Nov 8: Grafts and Flaps in H&N Surgery (updated 06/06)
Preceptor: Tadros; vacation Dara & Jeff

1. (Amy) Discuss the stages involved in the survival of a split thickness graft.

   Initial adherence: A thin fibrin network that temporarily anchors the graft to the wound bed until definitive circulation and connective tissue connections are established. This adherence begins immediately and is probably at its maximum by 8 hours postgrafting.

   Plastic imbibition: Period between grafting and revascularization. The graft imbibes wound exudate by capillary action through the spongelike structure of the graft dermis and through the dermal blood vessels. This prevents graft desiccation, maintains graft vessel patency, and provides nourishment for the graft. This process is entirely responsible for graft survival for 2-3 days until circulation is reestablished. During this period, the graft typically becomes edematous and increases in weight by 30-50%.

   Revascularization: Revascularization of the graft begins 2-3 days after grafting and is completed by 6-7 days postgraft. Possible mechanisms include the establishment of direct anastomoses between graft and recipient blood vessels (inosculation), vascular ingrowth of recipient bed vessels into the graft along the channels of previous graft vessels, or random new vascular ingrowth of recipient bed vessels into the graft.

   Wound contraction: Occurs up to 6-18 months following grafting and may cause cosmetic and functional problems. The ability of a graft to resist contraction is related to the thickness of the deep dermal component included in the graft, not just the absolute thickness of the graft. This deep dermal component suppresses myofibroblast function by an unknown mechanism. Wounds covered with thicker STSGs contract less than thin STSGs, and any wound covered by a STSG contracts less than an open wound.

   Regeneration: Hair may regrow if the STSG is thick. Only a portion of the sweat and sebaceous glands are transferred. Sweat gland regeneration is dependent on reinnervation with recipient bed sympathetic nerve fibers, while sebaceous gland regeneration is independent of graft reinnervation. Thus, sweat glands assume the functional characteristics of the recipient site while sebaceous glands retain the characteristics of the donor site.

   Reinnervation: Reinnervation is always incomplete, and occurs from the first month to several years following grafting. Sensation returns to the periphery of the graft and proceeds centrally. Pain is usually the first perceived sensation, followed by touch, heat, and cold. Usually protective sensation develops but not normal perception. Pigmentation: STSG may remain pale or white, or may become hyperpigmented with exposure to sunlight. Should be protected from direct sunlight for at least 6 months. Hyperpigmentation can be treated with dermabrasion and laser resurfacing with varying success.

2. (Amy) How are skin grafts (full and split thickness) harvested? What is the point of meshing?

   Full-thickness skin grafts are harvested with a scalpel. The graft should be enlarged by 3-5% of the size of the recipient site to compensate for the immediate primary contraction that occurs in elastic fibers in the graft dermis. Residual adipose is trimmed from the underside of the graft, because this fat is poorly vascularized and will prevent direct contact between the graft dermis and the wound bed. The donor site is usually closed primarily with excision of dog ears as necessary.

   Split thickness skin grafts are most commonly harvested using a blade dermatome, which rapidly harvests a large section of skin of uniform thickness. The thickness and width settings are adjusted by the surgeon. Drum dermatomes are used less often but are useful when the donor site is irregular; the blade is manually powered and rolled over the skin surface.

   Meshing increases the surface area of a graft up to 9 times the surface area of the original donor site. Meshing is useful when there is inadequate donor skin available, such as in burn patients, or when the
recipient site has an uneven contour. The slits in the meshed graft allow fluid to escape through the graft rather than accumulating beneath it and preventing adherence. The expansion slits heal by re-epithelialization and may contract significantly. Disadvantages include poor cosmetic outcome; the healed site usually has a typical "checkerboard" appearance.

3. **(Amy) How will you manage the donor site in a split thickness graft?**

The donor site should be dressed appropriately at the conclusion of the procedure. A moist gauze containing epinephrine solution can be used to aid in hemostasis. Multiple dressing options exist, including occlusive dressings (Duoderm), semi-occlusive dressings (Op-Site, Tegaderm), semi-open dressings (Vaseline gauze, Xeroform or scarlet red), and no dressing. The ideal dressing promotes rapid re-epithelialization, causes little pain, requires little care, is inexpensive, and has a low rate of infection. Many studies have found semi-occlusive dressings to be associated with faster healing rates, low subjective pain scores, low cost, and low infection rates. These dressings are also transparent, facilitating easy inspection. A thin fluid layer collects under the dressing, promoting a moist environment for wound healing.

Donor sites heal spontaneously from epithelial cells remaining in epithelial appendages within the dermis and at the wound edges. Healing begins within 24 hours of harvesting, and the rate of healing is directly proportional to the number of epithelial appendages remaining and inversely proportional to the thickness of graft harvested. The initial regenerated epithelium is very delicate and easily disrupted with tape or dressing changes. Semi-occlusive dressings have the additional benefit of not needing to be removed until healing is complete.

4. **(Deya) Help us understand random vs. axial pattern grafts. Give examples of each in the head and neck.**

Flaps may be classified according to their blood supply:

1. **Random Flaps** - Random flaps are created by dissecting in the level of the subcutaneous fat. In so doing, the flap base derives its blood supply from perforating musculocutaneous vessels that lie in the deep subdermal and muscular plane. Perfusion at the free portion of the flap is derived from communication between the superficial papillary dermal plexus and the deeper subdermal plexus. Most advancement and rotation flaps fall into this category. An example of a random flap is the rhombic flap. For most random flaps, a length-to-width ratio of 1:1 is safe; however, in the face, this ratio can be extended to 2:1 or even greater without significant risk of flap loss or skin necrosis.

2. **Axial Flaps** - In contrast to a random flap, an axial flap is based on a named vessel, which supplies the majority of the flap. Axial flaps have a subcutaneous artery extending along the linear axis of the flap. The blood supply of the most distal portion of an axial flap is often random. An example of an axial flap is the paramedian forehead flap, which is based on the supratrochlear artery and vein.

5. **(Deya) Discuss transposition, advancement, rotation and interpolation flaps.**

Transposition Flaps - pivotal flaps with their base immediately adjacent to the defect. They are usually designed so that the borders of the flap are at some distance from the defect to be repaired. The major disadvantages of transposition flaps include the risk of necrosis and the development of a trapdoor deformity.

6. **(Deya) What is the safe length to width ratio of a flap?**

1. Transposition Flaps
   - S Flaps: a transposition flap 30–40% of the size of the defect is created slightly longer and narrower (as narrow as one half) than the defect. The wound is closed in an S-shaped configuration. This flap is useful in the cheek, lip, and nasal areas. The small standing cutaneous deformity that develops may require correction by excision of a Burrow triangle.
Rhombic Flaps: variant of the transposition flap. The movement of a rhombic flap is by a combination of pivotal movement and advancement and is commonly used for repair of defects of the cheek and temple area.

Bilobe Flaps: double transposition flap. The primary flap is used to repair the cutaneous defect and a secondary flap is used to repair the primary flap donor site. The secondary flap donor site is then closed primarily. The bilobe flap is best suited for use in repairing 1-cm cutaneous defects of the nasal tip. The upper limit in the size of nasal defects that can be easily repaired with a bilobe flap is approximately 1.5 cm. The bilobe flap is also useful for reconstruction of cheek defects, away from the central part of the face.

Z-plasty: a transposition flap of two identical triangles. This technique is used primarily to lengthen a scar in an effort to treat scar contractures. In addition, Z-plasty can reorient the position of a scar so that it lies parallel with RSTLs. Limbs are drawn at angles ranging from 30° to 90° from the central scar. With an increase in angle size, the degree of lengthening of a scar predictably increases. Optimal angle for Z-plasty appears to be from 45° to 60°.

2. Advancement Flaps

- Simple linear closure- undermining & movement of opposite wound margins toward each other (most basic of advancement flaps). Undermining subcutaneous plane 2 to 4 cm provides benefit by decreasing wound tension. However, undermining tissue > 6 cm may actually increase flap tension.
- Rectangular-shaped advancement flap- created by parallel incisions extending from the border of the defect and involves a sliding movement of tissue into the defect. Two standing cutaneous deformities are created at the corners of the flap and can be corrected by excising Burrow triangles.

Advancement flaps may be designed unilaterally (the so-called U-plasty) or bilaterally (H-plasty or T-plasty). In designing these flaps, it is best not to exceed a 3:1 ratio of flap-to-defect length. Advancement flaps are particularly useful in the forehead, lip, and eyelid areas, where it is necessary to avoid any tension in a superior or inferior direction, thus avoiding distortion of important anatomical structures.

3. Rotation Flaps

Pivotal flaps with a curvilinear shape that rotate around a pivotal point near the defect. They are most appropriate for triangular-shaped defects. A curvilinear incision is made immediately adjacent to the defect. The standing cutaneous deformity that is formed can be excised as a Burrow triangle to facilitate wound closure. By combining rotation and advancement tissue movement and using the principle of halving (ie, dividing the length of the closure into equal halves until the entire defect is closed), the defect may often be closed without the need for excision of a Burrow triangle. The vector of greatest tension is from the pivotal point to the most distal point along the curvilinear incision. This flap usually has a random blood supply, but depending on the location of the base of the flap, it may acquire an axial pattern. The rotation flap is ideal for medium to large defects of the cheek, neck, and scalp. It is not useful in nasal reconstruction because of the lengthy incision required to achieve the proper tissue movement and the need to undermine and

<table>
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<tr>
<th>Angle Size</th>
<th>Length Increase</th>
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<tr>
<td>30°</td>
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<tr>
<td>45°</td>
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<td>60°</td>
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advance the pivotal point. One advantage of a rotation flap is its viability in an irradiated area or in patients with poor vascularity due to smoking or diabetes.

4. Interpolation Flap
Type of pivotal flap that rotates around a pivotal point and forms one standing cutaneous deformity. An interpolated flap has a linear axis and its base is removed from the defect site. This flap requires either detachment of the pedicle as a separate procedure or burying of the pedicle under a bridge of skin at the time of reconstruction.

7. (Josh) What is a burrow’s triangle?
A triangle of skin and subcutaneous fat excised so that a pedicle flap can be advanced without buckling the adjacent tissue.

8. (Josh) Describe some common regional flaps used in head and neck reconstruction. Give the blood supply for each.

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<tr>
<th>Flap</th>
<th>Description</th>
<th>Blood Supply</th>
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<tr>
<td>Pectoralis Major Myocutaneous Flap</td>
<td>Used to line large defects such as the tongue base, pharyngeal, palatal, and tonsillar areas. Advantages: bulk and reliability, applicability in a one stage procedure. Disadvantages: bulk and insensate therefore poor deglutition.</td>
<td>Pectoral branch of the thoracoacromial a</td>
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<tr>
<td>Deltopectoral Flap</td>
<td>Used to line oropharyngeal and pharyngoesophageal defects. Greater length can be achieved when the flap is delayed. Good secondary reconstructive option. Disadvantage: skin graft needed to reconstruct the donor site.</td>
<td>Perforating branches of the first four intercostal arteries, internal mammary perforators to the skin</td>
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<td>Latissimus Dorsi Pedicle Flap</td>
<td>Useful to line large defects because it is sizable and has considerable bulk. Used to reconstruct total glossectomy defects. Disadvantages: potential for kinking of feeding vessels at the shoulder, uncommon in oropharyngeal reconstruction.</td>
<td>Thoracodorsal artery</td>
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<td>Platysma myocutaneous flap</td>
<td>Advantages: provides thin pliable skin paddle ideal for oropharyngeal reconstruction. Disadvantages: fistula formation and desquamation are common complications.</td>
<td>Submental branch of the facial artery</td>
</tr>
<tr>
<td>Temporoparietal fascial flap</td>
<td>Advantages: thin highly vascular tissue for reconstruction of the oropharynx</td>
<td>Superficial temporal artery</td>
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9. (Rosow) Discuss the design of the rhomboid flap. Why is this a “work horse” flap in the face? Where is the point of greatest tension?

As previously discussed, the rhomboid flap is useful for covering defects that are too large for primary closure or whose primary closure would distort important facial landmarks. It relies on the dermal-subdermal plexus of blood vessels for its supply rather than an axial vessel, so it works well in the richly vascularized face. Its construction is seen below.

Here, the red area represents the primary defect to be filled, and the green line represents the vector of maximum tension. Maximum tension after rotation will be at point A.

10. (Kathy) How do you plan a classic bilobed flap? PRS 1999;104:495. How do you avoid pin cushioning?

The bilobe flap is a double transposition flap that is commonly used to reconstruct defects of the nasal tip or cheek defects away from the central part of the face. The primary flap is used to repair the cutaneous defect and a secondary flap is used to repair the primary flap donor site. The secondary flap donor site is then closed primarily. The original design required that the angle of tissue transfer be 90 degrees between each lobe, for a total transposition of 180 degrees. This wide angle has the disadvantage of maximizing standing cutaneous deformities and the likelihood of developing trapdoor deformities. Zitelli’s modification requires a 45 degree angle of transfer only between each lobe, thus limiting total transposition to 90-110 degrees, thus minimizing standing cutaneous and trapdoor deformity.

Depending on the location of the defect, the first lobe may be designed as much as 20% smaller than the defect. The second lobe that is used to repair the donor site of the first lobe is usually constructed 20% smaller than the first lobe. The advantages of this flap include: 1) the ability to recruit redundant tissue from two independent areas to assist in the repair of a defect; and 2) the use of adjacent tissue that provides excellent color and texture match for facial reconstruction. The disadvantages include 1) extensive undermining required; and 2) extensive curvilinear
11. (Caroline) You excise a melanoma that is located at nasolabial fold. What are your reconstructive options? There are multiple flaps that can be used for this tricky area: Cheek advancement flaps, V-Y advancement flaps, transposition flaps, nasolabial flaps (depends on size, surgeon preference and comfort level)

12. (Caroline) Are nasolabial flaps random or axial? They are axial based on the angular artery (branch of the facial artery). Note: During use, it is often thinned and the flap itself will often NOT contain the angular artery. This is the source of the controversy because then, technically, it becomes a random flap.

13. (Scott) A patient presents after resection of a basal cell carcinoma near the medial canthus. The defect is 5mm. Discuss reconstructive options. There are several types of flaps that can be used to help reconstruct the medial canthal region. Primarily there are full-thickness skin grafts and local flaps that can reconstruct the area depending on the defect. These include local rotation flap, transnasal advancement flaps, nasolabial V-Y advancement flaps and glabellar flaps. Some methods use a combination of the above for better reconstructive closure depending on the defect. A recent study also notes that one can use an upper eyelid rotation flap for medial canthal defects.

14. (Tali) You decide to perform an Indian forehead flap to reconstruct a nasal tip defect. Discuss the stages involved in this process. What is the blood supply? An “Indian” flap or midline forehead flap is the workhorse of nasal reconstruction.

Advantages: good color and texture match, reliable blood supply and minimal donor site deformity. Useful for reconstruction of tip, ala and lower dorsum.

Disadvantages: forehead scar, length limitations, 2-stage operation.

Stages:

- **Identify extent of nasal defect and flap design:** 1st need to repair underlying structural deficiencies. The proximal pedicle may be narrowed to 1.1-1.5 cm to allow easy rotation and transposition of flap with tension-free closure. Pedicles >1.5cm in width may cause flap strangulation. To gain extra length, can extent flap across orbital rim or into hairline to gain extra length.

- **Rotation of flap into defect**

- **Close Donor Site:** May need to undermine the surrounding forehead and scalp tissue in the loose areolar plan for 7 cm in all directions to improve apperance of forehead defect. Can also perform vertecl fasciotomies to ease closure.
  - Often upper 1/3 of wound cannot be closed. May cover with xeroform dressing and allow healing and scar contracture by secondary intention (usually within 7 wks).
  - If defect >4.5 cm, may consider skin grafts

- **Contouring flap:** Intermediary or secondary operations are performed to add contour to the flap prior to the division of the pedicle. Performed 3 weeks post-op.

- **Division of Pedicle:** The pedicle can be sectioned as early as 10 to 14 days based on vascular efficiency of the flap. Most advocate allowing it to remain attached for at least 3 weeks to allow for tensile strength to increase.
- **Additional Contouring:** Once the flap is detached it can be defatted or cartilage may be placed to obtain better tip projection but after pedicle division, no further contouring surgery may be performed for 4 months due to risk of devascularization. Thinning should be performed later in smokers due to compromised vascular supply.

*Blood Supply:* The axial blood supply is based on the vertically oriented supratrochlear artery which is identified with the doppler located near the corrugator frown crease.