patch or primary closure; a circumferential defect requires a tube or visceral conduit.

7. WHY IS THE SCAPULAR SYSTEM USEFUL FOR COMPLEX COMPOSITE DEFECTS?

Its branching vascular anatomy can supply separately mobile bone, muscle, and skin components.

8. WHAT IS THE FIRST ONCOLOGIC PRINCIPLE OF RECONSTRUCTION?

Do not compromise tumor resection or margins to preserve a reconstructive structure or simplify flap design.

Last-minute pearls

- Reconstruct the actual defect, not the name of the ablation.
- Integrity first: separate contaminated compartments and protect carotid, dura, hardware, and bone.
- Partial tongue favors mobility and thinness; subtotal/total tongue favors volume and palatal contact.
- Anterior mandibular continuity is central to tongue support, chin projection, and oral competence.
- Maxillectomy planning must address palate, orbit, alveolus, facial projection, and prosthetic goals separately.
- Patch and tube are different problems. Do not narrow a partial pharynx or twist a circumferential conduit.
- Venous congestion is dark, swollen, and brisk; arterial insufficiency is pale, cool, and slow.
- Age alone is not a contraindication; frailty, reserve, vascular status, donor morbidity, and goals matter.
- Pedicle geometry is part of flap selection. Length on the back table is not the same as reach after inset.
- Every major case needs a backup donor site and recipient-vessel plan.

CHAPTER A

Appendix A: One-Page Defect Card

A compact framework for preoperative planning, intraoperative reassessment, and oral-board presentation

Table 11. *The resident defect card.*

Prompt	Document
Oncologic resection	Primary site, margins, subunits, bone, skin, nerves, vessels, neck dissection, prior treatment.
Lining	Location, surface area, mobility, single vs multiple surfaces, patch vs tube.
External cover	Skin dimensions, landmark involvement, contour, monitoring paddle.
Volume	Where bulk is needed, dead space, expected atrophy or radiation change.
Structure	Bone/cartilage/fascia/hardware; length, height, geometry, buttress, implants.
Conduit / barrier	Spaces to separate, lumen length/circumference, structures to protect.
Dynamic function	Residual tongue, palate, lips, larynx, pharynx, motor and sensory nerves.
Pedicle / vessels	Exit side, required reach, recipient artery and vein, alternative basin.
Patient modifiers	Frailty, nutrition, vascular disease, donor scars, dominant hand, gait, goals.
Plan A	Flap, components, design, position, recipient vessels, airway, monitoring.
Plan B	Backup donor site, recipient vessels, conversion trigger, regional rescue option.

PRESENTATION TEMPLATE

“This is a [site] defect requiring [lining/cover/volume/structure] and [barrier/conduit task]. Residual [native function] remains. I would use [tissue profile and flap] because it provides [properties]. The pedicle would reach [recipient vessels] through [route]. Major donor risks are [risks]. Backup is [plan].”

CHAPTER B

Appendix B: Preoperative Planning Checklist

A practical checklist for conference, consent, and morning-of-surgery review

Oncologic and reconstructive plan

- Pathology, imaging, stage, prior surgery, radiation fields, and systemic therapy reviewed.
- Ablative surgeon confirms minimum and maximum expected defect.
- Need for bone, skin, multiple paddles, conduit, or skull-base separation identified.
- Dental/prosthodontic and virtual surgical planning incorporated when relevant.
- Primary and backup flap selected; patient positioned and prepped for both.

Patient and donor site

- Cardiopulmonary reserve, frailty, nutrition, anemia, renal function, diabetes, and thrombosis history assessed.
- Tobacco/nicotine and alcohol risks addressed; withdrawal plan when needed.
- Donor pulses, scars, range of motion, dominant hand, gait, and occupational demands documented.
- Required vascular imaging completed and personally reviewed.
- Donor-site expectations included in consent and rehabilitation planning.

Recipient site and logistics

- Prior operative reports and neck imaging reviewed for recipient vessels.
- Primary and alternative recipient arteries and veins named.
- Pedicle length and route compatible with defect and neck side.
- Hardware, cutting guides, couplers, monitoring devices, and graft supplies available.
- Two-team sequence, anticipated ischemia point, airway, enteral access, and postoperative bed confirmed.

Before leaving the operating room

- Inset is tension free; no blind salivary pocket or unfilled critical dead space.
- Pedicle is untwisted, uncompressed, and separated from drains, hardware edges, and tracheostomy ties.
- Arterial and venous signals and clinical examination recorded after final closure and positioning.
- Monitoring site marked; nursing and resident teams know the baseline.
- Donor-site neurovascular examination and restrictions documented.

CHAPTER C

Appendix C: Glossary

High-yield terms used throughout the free-flap series

Table 12. *Glossary of foundational reconstructive terms.*

Term	Definition
Adipofascial flap	Vascularized fat and fascia without a skin paddle, useful for thin coverage or conformable volume.
Chimeric flap	Multiple tissue components supplied by separate branches of one source vascular system, allowing independent positioning.
Fasciocutaneous flap	Skin and subcutaneous tissue transferred with its investing fascia and vascular pedicle.
Flow-through flap	A flap whose vascular pedicle also reconstructs recipient-vessel continuity or supplies a second flap distally.
Free flap	Tissue completely detached from its native blood supply and revascularized at a distant site by microvascular anastomosis.
Ischemia time	Interval between interruption of donor circulation and restoration of perfusion; definitions vary by institution.
Monitoring paddle	Externally visible skin component used to assess a flap whose critical tissue may be buried.
Myocutaneous flap	Muscle and overlying skin transferred together on a vascular pedicle.
Osteocutaneous flap	Vascularized bone and skin supplied by the same source pedicle.
Perforator	Vessel that traverses or passes between deeper structures to supply skin and subcutaneous tissue.
Recipient vessels	Artery and vein at the defect site to which the donor pedicle is anastomosed.
Regional flap	Pedicled tissue transferred within its arc of rotation without dividing and reanastomosing the source vessels.
Vessel-depleted neck	Previously treated neck in which standard recipient vessels are absent, scarred, irradiated, thrombosed, or oncologically unavailable.
Venous coupler	Mechanical device used to create a venous anastomosis by everting vessel ends over rings and coupling them.
Virtual surgical planning	Computer-assisted planning of osteotomies, plates, guides, and skeletal positioning from imaging data.

CHAPTER D

Appendix D: References and Figure Credits

Core reviews, open-access articles, consensus guidance, and attribution for reproduced figures

This guide synthesizes reconstructive reviews, open-access clinical series, and perioperative consensus guidance. It is an educational review rather than a substitute for local protocols, multidisciplinary planning, or attending-level patient-specific judgment.

Core references

1. Chim H, Salgado CJ, Seselgyte R, Wei FC, Mardini S. Principles of head and neck reconstruction: an algorithm to guide flap selection. Semin Plast Surg. 2010;24:148-154. doi:10.1055/s-0030-1255332.
2. Cannady SB, Hatten KM, Bur AM, et al. Head and neck reconstruction. Plast Reconstr Surg. 2018;141:510e-520e.
3. Hanasono MM. Reconstructive surgery for head and neck cancer patients. Adv Med. 2014;2014:795483.
4. Kim S, Lee DH, Ahn KM. Microvascular reconstruction for maxillofacial defects: a retrospective analysis of outcomes and complications in 121 consecutive cases. Maxillofac Plast Reconstr Surg. 2020;42:29. doi:10.1186/s40902-020-00273-4.
5. Ferrari S, Copelli C, Bianchi B, et al. Free flaps in elderly patients: outcomes and complications in head and neck reconstruction after oncological resection. J Craniomaxillofac Surg. 2013;41:167-171.
6. Herle P, Shukla L, Morrison WA, Shayan R. Preoperative radiation and free flap outcomes for head and neck reconstruction: a systematic review and meta-analysis. ANZ J Surg. 2015;85:121-127.
7. Prince ADP, Broderick MT, Roughton MC, et al. Head and neck reconstruction in the vessel depleted neck. Front Oral Maxillofac Med. 2020;2:13.
8. Benatar MJ, Dassonville O, Chamorey E, et al. Impact of preoperative radiotherapy on head and neck free flap reconstruction: a report on 429 cases. J Plast Reconstr Aesthet Surg. 2013;66:478-482.
9. Chang EI, Zhang H, Liu J, Yu P, Skoracki RJ, Hanasono MM. Analysis of risk factors and prevention strategies for free flap compromise in head and neck reconstruction. Head Neck. 2016;38 Suppl 1:E661-E668.
10. Zhou W, Zhang WB, Yu Y, et al. Risk factors for free flap failure: a retrospective analysis of 881 free flaps for head and neck defect reconstruction. Int J Oral Maxillofac Surg. 2017;46:941-945.
11. Dort JC, Farwell DG, Findlay M, et al. Optimal perioperative care in major head and neck cancer surgery with free flap reconstruction: enhanced recovery after surgery society recommendations. JAMA Otolaryngol Head Neck Surg. 2017;143:292-303.
12. Swanson M, Wong A, Schaefer E, et al. Intraoperative vasopressor use is not associated with increased free flap failure and complication rates. Front Pharmacol. 2022;13:880098.
13. Kim BD, Ver Halen JP, Mlodinow AS, Kim JYS. Intraoperative transfusion of packed red blood cells in microvascular free tissue transfer patients: assessment of 30-day morbidity using NSQIP. J Reconstr Microsurg. 2014;30:103-114.
14. Vincent A, Kohlert S, Lee TS, Inman J, Ducic Y. Free-flap reconstruction of the tongue. Semin Plast Surg. 2019;33:38-45. doi:10.1055/s-0039-1677789.
15. Brown JS, Shaw RJ. Reconstruction of the maxilla and midface: introducing a new classification. Lancet Oncol. 2010;11:1001-1008.
16. Vincent A, Burkes J, Williams F, Ducic Y. Free flap reconstruction of the maxilla. Semin Plast Surg. 2019;33:30-37. doi:10.1055/s-0039-1677701.
17. Moreno MA, Skoracki RJ, Hanna EY, Hanasono MM. Microvascular free flap reconstruction versus palatal obturation for maxillectomy defects. Head Neck. 2010;32:860-868.
18. Balasubramanian D, Subramaniam N, Rathod P, et al. Outcomes following pharyngeal reconstruction in total laryngectomy. Indian J Plast Surg. 2018;51:190-195.

19. Piazza C, Taglietti V, Nicolai P. Reconstructive options after total laryngopharyngectomy. Curr Opin Otolaryngol Head Neck Surg. 2012;20:77-84.

20. Murray DJ, Novak CB, Neligan PC. Fasciocutaneous free flaps in pharyngolaryngo-oesophageal reconstruction: a critical review. J Plast Reconstr Aesthet Surg. 2008;61:1148-1156.

21. Jacobson AS, Eloy JA, Park E, et al. Vessel-depleted neck: techniques for achieving microvascular reconstruction. Head Neck. 2008;30:201-207.

22. Zhang C, Sun J, Zhu H, Xu L, Ji T, He Y. Oromandibular reconstruction: operative options and strategies. ISRN Surg. 2011;2011:824251.

23. Wang X, Zhang Y, Mu X, et al. Reconstruction of composite oral and maxillofacial defects by free flaps based on a new classification. Sci Rep. 2020;10:4300. doi:10.1038/s41598-020-61345-z.

24. Cordeiro PG, Disa JJ. Challenges in midface reconstruction. Semin Surg Oncol. 2000;19:218-225.

25. Spiegel JH, Polat JK. Microvascular flap reconstruction by otolaryngologists: prevalence, postoperative care, and monitoring techniques. Laryngoscope. 2007;117:485-490.

26. Salgado CJ, Moran SL, Mardini S. Flap monitoring and patient management. Plast Surg Nurs. 2009;29:13-19.

27. Sweeny L, Rosenthal EL, Light T, et al. Outcomes and cost implications of microvascular reconstructions of the head and neck. Head Neck. 2019;41:930-939.

28. Patel UA, Moore BA, Wax M, et al. Impact of postoperative monitoring on early detection and salvage of free flaps. Arch Otolaryngol Head Neck Surg. 2007;133:871-875.

Figure credits and licenses

Table 13. *Figure attribution and adaptation notes.*

Figure group	Credit
Cover montage	Kim et al. 2020, CC BY 4.0; Zhang et al. 2011 open access; Wang et al. 2020, CC BY 4.0. Cropped and arranged for this guide.
Through-and-through cheek, perforator ALT, and chimeric fibula figures	Wang X et al. Scientific Reports. 2020;10:4300. Article and figures licensed CC BY 4.0. Cropped for legibility.
Radial forearm tongue, latissimus, and other maxillofacial cases	Kim S et al. Maxillofac Plast Reconstr Surg. 2020;42:29. Licensed CC BY 4.0. Cropped for legibility.
Oromandibular defect classification and sequence	Zhang C et al. ISRN Surgery. 2011;2011:824251. Open-access article; figures adapted/cropped.
External carotid branches	Sobotta anatomical plate via Wikimedia Commons; public domain.
Maxillectomy figures	Vincent A et al. Semin Plast Surg. 2019;33:30-37. Used as limited educational figures with attribution; cropped from the publicly accessible article PDF.
Original diagrams	Reasoning chain, treatment timeline, reconstructive ladder, defect audit, oral-cavity schematic, flap physiology, and master algorithm created specifically for this guide.

Online access

Principles of head and neck reconstruction

Free-flap reconstruction of the tongue

Oromandibular reconstruction

ERAS Society head and neck recommendations

Composite defect classification

Free-flap reconstruction of the maxilla

Postoperative monitoring review