FREE-FLAP RECONSTRUCTION | FOR HEAD AND NECK CANCER

VOLUME V

The Postoperative Flap

Monitoring, Vascular Compromise, Salvage, Complications, Rehabilitation, and Long-Term Outcomes

Cover montage. Representative oral, through-and-through cheek, oromandibular, and large composite reconstructions. Open-access web figures; full credits in Appendix E.

A resident-level guide from PACU handoff through survivorship

Resident study guide • July 2026

How to use this volume

This volume begins when the last skin suture is placed. The postoperative flap is not a passive wound: it is a newly constructed vascular organ whose survival depends on the continuity of one arterial inflow pathway, one or more venous outflow pathways, a protected pedicle geometry, and adequate systemic perfusion. The resident's task is to know the operative baseline, detect a meaningful change early, and escalate before tissue injury becomes irreversible.

The same patient then moves through a second sequence of problems. During the first hours, the dominant threats are thrombosis, kinking, compression, hematoma, hypotension, and airway compromise. Over the next days and weeks, salivary contamination, infection, fistula, dehiscence, donor-site morbidity, malnutrition, and pulmonary complications become more prominent. Months later, recurrence, radiation fibrosis, stricture, hardware problems, contour change, and functional disability replace flap patency as the central questions. This volume follows that chronology.

CORE CLINICAL PRINCIPLE

A free flap rarely fails silently if the team knows the baseline and examines it consistently. The dangerous delay usually occurs when an abnormal finding is explained away, compared with the wrong reference point, or deferred to the next scheduled check.

Learning objectives

- Construct a postoperative handoff that transfers the flap's anatomy, pedicle geometry, monitoring plan, airway plan, and escalation thresholds.
- Perform and document a reproducible flap examination and distinguish arterial insufficiency from venous congestion.
- Use Doppler and adjunctive monitoring devices as supplements to—not replacements for—clinical reasoning.
- Initiate the resident response to a threatened flap without delaying operative salvage for low-yield testing.
- Recognize and manage common early wound, airway, salivary, infectious, donor-site, and systemic complications.
- Coordinate nutrition, mobilization, swallowing, speech, dental, and adjuvant-treatment goals.
- Approach late swelling, pain, drainage, dysphagia, and functional decline with a differential that includes recurrence, treatment effect, infection, hardware, and mechanical dysfunction.

The postoperative story at a glance

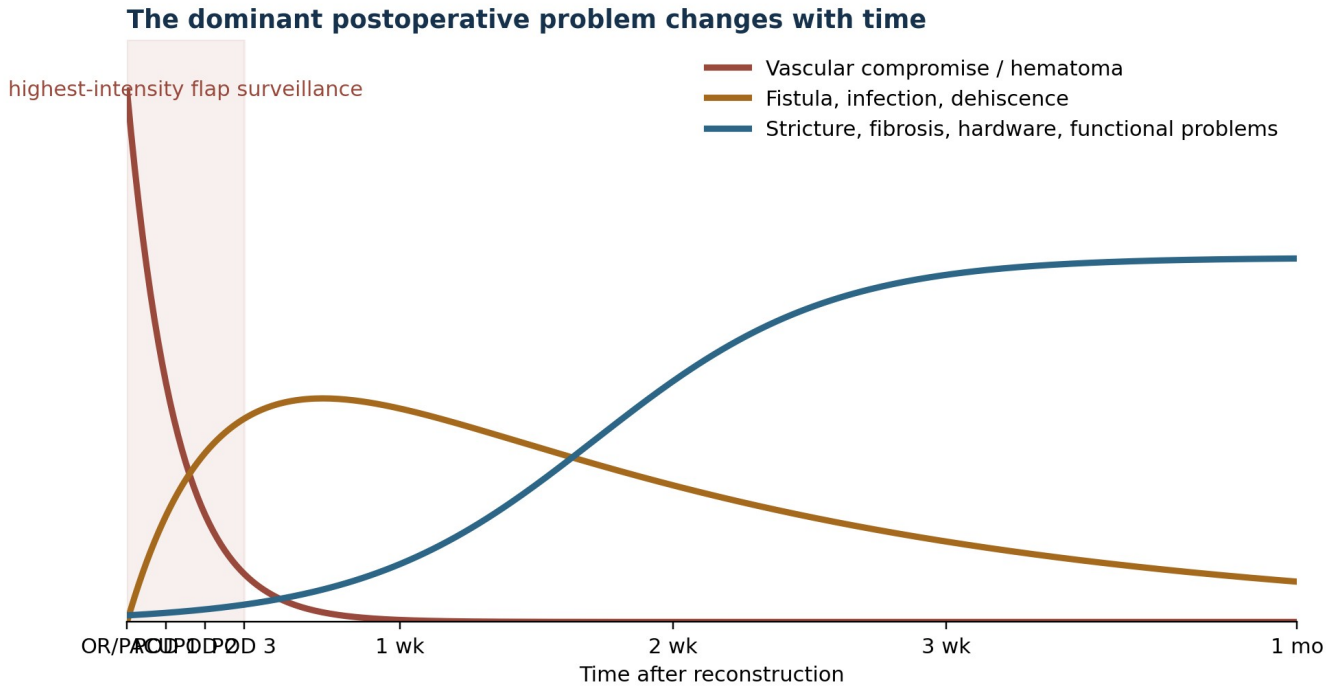


Figure 1. The dominant postoperative threat changes with time. The curves are conceptual rather than incidence estimates; they emphasize why surveillance priorities must evolve. Original synthesis diagram created for this guide.

Table 1. The postoperative phase changes the resident's primary question.

Phase	Dominant question	High-risk problems	Resident endpoint
OR to POD 3	Is the vascular construct patent and mechanically protected?	Arterial or venous thrombosis, hematoma, kinking, compression, systemic hypoperfusion, airway compromise	Stable serial examination and immediate escalation of any concerning change
POD 3 to discharge	Is the reconstruction healing without contamination or systemic deterioration?	Salivary leak, infection, pneumonia, delirium, chyle leak, donor-site problems, malnutrition	Controlled wound, safe airway, nutrition and mobility plan
Early follow-up	Can the patient progress through rehabilitation and adjuvant therapy?	Fistula, dehiscence, aspiration, trismus, wound breakdown, delayed donor healing	Durable closure and treatment-ready recovery
Late survivorship	Is new dysfunction caused by recurrence, treatment effect, hardware, or altered mechanics?	Recurrence, fibrosis, stricture, osteoradionecrosis, plate exposure, lymphedema, contour change	Diagnosis tied to function, oncologic surveillance, and a realistic revision plan

PART I

The First 72 Hours

Establish the operative baseline, examine the flap reproducibly, and understand what each monitoring signal can—and cannot—tell you.

01

The immediate handoff

The postoperative team cannot recognize a change unless it knows what was built and what “normal” looked like before the patient left the operating room.

A generic statement such as “fibula free flap, good Doppler” is not an adequate handoff. The receiving resident or nurse needs a mental map of the construct. Which component is visible? Does the visible skin paddle directly reflect the bone segment or a separate perforator? Where does the pedicle travel? Which vessel produces the marked arterial signal? Is the venous signal audible? Was the skin paddle naturally pale or thick? Was capillary refill brisk or difficult to assess? Was the flap edematous at baseline? What neck position was used when the final signals were checked?

The handoff should also distinguish flap-specific findings from patient-wide physiology. A cool, pale flap in a vasoconstricted, hypothermic patient may improve with systemic correction; a newly pale flap with lost bleeding and an absent arterial signal should not be normalized by the presence of a low blood pressure alone. The important comparison is simultaneous: flap versus baseline, flap versus adjacent tissue, and local findings versus the entire patient.

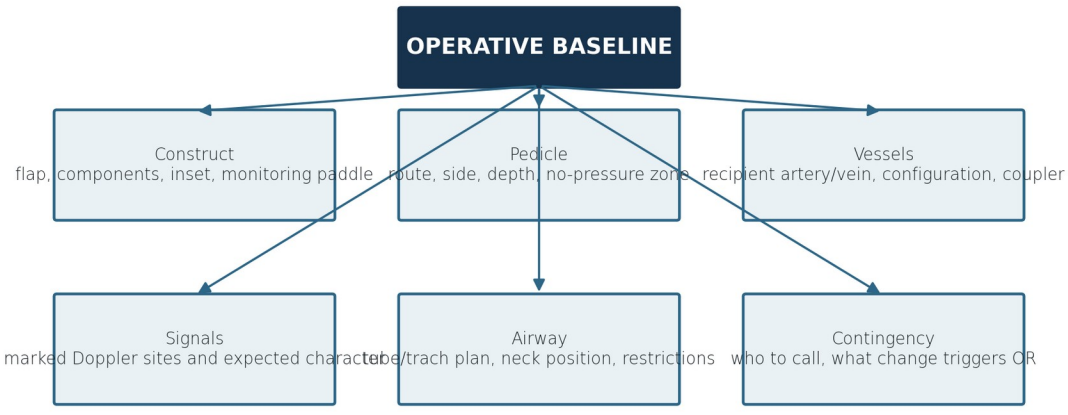


Figure 2. Minimum domains of a useful free-flap handoff. The baseline converts later observations into interpretable change. Original synthesis diagram created for this guide.

Table 2. Minimum postoperative handoff dataset.

Domain	What the receiver should know	Why it matters
Construct	Flap type; tissue components; orientation; visible or buried; location of monitoring paddle	The visible skin may not represent every component equally.
Pedicle	Side, route, depth, points vulnerable to compression, neck-position restrictions	A patent anastomosis can still fail from downstream geometry.
Recipient vessels	Artery, vein(s), end-to-end or end-to-side configuration, coupler size if used	Directs interpretation and exploration.
Baseline examination	Color, temperature, turgor, refill, pinprick response, marked Doppler character	Serial change is more informative than a textbook adjective.
Airway and drains	ETT or tracheostomy, planned position, cuff plan, drain trajectories, no-pressure zones	Airway devices and drains can threaten the pedicle or neck closure.
Medication and physiology	Antithrombotic plan, DVT prophylaxis, transfusion or pressure goals, antibiotic plan	Prevents conflicting generic orders.
Escalation	Who must be called, expected response time, bedside actions permitted, OR pathway	The first abnormal check is not the time to discover the chain of command.

AT THE BEDSIDE

Before accepting the handoff, find the flap, find every marked Doppler site, reproduce the baseline examination yourself, and verify the safe head and neck position. A documented signal that the receiver cannot locate is not a transferred baseline.

02

The normal postoperative flap

Normal is a trajectory, not a color chart.

A healthy skin paddle is generally warm, soft or appropriately full, and similar in color to its donor skin. Capillary refill is usually prompt but not instantaneous. Pinprick—when part of the local protocol—produces bright red blood after a brief delay rather than no blood or immediate dark venous ooze. The arterial Doppler signal should have a stable, pulsatile character at the marked site. A venous signal, when monitored, is lower-pitched and often changes with gentle respiratory or positional variation.

The expected appearance depends on the donor and inset. A radial forearm paddle is thin and may appear relatively pale. An ALT paddle can be thick, naturally mottled, or difficult to blanch. Intraoral lighting distorts color, saliva obscures the surface, and pressure from the tongue or teeth can alter refill. A muscle flap without a skin paddle may have no direct surface examination. A jejunal flap has

mucosal color and peristalsis rather than cutaneous characteristics. These are reasons to establish a patient-specific baseline—not reasons to abandon clinical examination.

Some edema is expected after a long operation, fluid administration, and reperfusion. Edema becomes concerning when it is asymmetric, rapidly progressive, tense, associated with darkening or very brisk refill, accompanied by loss or change in venous signal, or explained by a growing neck hematoma. Similarly, a stable surface crust is different from progressive epidermolysis, edge necrosis, or a change in bleeding quality.

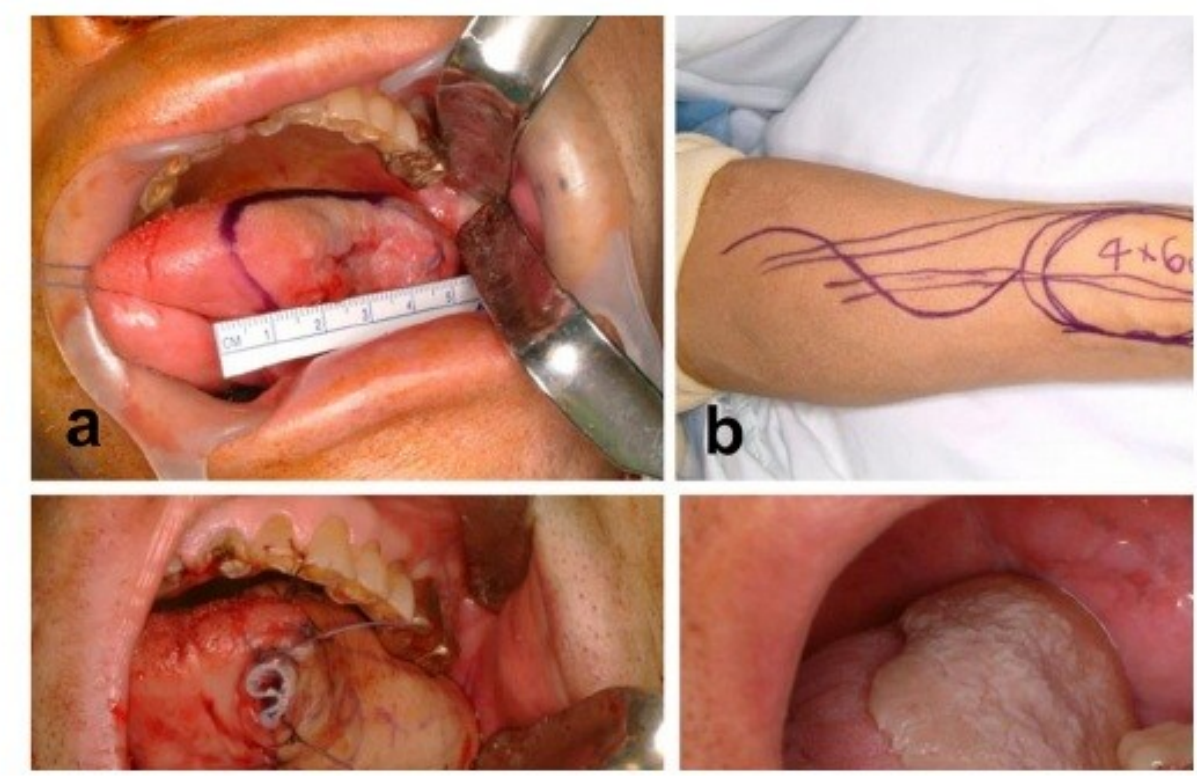


Figure 3. Radial forearm free-flap reconstruction of a lateral tongue defect, demonstrating the thin intraoral skin paddle that must be assessed under consistent lighting and compared with its operative baseline. Kim et al., 2020; CC BY 4.0.

Table 3. Expected findings versus a concerning trend.

Parameter	Generally reassuring	Concerning change
Color	Stable donor-skin color; mild expected pallor	New pallor/whitening, dusky blue-purple change, patchy mottling that progresses
Temperature	Warm or similar to surrounding tissue	New coolness, particularly with other inflow findings
Turgor	Soft or appropriately full	Flat and empty, or rapidly tense and swollen
Capillary refill	Prompt and reproducible	Markedly delayed/absent, or nearly instantaneous with congestion
Bleeding	Bright red after brief delay when tested per protocol	No/scant blood or rapid dark venous bleeding

Parameter	Generally reassuring	Concerning change
Doppler	Stable character at the marked point	Loss, progressive weakening, new monophasic/water-hammer character, or discordance with the clinical exam
Incision/neck	Expected edema without expansion	Expanding swelling, firmness, drain failure, tracheostomy tie or dressing pressure

BOARDS PEARL

Venous obstruction may initially preserve an arterial Doppler signal. The flap can become blue, swollen, and briskly refill while arterial inflow continues into a closed outflow system.

03

A reproducible flap examination

Consistency turns subjective findings into a trend.

The examination should be performed in the same sequence, under adequate light, with the patient and neck in the prescribed position. First look at the flap and surrounding wound. Then feel temperature and turgor. Blanch a consistent area and observe refill. Listen at the marked signals. Perform pinprick only when it is part of the reconstructive team's protocol, because repeated puncture can injure the paddle and poorly placed puncture may miss the diagnostic surface.

Document the exact findings and the comparison point. "Flap checks good" is nearly useless if the next examiner sees a change. A better note states: "Skin paddle warm, pink and soft; capillary refill approximately 2 seconds; bright red bleeding after 5 seconds at the marked inferolateral site; strong biphasic arterial signal and stable venous signal; neck soft; no increasing edema compared with 0200." The purpose is not literary detail. It is to leave a reproducible physiological record.

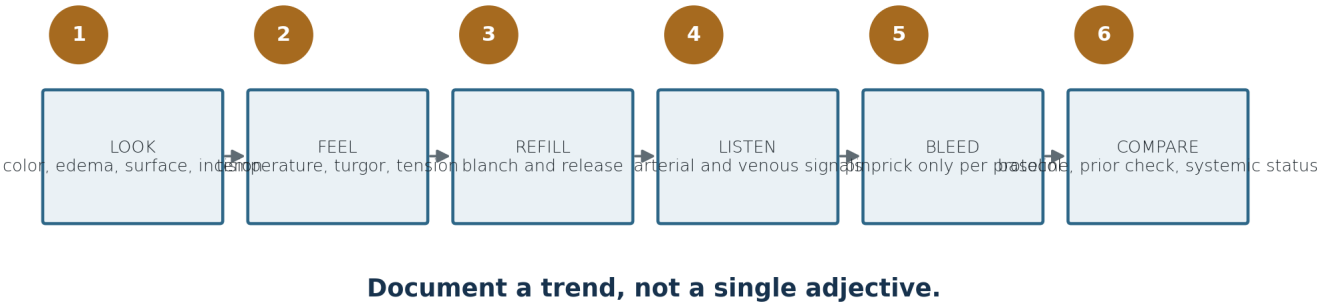


Figure 4. A six-step bedside flap examination. The sequence is intentionally simple so that it can be reproduced under pressure. Original synthesis diagram created for this guide.

Table 4. Practical examination pitfalls.

Pitfall	Why it misleads	Correction
Inconsistent lighting	Warm and cool light sources change perceived color, especially intraorally.	Use a reliable light source and compare with the prior examination.
Listening over native vessels	A facial or carotid signal may remain audible despite flap-vessel compromise.	Use the intraoperatively marked site and confirm that the signal belongs to the pedicle.
Testing a different paddle region each time	Perforator distribution and thickness produce regional variation.	Use a consistent diagnostic area away from the edge or suture line.
Equating any Doppler with perfusion	Doppler detects flow at a point, not necessarily tissue-level delivery and drainage.	Interpret signal with color, refill, turgor, temperature, and bleeding.
Ignoring systemic physiology	Hypothermia, vasoconstriction, anemia, hypoxemia, and low cardiac output alter the whole flap.	Examine the patient and correct systemic contributors while escalating local concern.
Waiting for all classic signs	Textbook findings may appear late or be incomplete.	Act on a convincing change pattern and trend.

04

Monitoring frequency and location of care

Intensity should match risk; location should match capability.

Most vascular compromise presents early, with the first 24 to 48 hours carrying the greatest value for intensive surveillance. Many institutions continue frequent checks through 72 hours and then taper. Exact intervals vary by reconstructive team, nursing model, monitoring technology, patient comorbidity, flap accessibility, and institutional experience. A rigid universal schedule is less important than ensuring that the team performing each check is trained, the escalation pathway is immediate, and no reduction in frequency occurs simply because the patient moves to a lower-acuity unit.

Routine ICU admission is not inherently required for every uncomplicated free flap. Specialized step-down or floor pathways can be safe when they provide appropriate nurse-to-patient ratios, airway capability, flap-monitoring expertise, hemodynamic support, and rapid access to the operating room. Conversely, the ICU may be necessary for ventilatory support, complex airway management, severe comorbidity, vasopressor titration, massive transfusion, delirium risk, or other critical illness. The flap itself is only one reason for the care location.

PROTOCOL DISCIPLINE

Follow the reconstructive team's written monitoring schedule. The guide teaches interpretation and escalation; it does not replace local check intervals, pinprick rules, antithrombotic orders, or unit criteria.

Table 5. Factors that justify higher monitoring intensity.

Factor	Reason
Buried or difficult-to-see flap	Clinical examination is less direct and device interpretation may carry more weight.
Questionable intraoperative flow or revision	The construct has already demonstrated vulnerability.
Vessel-depleted or irradiated neck	Recipient quality and pedicle routing are less forgiving.
Long pedicle, vein graft, or complex geometry	More potential sites exist for kinking, compression, and thrombosis.
Large transfusion, hemodynamic instability, or severe cardiopulmonary disease	Systemic oxygen delivery may fluctuate.
Agitation, inability to maintain position, or difficult airway	Movement and urgent airway interventions can threaten the reconstruction.
Limited local examination expertise	Objective adjuncts and senior review may need to be deployed earlier.

05

Doppler and adjunctive technologies

A monitor is useful when the team understands what structure it measures, where it can fail, and how it changes management.

Handheld acoustic Doppler is the most common adjunct. It is inexpensive, rapid, and familiar, but it is intermittent and operator dependent. The device may detect a nearby native artery rather than the flap pedicle, and a preserved arterial signal does not exclude venous obstruction. The signal's location and character should be marked in the operating room and transferred during handoff.

Implantable Doppler probes and flow couplers provide continuous or readily accessible signals at a vessel, which is especially attractive for buried flaps. They can detect change before a surface paddle becomes abnormal, but false-positive signal loss can occur from displacement, wire problems, patient position, or device malfunction. A high negative predictive value is reassuring when the signal remains stable; a lost signal still requires immediate clinical correlation and senior review.

Near-infrared spectroscopy, laser Doppler flowmetry, tissue oxygenation systems, hyperspectral imaging, thermal imaging, and color duplex ultrasonography can provide objective information about tissue perfusion or vessel flow. Their value depends on device-specific thresholds, probe placement, flap thickness, movement, skin pigmentation, ambient light, tissue depth, and local familiarity. No device abolishes the need to examine the patient or to return to the operating room when the combined evidence suggests vascular compromise.

Figure 5. Through-and-through cheek reconstruction with a perforator-based ALT flap. An external skin paddle provides a visible monitoring surface, but the resident must remember that tissue thickness, paddle geometry, and perforator location influence the surface examination. Wang et al., 2020; CC BY 4.0.

Table 6. Monitoring methods: what they measure and where they mislead.

Method	Primary information	Strengths	Limitations / false alarms
Clinical examination	Tissue-level color, refill, turgor, temperature, bleeding	Fast, inexpensive, evaluates whole construct surface	Subjective; difficult in buried or intraoral flaps; depends on experience and lighting
Handheld Doppler	Flow-related acoustic signal at a superficial vessel	Available, repeatable, inexpensive	May sample native vessel; intermittent; venous failure may preserve arterial signal

Method	Primary information	Strengths	Limitations / false alarms
Implantable Doppler / flow coupler	Flow at the instrumented artery or vein	Continuous; useful in buried flaps; early change detection	Probe displacement, wire/device failure, false-positive loss; measures one site
NIRS / tissue oximetry	Regional tissue oxygen saturation trend	Continuous and objective; trend-based alerts	Thresholds vary by flap/device; motion, thickness, probe pressure and systemic factors interfere
Laser Doppler / O2C	Microvascular flow plus spectroscopic oxygenation/hemoglobin metrics	Tissue-level data; may distinguish patterns	Depth- and probe-specific values; cost; movement/contact effects
Color duplex ultrasound	Anatomic and flow assessment of vessels	Can evaluate buried pedicle and quantify flow	Operator and equipment dependent; intermittent; may delay OR if used indiscriminately
ICG angiography	Perfusion distribution after contrast bolus	Excellent intraoperative mapping of poorly perfused regions	Not a continuous postoperative monitor; contrast and logistics

INTERPRETATION RULE

A device should shorten time to recognition. When it creates a prolonged debate about whether the machine or the flap is wrong, perform a complete examination and call the reconstructive surgeon.

PART II

The Threatened Flap

Recognize inflow failure, outflow failure, and mechanical compression as time-sensitive surgical problems.

06

Arterial insufficiency

The flap is underfilled because oxygenated blood is not reaching the tissue.

Arterial compromise classically produces a pale, cool, soft or empty flap with delayed or absent capillary refill, scant or absent bleeding, and a weakened or absent arterial signal. The process may begin subtly: the signal becomes less robust, bleeding is delayed, or the flap gradually loses warmth. Complete thrombosis produces a clearer pattern, but waiting for every sign sacrifices salvage time.

The differential includes arterial thrombosis at the anastomosis, pedicle kinking or tension, vasospasm, external compression, intimal injury, severe systemic hypoperfusion, and—in osseous or chimeric constructs—component-specific perforator compromise. A patient with global shock may have a poorly perfused flap without a technical thrombosis. However, systemic hypotension should not be used to explain an isolated abnormal flap. Correct systemic physiology while the local evaluation and escalation proceed in parallel.

The resident should confirm the finding, check the head and neck position, remove clearly external pressure according to protocol, assess the neck for hematoma, review the marked signals, and call the reconstructive surgeon immediately. Warm blankets, fluid, or a vasopressor adjustment are not substitutes for exploration when the pattern persists.

BOARDS PEARL

Pale + cool + delayed refill + absent/scant bright bleeding suggests arterial inflow failure. The definitive response to a persistent convincing pattern is urgent exploration, not observation for evolution.

07

Venous congestion

The flap receives inflow but cannot empty.

Venous obstruction produces an increasingly full, tense, blue-purple or dusky flap with rapid capillary refill and brisk dark bleeding. The skin paddle may initially remain warm because arterial inflow continues. The arterial Doppler can remain strong early and may develop a high-resistance or water-hammer character as venous pressure rises. A monitored venous signal may disappear first.

Venous thrombosis is common because the venous system is low pressure and sensitive to kinking, compression, size mismatch, valve orientation, and pedicle redundancy. A tight tunnel, bite pressure on an intraoral paddle, dependent neck position, drain compression, hematoma, tight closure, or

tracheostomy ties can create outflow obstruction without primary anastomotic thrombosis. The resident's examination must therefore extend from the skin paddle to the entire route and neck.

Temporary improvement after repositioning or releasing external pressure is informative but not automatically definitive. Recurrent congestion suggests that the underlying geometry remains unstable. A flap that repeatedly normalizes only in one carefully held position may need operative correction rather than a prolonged bedside workaround.

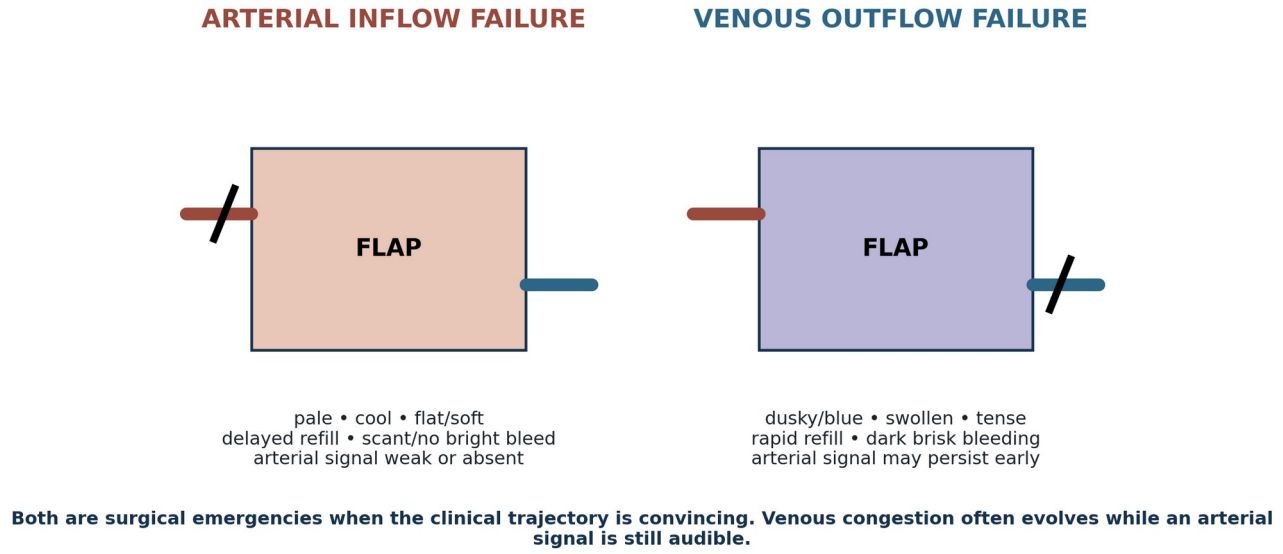


Figure 6. Conceptual arterial inflow failure versus venous outflow failure. Real flaps may show incomplete or mixed patterns; the point is to recognize the direction of the physiology. Original synthesis diagram created for this guide.

Table 7. Arterial versus venous compromise.

Finding	Arterial insufficiency	Venous congestion
Color	Pale, white, gray	Dusky, blue, purple
Temperature	Cool	May be warm early; can cool late
Turgor	Soft, flat, empty	Tense, swollen, boggy
Capillary refill	Delayed or absent	Very brisk / nearly immediate
Pinprick	Scant or no blood; may be delayed	Rapid dark venous bleeding
Arterial Doppler	Weak or absent	May persist; can become high resistance
Venous Doppler	May be present if inflow gradually declines	Often lost or altered
Common mechanical causes	Kink, tension, compression, spasm	Kink, compression, redundancy, tight tunnel/closure
Clinical action	Immediate escalation and likely exploration	Immediate escalation and likely exploration

08

Hematoma, compression, kinking, and position

A normal anastomosis cannot rescue a pedicle that is mechanically obstructed.

An expanding neck hematoma can threaten both the airway and the flap. Venous compression usually occurs before arterial inflow is lost, so the first flap finding may be congestion. Neck firmness, asymmetry, increasing drain output followed by sudden cessation, sanguineous swelling, tracheal deviation, respiratory distress, or a rapidly changing flap should trigger urgent assessment. The airway and the flap may require simultaneous rescue.

External compression can be deceptively mundane: a tracheostomy tie crosses the pedicle, a circumferential dressing is too tight, the patient rests on the reconstructive side, the tongue compresses an intraoral pedicle, or the head is rotated away from the position in which the pedicle was checked. Internal causes include a narrow tunnel, drain tubing, redundant loop, acute angle around the mandible, plate edge, or swollen tissue.

Safe bedside actions are limited to those explicitly allowed by the reconstructive team: restoring the prescribed neutral position, removing or loosening obvious external pressure, correcting hypotension or hypoxemia, and exposing the flap for examination. Blindly opening the neck, manipulating the pedicle, repeatedly milking the flap, or placing unapproved needles is dangerous. When hematoma or vascular compromise is suspected, mobilize the operating room.

Table 8. Lost or changed Doppler: a rapid differential.

Cause	Clues	Do not miss
True arterial occlusion	Clinical pallor, delayed refill, no bright bleeding	Urgent exploration
Venous obstruction with high resistance	Congested flap; arterial signal may become abnormal before disappearing	Outflow failure despite “some Doppler”
Probe moved / wrong site	Flap otherwise stable; signal found nearby or after repositioning device	Still requires complete examination and senior correlation
Native vessel sampled previously	Signal persists while flap exam worsens, or site not clearly transferred	Do not let a non-pedicle signal reassure you
Patient position or external compression	Signal changes reproducibly with neck position or pressure relief	Recurrent positional dependence may require operative correction
Systemic low flow / vasoconstriction	Global hypotension, hypothermia, cool extremities, multiple weak signals	Correct systemically while excluding local technical failure
Device/wire failure	Implantable monitor alarm without concordant exam	Device failure is a diagnosis made with the reconstructive team, not by waiting

09

The resident’s failing-flap algorithm

The algorithm exists to shorten the interval between first abnormality and definitive decision.

The first step is to repeat the examination immediately, not at the next scheduled check. Confirm the signal at the marked site, compare with the documented baseline, inspect the neck and airway, and review the patient’s hemodynamics, oxygenation, temperature, and hemoglobin. Restore the prescribed head position and remove obvious external compression if this is within protocol. The reconstructive surgeon should be called while these steps occur—not after they fail.

The communication should be concrete: “POD 1 fibula flap; over 20 minutes the paddle became purple and tense, refill is now instantaneous, dark blood appears immediately on protocol pinprick, venous signal is absent, arterial signal remains strong, neck is soft, MAP 78, and the findings did not resolve with neutral position.” This creates an operative decision. “Flap looks a little off” does not.

Imaging has a limited role in an acutely threatened, clinically accessible flap. Duplex ultrasound may help in selected buried flaps or ambiguous cases when it can be obtained immediately without delaying exploration. CT angiography is rarely the correct next step for a classic early vascular compromise pattern. The definitive test is often surgical exploration.

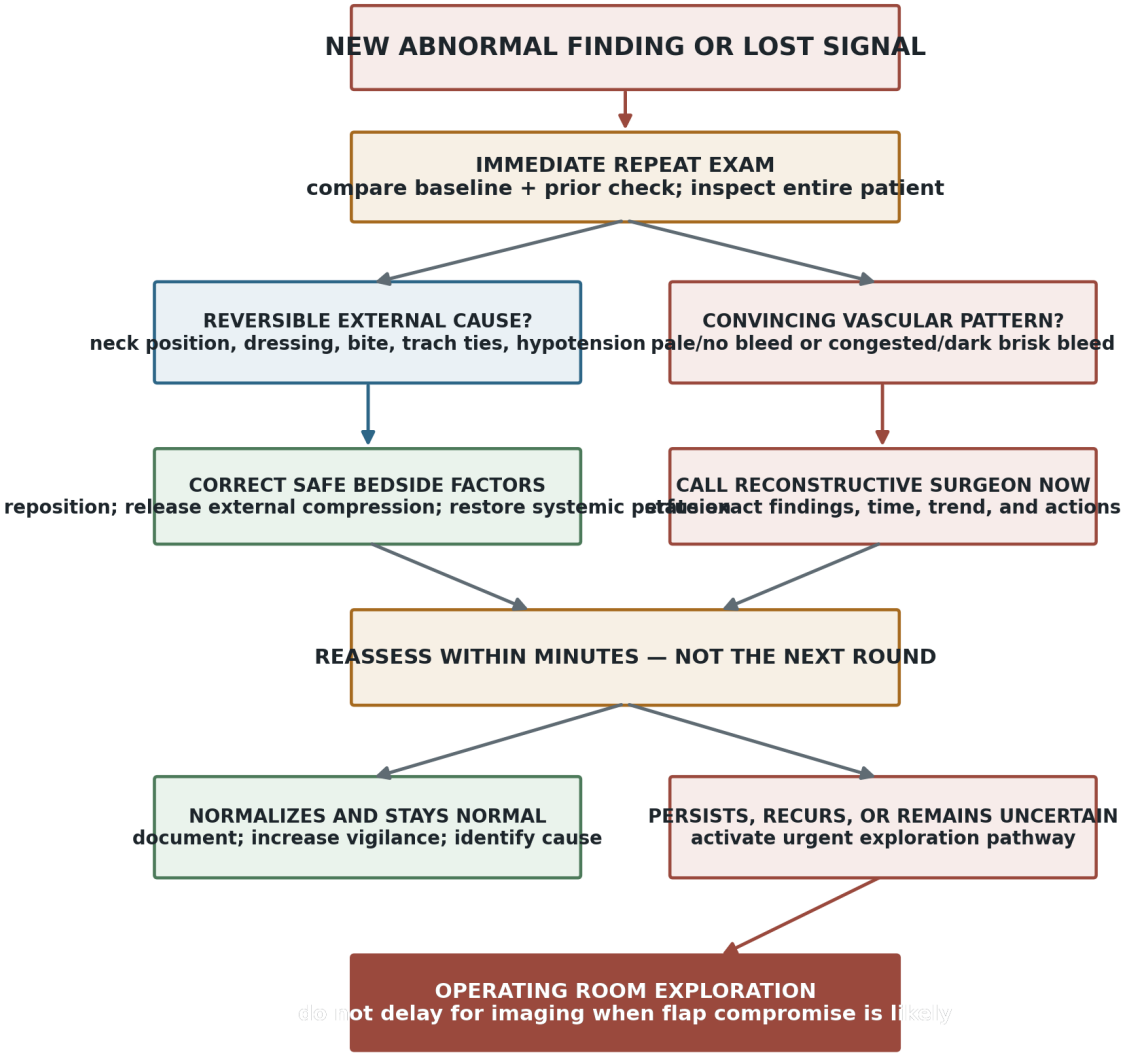


Figure 7. Resident response to a new abnormal flap finding. The pathway emphasizes parallel correction, escalation, and reassessment within minutes. Original synthesis diagram created for this guide.

WORDS THAT SHOULD TRIGGER ACTION

New pallor; new congestion; progressive swelling; absent or changed signal; no bleeding; immediate dark bleeding; expanding neck; positional loss of signal; discordance between monitor and examination.

10

Return to the operating room

Exploration must identify and correct the cause, not simply remove a clot.

Exploration begins by releasing the closure and any hematoma, then assessing the pedicle route before assuming the anastomosis is the only problem. The surgeon looks for twist, kink, tension, compression, unfavorable vessel orientation, or a tight tunnel. Arterial and venous inflow/outflow

are assessed in an orderly fashion. A thrombus may require opening the anastomosis, thrombectomy, irrigation, revision to healthier vessel, addition of venous outflow, or an interposition graft. The exact sequence varies, but the principle is constant: repair the lesion and the mechanical environment that produced it.

After reperfusion, the team must confirm tissue-level recovery—warmth, color, refill, appropriate bleeding, and stable signals—not only visible flow through a vessel. The inset and closure are then reconstructed with greater protection for the repaired pathway. A second thrombosis after technically successful revision often reflects persistent geometry, damaged intima, inadequate recipient vessel, ongoing hypercoagulability, or unrecognized outflow limitation.

Thrombolytic agents have been described for selected salvage situations, usually after mechanical thrombectomy and under direct operative control. Their use is surgeon- and protocol-specific because bleeding risk is substantial in a fresh head and neck wound. They are not a bedside therapy and should not distract from mechanical correction.

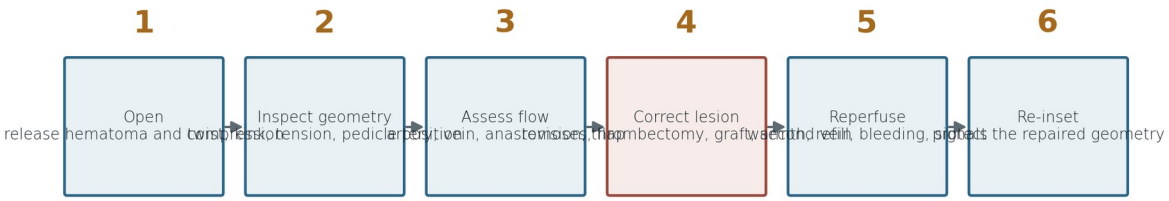


Figure 8. A structured exploration sequence. The lesion may be in the wound geometry, anastomosis, recipient vessel, pedicle, or flap itself. Original synthesis diagram created for this guide.

Table 9. Common exploration findings and corrective principles.

Finding	Corrective principle
Hematoma or tight closure	Evacuate, secure hemostasis, re-create a noncompressive pedicle corridor.
Pedicle twist or kink	Reorient and secure the route; eliminate the geometry that recurs after closure.
Arterial thrombus	Revise to healthy intima, remove thrombus, correct tension/size mismatch/spasm.
Venous thrombus	Thrombectomy and revision; assess redundancy, valve, coupler, recipient vein, and need for additional outflow.
Recipient-vessel injury or poor quality	Move to a healthier segment or alternative vessel; use graft only when geometry requires it.
Component-specific failure	Determine whether perforator or branch revision is possible and whether partial tissue remains salvageable.

Finding	Corrective principle
No correctable lesion with nonviable tissue	Debride and proceed to a planned reconstructive salvage strategy.

11

When the first flap cannot be salvaged

Failure is a reconstructive problem, not merely a technical endpoint.

When a flap is irreversibly nonviable, the immediate priorities are debridement of devitalized tissue, control of contamination, protection of great vessels and hardware, and restoration of the essential barrier or conduit. The next construct depends on why the first flap failed, what recipient vessels remain, the patient's physiologic reserve, the oncologic timeline, and the consequences of leaving the defect temporarily or permanently incomplete.

A second free flap often offers the best chance of restoring the original reconstructive goals and has high reported success in experienced centers. However, repeating the same design without understanding the cause of failure invites recurrence. Alternative recipient vessels, a different pedicle route, a different donor site, a regional flap, or staged reconstruction may be safer. In unstable patients, temporary wound control and delayed definitive reconstruction may be appropriate.

Table 10. Choosing the salvage construct after total flap loss.

Question	Implication
Why did the first flap fail?	Technical thrombosis, geometry, recipient quality, systemic shock, infection, or hypercoagulability require different corrections.
What must be restored now?	Carotid coverage and pharyngeal separation may be urgent; contour or dental goals can sometimes wait.
What vessels remain?	Contralateral neck, transverse cervical, thoracoacromial, internal mammary, or grafted pathways may be considered.
Can the patient tolerate another long operation?	Physiologic instability may favor regional tissue or staged treatment.
Is contamination controlled?	Active salivary soilage and necrosis must be debrided and isolated.
Will delay compromise adjuvant therapy?	A durable early solution may be more valuable than an ideal but protracted reconstruction.

PART III

Early Nonvascular Complications

Protect the airway, control contamination, and prevent local wound problems from becoming vascular catastrophes.

12

Airway and tracheostomy management

The airway plan is part of the reconstruction, not a separate postoperative checklist item.

Airway risk depends on the resection, flap bulk, tongue or floor-of-mouth edema, mandibular stability, neck dissection, prior radiation, pulmonary reserve, and likelihood of bleeding or return to the operating room. Some patients are extubated after uncomplicated reconstruction; others remain intubated overnight or receive tracheostomy. The correct plan is individualized and should be communicated before handoff.

A new tracheostomy requires humidification, suction, pulmonary toilet, secure but noncompressive ties, cuff management, and vigilance for false passage, mucus plugging, bleeding, and subcutaneous emphysema. The tube, flange, ties, and ventilator circuit must not compress the pedicle or pull the neck into an unsafe position. Agitation and repeated airway manipulation are especially dangerous during the period of highest flap vulnerability.

An expanding hematoma, worsening tongue edema, stridor, increased work of breathing, inability to handle secretions, sudden desaturation, or difficult ventilation should be treated as an airway emergency. Do not allow concern for the flap to delay oxygenation. At the same time, airway rescue should be coordinated with the reconstructive team whenever possible because neck extension, oral instrumentation, or urgent tracheostomy revision may disrupt the pedicle.

Table 11. Decannulation domains after head and neck reconstruction.

Domain	Reassuring features
Upper airway	Patent on examination; manageable edema; no anticipated immediate return to OR
Pulmonary status	Adequate oxygenation/ventilation; effective cough; manageable secretions
Swallow/aspiration risk	Ability to protect airway is understood; feeding route established
Mental status	Awake enough to manage tube and secretions; low delirium/agitation risk
Surgical field	No expanding neck process; flap stable; planned adjuvant procedures considered

Domain	Reassuring features
Team/logistics	Capping or speaking-valve pathway completed per protocol; emergency plan available

13

Hemorrhage, neck hematoma, and chyle leak

Drain output is data, but the wound and patient are the diagnosis.

Postoperative hemorrhage may present as brisk drain output, expanding neck swelling, blood in the mouth or tracheostomy, hemodynamic change, falling hemoglobin, or progressive flap congestion from compression. A drain can clot, so low output does not exclude a hematoma. The neck should be examined directly and compared serially. When the airway, flap, or hemodynamics are threatened, operative control is usually required.

Chyle leak most often follows lower neck dissection and may become apparent after enteral fat is introduced. Milky drainage is suggestive, but early output can be serous. The clinical consequences include fluid and electrolyte loss, protein and lymphocyte depletion, wound inflammation, delayed healing, infection, and carotid exposure. Management depends on output, duration, wound status, and institutional practice: dietary modification or specialized enteral/parenteral strategies, pressure or drainage plans, octreotide in selected protocols, and operative or interventional treatment for persistent high-output leaks.

DO NOT ANCHOR ON THE DRAIN

A suddenly quiet drain in a patient with increasing neck fullness may represent obstruction, not resolution.

14

Salivary leak and fistula

The clinical question is not simply “Is there a fistula?” but “Is the contamination controlled, and what structures are at risk?”

Salivary leak can follow oral cavity, oropharyngeal, hypopharyngeal, and laryngectomy reconstruction. Early clues include neck erythema, tenderness, fever, turbid or amylase-rich drainage, salivary taste or visible leakage, wound separation, air or fluid around the flap, and unexplained inflammatory deterioration. In a laryngectomy patient, leakage around the stoma or through the neck wound may signal a pharyngocutaneous fistula.

Small, well-drained fistulas in stable patients can often be managed with control of oral intake, reliable enteral nutrition, local wound care, drainage, and treatment of infection. The wound should be protected from ongoing soilage and followed for granulation and decreasing output. A fistula becomes a reconstructive emergency when it exposes the carotid or hardware, causes uncontrolled sepsis, tracks into the mediastinum, enlarges in irradiated tissue, accompanies flap necrosis, or cannot be effectively drained.

Imaging is useful when the extent is uncertain, deep abscess or mediastinal spread is suspected, a vascular complication must be excluded, or the result will guide intervention. Contrast swallow studies can help before oral feeding in selected patients, but a negative study does not override obvious clinical leakage. Management is based on the wound, patient, and reconstructive anatomy.

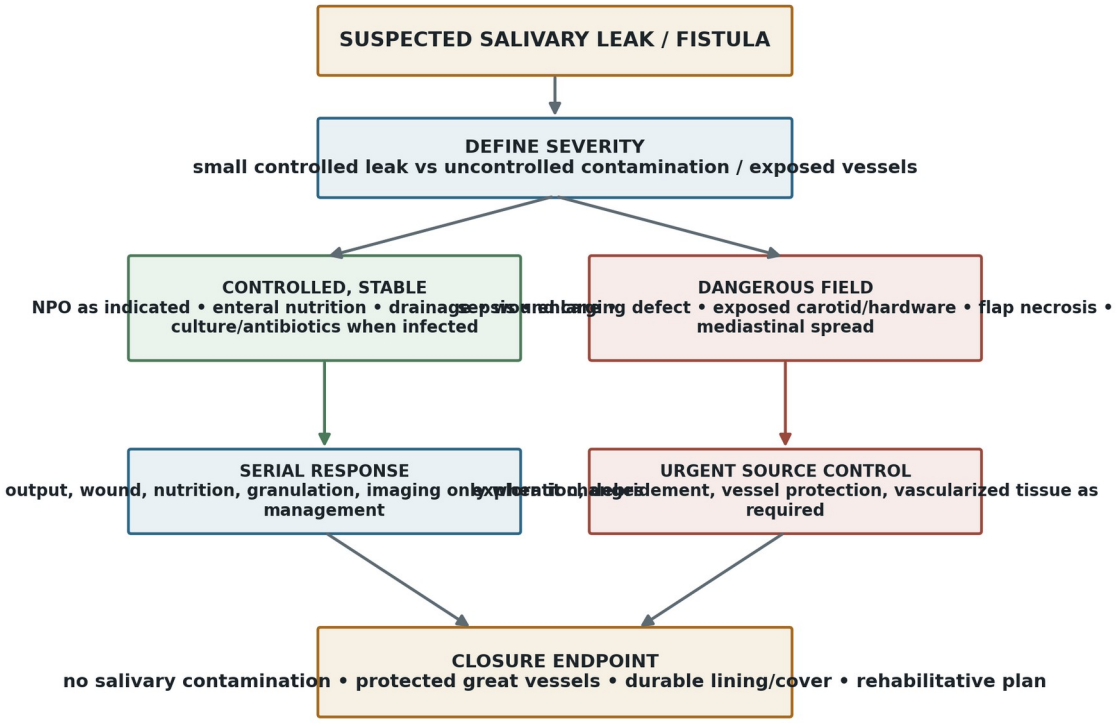


Figure 9. Salivary-leak and fistula pathway. The central distinction is controlled contamination versus a dangerous field involving sepsis, great vessels, hardware, or nonviable tissue. Original synthesis diagram created for this guide.

Table 12. Factors that make a salivary fistula less likely to heal conservatively.

Factor	Why it matters
Prior radiation or salvage surgery	Tissue perfusion and wound-healing reserve are reduced.
Large mucosal defect or circumferential reconstruction	The mechanical and salivary load is greater.
Infection or devitalized tissue	Source control and debridement may be required.
Malnutrition, anemia, hypothyroidism, or severe systemic illness	Healing substrate is impaired.
Carotid, plate, or bone exposure	The cost of continued contamination is high.
High-output or enlarging tract	Spontaneous closure is less likely without correcting the defect.
Distal obstruction or stricture	Pressure continues to drive saliva through the fistula.

15

Infection, dehiscence, and partial tissue loss

The wound must be interpreted in relation to flap perfusion, saliva, hardware, and prior treatment.

Postoperative erythema and edema are common; progressive pain, purulent drainage, malodor, fever, fluctuance, gas, wound separation, or systemic inflammatory deterioration are not. Infection may arise from salivary contamination, hematoma, devitalized tissue, dental or sinonasal flora, donor-site breakdown, pneumonia, or catheter-related sources. Cultures are most useful when obtained from meaningful purulence or deep tissue rather than superficial colonized surfaces.

Partial skin-paddle loss does not necessarily imply total flap loss. A marginal area may necrose because of perforator distribution, tension, folding, pressure, or component-specific ischemia while the main pedicle remains patent. The key questions are whether the underlying muscle or bone is viable, whether a watertight barrier persists, and whether exposed hardware or vessels require vascularized cover. Debridement should usually wait until demarcation unless infection, sepsis, or exposed critical structures demand earlier action.

Wound dehiscence can be a mechanical problem, a manifestation of infection or fistula, or the first visible sign of deeper necrosis. Simply re-suturing contaminated, irradiated, or tensioned tissue usually fails. Successful repair requires source control, viable edges, elimination of dead space, and—when needed—new vascularized tissue.

CLINICAL DISTINCTION

Partial paddle necrosis with a stable deep construct is different from vascular compromise of the entire flap. The former still requires deliberate wound planning; the latter requires immediate salvage.

16

Carotid exposure and carotid blowout syndrome

Sentinel bleeding in an irradiated or infected neck is a vascular emergency until proven otherwise.

Carotid blowout syndrome includes threatened blowout, sentinel hemorrhage, and active rupture. Risk rises with prior radiation, recurrent tumor, salivary fistula, infection, wound breakdown, exposed artery, radical neck dissection, and prior vascular manipulation. A small self-limited oral, pharyngeal, wound, or tracheostomy bleed may be the only warning before catastrophic hemorrhage.

The immediate priorities are airway protection, hemodynamic resuscitation, direct pressure or packing when anatomically possible, massive-transfusion readiness, and urgent involvement of head and neck surgery, vascular/interventional teams, anesthesia, and critical care. Blind clamping in a deep contaminated neck is dangerous. Definitive management may involve endovascular occlusion

or covered stent, open ligation or repair, tumor control, and vascularized-tissue coverage depending on anatomy and neurologic tolerance.

Table 13. Carotid blowout spectrum.

Category	Typical presentation	Resident response
Threatened	Exposed artery, pseudoaneurysm, necrotic tissue, imaging abnormality without active bleeding	Urgent multidisciplinary evaluation; protect wound; avoid delay until bleeding occurs.
Impending / sentinel	Transient self-limited bleeding from mouth, stoma, pharynx, or neck wound	Treat as an emergency; airway/resuscitation; urgent vascular imaging/intervention pathway.
Acute rupture	Uncontrolled hemorrhage, shock, airway contamination	Massive hemorrhage response, pressure/packing if possible, secure airway, immediate operative/endovascular control.

NEVER REASSURE ON VOLUME ALONE

A teaspoon of sentinel blood can be more important than a larger diffuse mucosal bleed when the patient has an irradiated, infected, fistulized, or vessel-exposed neck.

17

Hardware, bone, and donor-site complications

The reconstruction includes two wounds and often a skeletal implant.

Plate exposure, plate infection, nonunion, malunion, osteomyelitis, and osteoradionecrosis usually emerge later than acute vascular problems but may begin with early wound breakdown or salivary contamination. Persistent drainage over a plate, pain with mastication, new mobility, cutaneous fistula, exposed hardware, or radiographic lucency requires evaluation of soft-tissue cover, bone union, recurrent disease, dental infection, and radiation injury. Plate removal is safest after union when the plate is no longer structurally necessary, but timing depends on infection, exposure, bone viability, and construct stability.

Donor-site morbidity should be examined with the same discipline as the neck. A radial forearm donor requires graft and tendon surveillance, hand perfusion and sensory assessment. An ALT donor may develop seroma, wound separation, weakness, or sensory change. Fibula harvest requires distal perfusion, compartment and nerve assessment, graft/wound care, ankle function, and progressive weight bearing according to the harvest and local protocol. Scapular, iliac, abdominal, and latissimus sites each have position, wound, seroma, hernia, gait, and functional considerations.

Table 14. Donor-site complications residents should actively screen for.

Donor	Early threats	Later functional issues
Radial forearm	Hematoma, graft loss, tendon exposure, infection, hand ischemia, sensory change	Contour/cosmesis, stiffness, sensory symptoms, fracture if osseous harvest
ALT	Seroma, hematoma, dehiscence, infection, femoral-nerve branch injury	Thigh numbness, weakness, contour change, gait symptoms
Fibula	Distal ischemia, compartment syndrome, peroneal nerve injury, graft loss, DVT	Ankle instability, weakness, gait change, great-toe dysfunction, chronic pain
Scapular system	Seroma, hematoma, wound breakdown, positioning-related neuropraxia	Shoulder stiffness/weakness, contour change
DCIA	Hematoma, abdominal-wall injury, hernia, lateral femoral cutaneous symptoms	Gait pain, contour defect, hernia, chronic sensory symptoms
Latissimus / abdominal muscle	Seroma, wound problem, respiratory or abdominal-wall concerns	Shoulder weakness, bulge/hernia, contour change

DONOR-SITE EMERGENCY

Pain out of proportion, tense swelling, neurologic deficit, diminished distal perfusion, or rapidly increasing drainage requires urgent assessment; do not attribute every postoperative limb complaint to positioning.

PART IV

Recovery and Functional Rehabilitation

A surviving flap is the beginning of recovery, not the endpoint.

18

Hemodynamics, oxygen delivery, and antithrombotic care

Support systemic perfusion without creating edema, bleeding, or cardiopulmonary injury.

Flap perfusion depends on cardiac output, arterial pressure, oxygen content, temperature, and unobstructed venous return. Hypotension should be evaluated for bleeding, hypovolemia, vasodilation, myocardial dysfunction, sepsis, medication effect, or obstruction. Large empiric fluid boluses can increase flap and airway edema, venous pressure, pulmonary complications, and wound tension. Contemporary practice generally favors euvolemia and treatment of the actual hemodynamic mechanism, including judicious vasopressor use when indicated, rather than reflexive fluid loading solely to avoid vasopressors.

Transfusion decisions should consider symptoms, active bleeding, cardiac disease, oxygen delivery, and institutional thresholds rather than a flap-specific high hemoglobin target. Excess transfusion carries inflammatory, thrombotic, and volume risks; profound anemia can impair oxygen delivery. The reconstructive team should define any patient-specific target.

Antiplatelet and anticoagulation strategies vary widely. Aspirin, subcutaneous heparin or low-molecular-weight heparin for venous thromboembolism prophylaxis, and selective intraoperative anticoagulation may be used, but no universal regimen eliminates thrombosis. The resident should follow the operative plan, account for bleeding risk, and avoid independently escalating antithrombotic therapy for an abnormal flap. A mechanical thrombosis is treated by urgent evaluation and often surgery, not by hoping systemic anticoagulation will reopen it.

Table 15. Systemic causes of a poor flap examination.

Systemic problem	Flap effect	Parallel response
Hypotension / low cardiac output	Weak signal, delayed refill, cool tissue	Treat cause while excluding isolated technical failure.
Hypothermia / vasoconstriction	Pallor, coolness, weak peripheral signals	Active warming and hemodynamic reassessment.
Hypoxemia	Reduced oxygen delivery despite patent vessels	Airway and pulmonary treatment.
Severe anemia	Reduced oxygen content; tachycardia and demand stress	Assess bleeding and patient-specific transfusion need.

Systemic problem	Flap effect	Parallel response
Excess fluid / high venous pressure	Edema, congestion, airway swelling	Reassess volume, cardiac/renal function, and mechanical outflow.
Agitation / coughing / straining	Position changes, venous pressure, airway and pedicle stress	Analgesia, delirium treatment, safe positioning, pulmonary care.

19

Nutrition and oral intake

Nutrition supports wound healing; oral intake must respect the reconstructed barrier and swallowing physiology.

Many patients enter surgery with cancer-related weight loss, dysphagia, sarcopenia, alcohol use, or prolonged poor intake. Early enteral nutrition is generally preferred when the gastrointestinal tract is usable, but the route—nasogastric, gastrostomy, jejunal, or oral—depends on the defect, reconstruction, aspiration risk, expected duration, and local pathway. Refeeding risk should be considered in severely malnourished patients, with attention to phosphate, potassium, magnesium, thiamine, fluid balance, and gradual caloric advancement.

The timing of oral intake after mucosal reconstruction remains institution- and defect-specific. Some enhanced-recovery pathways support earlier feeding in selected patients; others delay until a predetermined postoperative day or an assessment of the closure. Salvage laryngectomy, circumferential pharyngeal reconstruction, uncontrolled salivary leak, severe aspiration risk, or complex wound healing may justify a slower pathway. The decision should reflect the actual barrier and swallowing mechanism rather than habit alone.

Nutrition plans should include protein and energy goals, glycemic control, electrolyte monitoring, bowel regimen, aspiration precautions, and a transition plan. The feeding tube should not become the default endpoint; it should be reassessed as function evolves.

Table 16. Before initiating or advancing oral intake.

Question	Why it matters
Is the mucosal closure clinically intact?	Visible leakage, wound erythema, salivary drainage, or fistula changes the plan.
What is the aspiration mechanism?	Oral competence, tongue propulsion, laryngeal sensation, airway closure, and pharyngeal clearance differ by defect.
Does the patient need instrumental assessment?	FEES or modified barium swallow can define safety and compensatory strategies.
Can nutrition goals be met orally?	A safe teaspoon trial is not equivalent to adequate caloric intake.
Will radiation begin soon?	Swallow use and nutrition access should support treatment completion.

Question	Why it matters
Are cognition and pulmonary reserve adequate?	Delirium, weak cough, and poor secretion control increase risk.

20

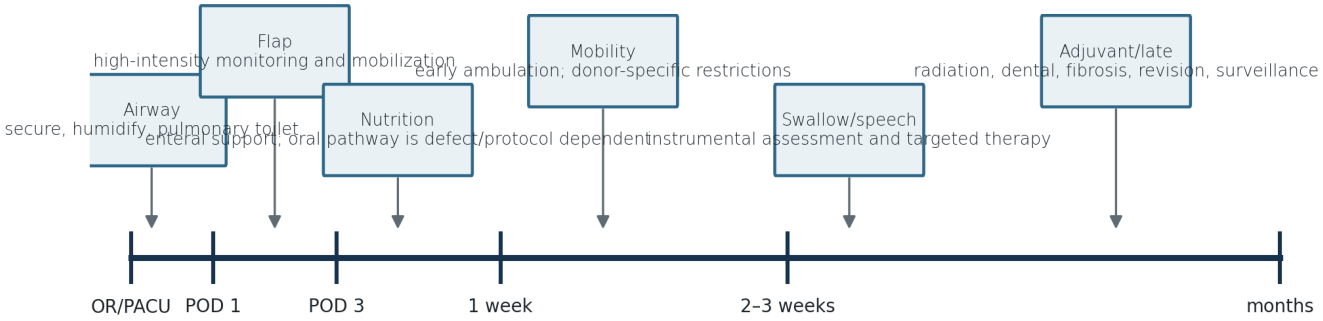
Swallowing rehabilitation

The flap changes geometry; therapy teaches the remaining system how to use it.

Swallowing outcomes are determined by the resection as much as the flap. A partial tongue reconstruction should preserve residual mobility and provide a stable surface against which the remaining tongue can propel a bolus. A subtotal or total glossectomy reconstruction needs sufficient bulk and palatal contact to assist propulsion, but excessive bulk can obstruct the airway or limit residual movement. Floor-of-mouth tethering, loss of sensation, laryngeal suspension, base-of-tongue resection, pharyngeal constrictor loss, and radiation fibrosis all alter the mechanism.

Bedside evaluation identifies secretion management, cough, voice change, oral control, and gross aspiration risk, but it cannot define every physiologic deficit. FEES provides direct assessment of secretion, penetration/aspiration, residue, and response to strategies; modified barium swallow visualizes oral and pharyngeal biomechanics and bolus flow. The study should answer a management question, not merely label aspiration.

Therapy may use postural adjustments, bolus modification, effortful swallow, multiple swallows, airway-protection maneuvers, range-of-motion work, lingual resistance, jaw stretching, and respiratory-swallow coordination. Exercises should be matched to the defect and radiation plan. Long-term “use it or lose it” principles are important, but unsupervised aggressive exercise in a fresh reconstruction can be harmful.



Milestones are individualized. The sequence matters more than a universal postoperative day.

Figure 10. Conceptual recovery timeline. Milestones vary, but airway security, flap stability, nutrition, mobilization, communication, and adjuvant planning should progress in parallel. Original synthesis diagram created for this guide.

Table 17. Defect-driven swallowing problems.

Defect / reconstruction	Dominant problem	Rehabilitation emphasis
Partial oral tongue	Reduced bolus manipulation and propulsion; tethering	Preserve mobility, bolus placement, lingual strength/coordination
Subtotal/total tongue	Poor palatal contact and propulsion; residue	Postural/bolus strategies, prosthetic options, airway protection, nutritional support
Floor of mouth	Tongue tethering and impaired elevation	Mobility, scar management after healing, compensatory bolus control
Oropharynx/base of tongue	Reduced pressure generation and residue	Effortful propulsion, residue clearance, airway-protection strategies
Hypopharynx/pharyngeal conduit	Stricture, impaired clearance, fistula risk	Instrumental assessment, dilation pathway, diet and pressure management
Laryngectomy	No aspiration from laryngeal route, but neopharyngeal dysphagia/stricture possible	Bolus flow, stricture evaluation, voice rehabilitation

21

Speech, voice, and communication

Communication planning should begin before the patient loses the ability to speak.

Oral cavity reconstruction affects articulation through tongue mobility, contact surfaces, oral competence, and sensation. Early speech-language pathology involvement helps patients use residual structures and compensatory articulation. Dental status, palatal shape, mandibular alignment, lip competence, and xerostomia can be as important as flap bulk.

After total laryngectomy, communication options include electrolarynx, esophageal speech, and tracheoesophageal puncture (TEP) with voice prosthesis. Primary versus secondary TEP depends on institutional practice, wound risk, reconstruction, pulmonary function, manual dexterity, cognition, support, and anticipated radiation. A prosthesis introduces maintenance requirements and can leak through or around the device; it should be incorporated into—not separated from—the wound and swallowing plan.

Temporary communication access matters in the ICU and ward. Writing boards, text devices, electrolarynx teaching, hearing aids, glasses, and interpreter access reduce delirium and improve participation. Communication failure is a patient-safety problem.

22

Mobilization and donor-specific rehabilitation

Early movement prevents systemic complications; precise restrictions protect the donor and reconstruction.

Enhanced-recovery pathways favor early mobilization, pulmonary hygiene, multimodal analgesia, sleep preservation, and reduction of unnecessary lines and restraints. The resident should know whether the patient may turn the neck, bear weight, use the donor arm, sit in a chair, or ambulate. “Bed rest for the flap” is rarely a physiologic strategy and increases venous thromboembolism, pneumonia, weakness, and delirium.

Restrictions must be donor specific. A forearm splint protects the graft and tendons but should not cause hand compression; finger motion and hand perfusion are assessed. Fibula patients need a clear weight-bearing and boot/splint plan, distal neurovascular checks, and progressive gait training. Scapular and latissimus harvests require shoulder range-of-motion planning. DCIA and abdominal harvests require core, gait, and hernia precautions. The reconstructive surgeon and therapy team should align orders so that protective restrictions do not become prolonged disability.

Table 18. Rehabilitation domains before discharge.

Domain	Minimum plan
Mobility	Safe transfers and ambulation; donor-specific weight-bearing; DVT prevention
Airway	Suction/humidification skills, tube care, emergency plan, supplies
Nutrition	Reliable route, regimen, medication administration, hydration and follow-up
Wound/flap	Incision and donor care, warning signs, pressure/position restrictions
Communication	Functional method for needs and emergencies
Swallow	Diet consistency or NPO plan, compensations, therapy and reassessment
Pain	Oral/enteral regimen, bowel plan, taper expectations
Social logistics	Caregiver training, home equipment, transportation, adjuvant-treatment timeline

PART V

Late Problems and Survivorship

The flap survives, remodels, receives radiation, and becomes part of a changing oncologic and functional system.

23

Radiation, fibrosis, edema, and flap remodeling

The postoperative construct does not remain the size or compliance it had in the operating room.

Fasciocutaneous and muscle flaps can lose volume over time through denervation atrophy, weight change, resolution of edema, and radiation. Radiation causes progressive fibrosis, reduced tissue compliance, microvascular injury, lymphedema, xerostomia, mucosal fragility, trismus, and impaired healing. A flap intentionally designed with modest excess volume may later reach an appropriate contour; excessive initial bulk can obstruct function, while inadequate volume can worsen after atrophy.

Head and neck lymphedema may be external, internal, or both. Patients report neck fullness, tightness, dysphagia, voice change, or episodic swelling. Management can include specialized therapy, compression when safe, manual techniques, exercise, skin care, and treatment of contributing infection or obstruction. New unilateral or progressive swelling still requires evaluation for recurrence, venous obstruction, fistula, or abscess rather than automatic attribution to lymphedema.

Scar and fibrosis management may involve jaw stretching, range-of-motion therapy, myofascial techniques after healing, dental care, and selected surgical release or debulking. Revision should be timed around oncologic surveillance, tissue maturation, radiation, nutrition, and the functional problem being solved.

24

Stricture, dysphagia, trismus, and dental rehabilitation

Late function often fails at a mechanical bottleneck.

Neopharyngeal or esophageal stricture presents with progressive solid-food dysphagia, prolonged meals, regurgitation, weight loss, or inability to pass a prosthesis or endoscope. The differential includes scar, anastomotic narrowing, recurrent tumor, external compression, dysmotility, and pseudodiverticulum. Endoscopic or contrast evaluation defines location and length. Dilation may be effective but often requires repetition; complex strictures can require incision, stenting, or reconstructive revision.

Trismus may result from radiation, masticator-space surgery, scar, pain, or prolonged limited use. Early recognition and a structured jaw-opening program are more effective than waiting for severe fixed restriction. Dental rehabilitation after mandibular or maxillary reconstruction requires

assessment of bone position, height, radiation exposure, soft-tissue thickness, oral hygiene, occlusion, and patient capacity. Implant timing varies; the goal is functional mastication, not simply implant placement.

Table 19. Late functional complaint to likely anatomic problem.

Complaint	Common reconstructive mechanisms	Evaluation
Progressive solid dysphagia	Neopharyngeal stricture, flap redundancy, scar, recurrence	Endoscopy and/or contrast swallow; oncologic assessment
Nasal regurgitation / hypernasality	Velopharyngeal insufficiency, palatal contraction	Speech and swallowing assessment; endoscopy; prosthetic review
Poor oral propulsion	Tongue tethering, inadequate palatal contact, denervation, xerostomia	Clinical and instrumental swallow evaluation
Trismus	Radiation fibrosis, masticator scarring, pain, recurrence	Interincisal measurement, examination, imaging when progressive
Malocclusion / chewing pain	Segment position, nonunion, plate or dental problem	Dental/maxillofacial exam and CT
TEP leakage / poor voice	Prosthesis failure, tract enlargement, stricture, pulmonary insufficiency	SLP/TEP evaluation; neopharyngeal assessment

25

Secondary revision, debulking, and hardware management

Revision should be linked to a defined functional or protective endpoint.

Common secondary procedures include flap debulking, liposuction, scar release, vestibuloplasty, commissuroplasty, contour correction, dental implant exposure, plate removal, fistula closure, and revision of donor-site scars. Debulking can improve oral competence, tongue movement, airway, prosthetic fit, and facial symmetry, but aggressive reduction can injure perforators or expose hardware. The vascular anatomy may be less obvious after radiation and scar.

A plate exposed through thin or irradiated tissue may require local wound care temporarily, but durable treatment often needs infection control, assessment of bony union, removal or exchange of hardware, and vascularized cover. If the bone has united, removing a symptomatic plate may be straightforward. If union is absent or the bone is nonviable, the problem is skeletal reconstruction, not merely exposed metal.

REVISION PRINCIPLE

Name the problem before naming the procedure: excessive bulk limiting tongue motion, absent sulcus preventing prosthesis, plate exposure over united bone, or contour loss after atrophy.

26

Surveillance in reconstructed anatomy

Normal postoperative change, treatment effect, and recurrence overlap; comparison and chronology matter.

Free flaps alter expected anatomy on CT, MRI, PET, and physical examination. Early postoperative imaging can show edema, fluid, gas, enhancement, and inflammatory uptake. Later, the flap develops fat or muscle characteristics according to its tissue type and may atrophy. Denervated muscle can change signal and volume. Hardware creates artifact. Radiation produces diffuse edema and fibrosis. The radiologist and surgeon need the operative report to know the flap type, pedicle, inset, and expected interfaces.

Recurrence often arises at the flap–native tissue interface, deep margin, skull base, perineural pathway, or nodal basin rather than in the center of transferred tissue. New focal nodular enhancement, progressive mass, ulceration, pain, cranial neuropathy, bleeding, or unexplained functional decline deserves directed examination and imaging. PET avidity soon after surgery or radiation is not specific; timing and serial change are essential.

The late swollen or painful flap should not be dismissed as “postoperative.” The differential includes recurrence, infection, occult fistula, abscess, venous obstruction, carotid pathology, hardware infection, osteoradionecrosis, lymphedema, and treatment-related fibrosis. The urgency is driven by airway, sepsis, bleeding, neurologic findings, and exposed vessels.

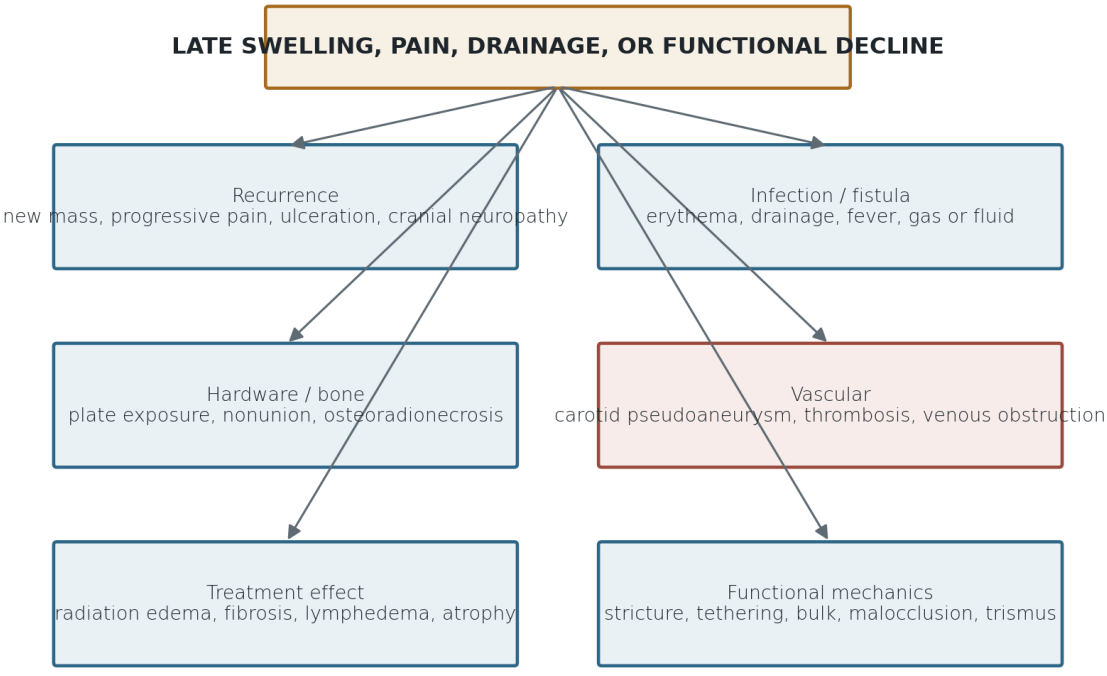


Figure 11. Differential diagnosis of a late painful, swollen, draining, or dysfunctional reconstruction. Original synthesis diagram created for this guide.

Table 20. Imaging patterns that warrant focused review.

Pattern	Possible explanation	Clinical correlation
Diffuse smooth flap edema	Early postoperative change, radiation, lymphedema, venous problem	Timing, symmetry, wound and vascular examination
Focal nodular enhancement at interface	Recurrence, granulation, infection	Examination, serial imaging, biopsy when indicated
Gas or fluid around hardware	Recent surgery, fistula, abscess, hardware infection	Wound drainage, fever, salivary leak, timing
Bone lucency/nonunion	Mechanical nonunion, infection, osteoradionecrosis, recurrence	Pain, mobility, plate exposure, radiation history
Pseudoaneurysm or contrast extravasation	Threatened or active carotid blowout	Emergency vascular pathway
FDG uptake	Inflammation, infection, muscle activity, recurrence	Post-treatment interval and anatomic imaging

27

Quality of life and survivorship

The outcome is measured by the life the reconstruction permits.

Flap survival is a necessary technical endpoint, but patients experience speech, swallowing, appearance, pain, shoulder and leg function, smell, taste, saliva, fatigue, financial stress, return to work, and social participation. A reconstruction that closes the wound but leaves an avoidable feeding, communication, or donor-site disability is incomplete. Conversely, some patients prioritize rapid recovery and adjuvant therapy over complex dental or aesthetic goals.

Survivorship care should integrate oncologic surveillance, dental prevention, thyroid monitoring after neck radiation, nutrition, speech and swallowing follow-up, lymphedema therapy, pain management, smoking and alcohol support, psychosocial care, caregiver burden, and rehabilitation. Patient-reported outcomes can expose problems that are not obvious during a brief surgical examination.

RESIDENT PERSPECTIVE

Ask one functional question at each follow-up: “What is the reconstruction preventing you from doing now?” The answer often identifies the next useful examination, referral, or revision.

PART VI

Clinical Cases and Rapid Review

Apply the monitoring and complication framework to common resident calls and oral-boards scenarios.

28

Case-based reasoning

State the physiology, immediate action, and definitive plan.

CASE 1 — A SIGNAL IS PRESENT, BUT THE FLAP IS BLUE

POD 1 after fibula osteocutaneous reconstruction, the intraoral paddle becomes progressively purple and tense. Refill is immediate and pinprick produces dark brisk blood. The arterial Doppler remains strong.

Question: What is the diagnosis and next step?

REASONED ANSWER

Venous outflow obstruction is the leading diagnosis. A preserved arterial signal is expected early because inflow continues. Repeat the examination immediately, inspect position and external compression, call the reconstructive surgeon, and activate urgent exploration if the pattern persists. Do not wait for loss of the arterial signal.

CASE 2 — THE FLAP IS PALE IN A HYPOTENSIVE PATIENT

Six hours after ALT reconstruction, the paddle is cooler and paler with delayed refill. MAP is 52 after sedation and a large urine output. The marked arterial signal is weaker than baseline.

Question: Can the finding be attributed to hypotension?

REASONED ANSWER

Systemic hypoperfusion may contribute, but the flap change must be treated as possible arterial insufficiency. Correct hemodynamics while repeating the local examination and calling the reconstructive surgeon. If the local pattern does not promptly normalize or the signal remains abnormal, urgent exploration is indicated.

CASE 3 — LOST IMPLANTABLE DOPPLER SIGNAL

A buried pharyngeal flap has a sudden implantable venous Doppler alarm. The visible monitor paddle is unchanged and the neck is soft.

Question: What should the resident do?

REASONED ANSWER

Check connections and patient position, perform the complete available clinical examination, confirm other signals, and notify the reconstructive surgeon immediately. Device failure is possible, but it should not be assumed. The decision may require urgent exploration because a buried flap has limited clinical reserve for observation.

CASE 4 — NECK FULLNESS AND NO DRAIN OUTPUT

A patient with an oral cavity free flap develops increasing unilateral neck firmness and mild flap congestion. Drain output, previously 60 mL/h sanguineous, abruptly stops.

Question: What is the unifying diagnosis?

REASONED ANSWER

An obstructed drain with accumulating neck hematoma is concerning. This threatens venous outflow and potentially the airway. Call the reconstructive surgeon, prepare for urgent wound evaluation/exploration, and manage the airway and hemodynamics in parallel.

CASE 5 — SALIVA IN THE WOUND

POD 8 after salvage laryngectomy with vascularized tissue reinforcement, the patient develops erythema and salivary drainage from the neck. He is stable, the carotid is not exposed, and the wound is draining freely.

Question: What are the management domains?

REASONED ANSWER

Control oral intake according to protocol, maintain enteral nutrition, define and drain the wound, treat infection when present, optimize nutrition and endocrine factors, and follow output and tissue viability. Escalate to operative source control and vascularized coverage if the field becomes uncontrolled, necrotic, septic, or threatens the carotid/hardware.

CASE 6 — A TEASPOON OF BLOOD

Three weeks after salvage surgery in an irradiated neck with a persistent fistula, a patient has a brief self-limited bleed from the wound. Vital signs are normal.

Question: Why is this an emergency?

REASONED ANSWER

This may be sentinel bleeding from impending carotid blowout. Initiate urgent airway, resuscitation, and multidisciplinary vascular evaluation rather than routine clinic observation. The small volume does not lower the risk.

CASE 7 — LATE PROGRESSIVE DYSPHAGIA

Nine months after circumferential pharyngeal reconstruction and radiation, a patient progresses

from solid-food dysphagia to difficulty with liquids and weight loss.

Question: What is the differential and next evaluation?

REASONED ANSWER

Consider anastomotic stricture, flap redundancy, dysmotility, recurrence, and treatment fibrosis. Perform focused examination and oncologic assessment, then define the conduit with endoscopy and/or contrast study. Biopsy suspicious tissue before attributing the problem solely to scar.

29

Resident call checklists

Use checklists to prevent omission, not to postpone judgment.

A. Routine flap-check note

- Postoperative time and reconstruction type.
- Patient physiology: airway, oxygenation, temperature, blood pressure, major interval events.
- Flap color, temperature, turgor, capillary refill, bleeding response if tested.
- Arterial and venous signal location and character compared with baseline.
- Neck/oral wound: swelling, firmness, drainage, dressing or device pressure.
- Donor site: perfusion, neurologic status, swelling, graft/incision, drains.
- Explicit comparison with the prior examination and escalation if changed.

B. New abnormal flap finding

1. Repeat the complete examination immediately under reliable light.
2. Confirm marked signals and compare with operative baseline and prior check.
3. Inspect the entire neck, airway, drains, dressings, tracheostomy ties, and head position.
4. Review systemic pressure, oxygenation, temperature, hemoglobin trend, and recent events.
5. Correct safe external/systemic factors in parallel.
6. Call the reconstructive surgeon with exact findings and time course.
7. Prepare for urgent exploration; do not delay a convincing pattern for routine imaging.

C. Suspected fistula or wound breakdown

- Define source, output, drainage, infection, and whether saliva/enteric content is present.
- Inspect for flap necrosis, plate/bone exposure, carotid exposure, and airway involvement.
- Assess sepsis, nutrition, anemia, glycemia, thyroid status when relevant, and distal obstruction.
- Establish feeding and wound-care plan; obtain imaging only when it defines extent or changes intervention.
- Escalate urgently for uncontrolled contamination, great-vessel risk, mediastinal spread, or nonviable tissue.

D. Discharge readiness

- Stable flap and wounds with a clear dressing/drain plan.

- Safe airway or tracheostomy care with equipment and emergency instructions.
- Reliable nutrition and medication route.
- Safe mobility with donor-specific restrictions.
- Functional communication and swallowing plan.
- Follow-up dates, pathology and tumor-board plan, and anticipated adjuvant timeline.
- Return precautions for bleeding, airway change, swelling, fever, wound drainage, flap change, donor neurovascular symptoms, and feeding intolerance.

30

Last-minute boards review

High-yield distinctions and management priorities.

Table 21. Rapid boards pearls.

Prompt	Answer
Pale, cool flap with delayed refill	Arterial insufficiency until proven otherwise.
Blue, tense flap with immediate refill and dark bleeding	Venous congestion until proven otherwise.
Strong arterial Doppler in a congested flap	Does not exclude venous obstruction.
Most important determinant of salvage	Early recognition and prompt operative correction.
Classic early mechanical causes	Kink, twist, tension, compression, hematoma, tight tunnel/closure.
Role of monitoring devices	Adjuncts; clinical examination and trajectory remain central.
Classic response to a persistent concerning pattern	Immediate reconstructive-team escalation and urgent exploration.
Small self-limited bleed in irradiated fistulized neck	Sentinel carotid bleed until proven otherwise.
Stable, controlled small salivary fistula	Drainage, nutrition, wound care, infection control, close follow-up.
Fistula with exposed carotid or uncontrolled sepsis	Urgent source control and vascularized protection.
Second free flap after total failure	Often effective, but only after cause and recipient strategy are reconsidered.
Progressive late dysphagia	Evaluate stricture and recurrence; do not assume fibrosis.
Donor limb pain out of proportion with tense swelling	Compartment syndrome until excluded.
Ultimate reconstructive outcome	Durable separation/protection plus speech, swallowing, mastication, airway, mobility, and patient quality of life.

ONE-SENTENCE ORAL-BOARDS ANSWER Repeat the exam immediately, correct safe reversible factors in parallel, call the reconstructive surgeon with the exact change from baseline, and proceed urgently to exploration if compromise remains likely.

PART APPENDICES

Reference Tools

Glossary, source notes, and figure credits.

Appendix A. Glossary

Table A1. Postoperative free-flap terms.

Term	Meaning
Arterial insufficiency	Inadequate inflow to the flap, caused by thrombosis, spasm, kink, compression, tension, or systemic low flow.
Venous congestion	Inadequate outflow with continued inflow, producing elevated tissue venous pressure and edema.
Monitor paddle	Visible tissue component intended to reflect perfusion of a buried or composite construct.
Pinprick test	Protocol-dependent puncture used to assess bleeding color and timing; must be performed in an approved location.
Implantable Doppler	Probe secured to a pedicle vessel to provide postoperative flow signal.
Flow coupler	Venous anastomotic coupler incorporating a Doppler monitoring element.
Flap salvage	Intervention that restores viability to a threatened flap.
Sentinel bleed	Transient hemorrhage that may precede catastrophic carotid rupture.
Pharyngocutaneous fistula	Abnormal communication between pharyngeal lumen and neck skin/wound.
Second free flap	New free tissue transfer after loss or inadequacy of the first construct.
Osteoradionecrosis	Radiation-associated devitalization of bone with impaired healing, often complicated by infection or exposure.
Neopharyngeal stricture	Narrowing of reconstructed pharyngeal conduit causing dysphagia.

Appendix B. Selected references

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Appendix C. Figure credits

Table C1. Figure provenance.

Figure(s)	Credit
Cover montage and Figures 3, 5	Kim et al. and Wang et al., open-access reconstructive case figures used elsewhere in this series; CC BY 4.0. Images cropped only for layout; clinical content unaltered.
Figures 1, 2, 4, 6–11	Original synthesis diagrams created for this guide from the referenced monitoring, salvage, fistula, rehabilitation, and imaging literature.

Clinical images are educational illustrations and do not establish a universal postoperative appearance. All patient care should follow the reconstructive surgeon's protocol and local emergency pathways.

Appendix D. Educational scope

This guide is intended for resident education and board review. It synthesizes published reviews, cohort studies, consensus pathways, and reconstructive practice principles. Exact flap-check intervals, pinprick technique, medication regimens, oral-feeding schedules, decannulation criteria, and thresholds for imaging or reoperation vary by institution and patient. A concerning change in an actual free flap requires immediate involvement of the responsible reconstructive surgeon.

FINAL MENTAL MODEL

Know the baseline. Examine the whole construct. Name the physiology. Correct safe reversible factors in parallel. Escalate immediately. Protect the airway and great vessels. Then carry the patient from wound survival to functional recovery.