Paparella: Volume IV: Plastic and Reconstructive Surgery and Interrelated Disciplines

Section 1: Plastic and Reconstructive Surgery

Chapter 4: Distal Flaps

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The value of immediate closure of large soft tissue and bony defects in the head and neck is readily apparent to all involved. For the patient it means a shortened hospital stay and early restoration of function. For the physician it allows proper management of malignant conditions without concern for the ability to reconstruct, and it means a lessened postoperative burden.

The area of flap reconstruction has exploded to become one of the most essential tools of any head and neck surgeon. Much of the success in this area can be attributed to an improved understanding of the physiology of the tissues being used for transfer. In terms of what is contained in a flap, we can identify three types in the head and neck:

1. Cutaneous: containing skin only.

2. Myocutaneous: containing muscle and skin.

3. Osteomyocutaneous: containing bone, muscle, and skin.

This chapter discusses the larger pedicled flaps used in the head and neck.

Anatomy

Integral to an understanding of the use of flaps is a familiarity with the blood supply to skin, muscle, and bone. The eventual blood supply to skin arrives via the dermal-subdermal plexus. It is how blood reaches this plexus, however, that determines the various types of skin flaps recognized today. When the major blood vessels of a skin flap enter the subdermal plexus at the most proximal point of the flap, and then make no other contributions to the subdermal plexus, the flap is referred to as a *random pattern flap*. In some flaps the major vessel is referred to as the *segmental* artery, which travels beneath the skin but above the muscle. This vessel makes contributions not only to the subdermal plexus proximally, but throughout the whole length of the flap in an axial fashion. Such flaps are called *axial pattern* flaps. Most local flaps are random pattern; examples of axial pattern flaps include the deltopectoral and temporal flaps. Some flaps may be a combination of axial and random patterns, in which case that part distal to where the last axial contribution is made is referred to as random: eg, a deltopectoral flap that has its length extended.

The blood supply to muscle can be separated in a similar fashion. When the major vessel (segmental artery) enters the muscle at a proximal site and then travels throughout its substance, it is referred to as a random pattern blood supply. In some muscles the segmental artery travels beneath the fascia on its deep surface and then makes axial contributions throughout its course. Such a muscle has an axial pattern blood supply, whereas flat muscles such as the trapezius or pectoralis major tend to have axial pattern blood supply.

The skin of a myocutaneous flap receives its blood supply from the vessels from the underlying muscle. The vessels traveling through the muscle to the skin are referred to as *perforator arteries.* As the perforator vessels penetrate the superficial fascia, they may go directly to the subdermal plexus as *myocutaneous arteries,* or they can travel a short distance on the surface of the fascia parallel with the muscle as *direct cutaneous arteries,* giving off contributions to the subdermal plexus throughout its course. Although a myocutaneous flap is described as random or axial on the basis of the blood supply pattern to the muscle, blood reaching the subdermal plexus arrives in an axial fashion from the perforator vessels. In myocutaneous flaps where the skin is extended beyond the muscle, that skin receives a random pattern supply. The perforator vessels may also have anastomotic connections on the superficial fascia to form a plexus. Such connections may make it beneficial to maintain superficial fascia beyond the limits of the planned skin flap. An axial pattern myocutaneous flap can be transferred as an island flap by separating the muscle at its base and leaving only the vascular pedicle to transport the flap. However, this can never be performed with a random pattern myocutaneous flap, because severing the muscle at its base destroys the whole blood supply of the muscle and skin.

The blood supply to long bones arrives by three routes:

1. Epiphyseal-metaphyseal vessels.

2. Periosteal vessels.

3. A nutrient artery.

The nutrient artery penetrates the cortex of the bone to enter the marrow and is usually the major blood supply. This vessel anastomoses with the epiphyseal-metaphyseal vessels and also with the periosteal contribution. The periosteal vessels arrive along with the muscular attachments to bone, and travel along the surface of the periosteum to give off vessels that penetrate into the cortex. These anastomose throughout the haversian system with the anastomotic vessels of the nutrient artery. In most long bones this blood supply is relatively minor. The blood flow within a bone is described as being from an internal to an external direction. The periosteal vessels are said to supply the outer one-third to one-fourth of the cortex, with the nutrient arteries supplying the remainder. The epiphyseal-metaphyseal vessels are separated in children by the epiphyseal plate; after its fusion, these vessels unite. It is important to note that although the nutrient artery is the major blood supply to bone, after it has been ligated, the periosteal-metaphyseal vessels take on a new role and can supply enough blood to maintain viable bone. The ideal bone flap should be one that contains a nutrient artery. In the rib this nutrient artery

is believed to come from the posterior intercostal vessels. Flat bones, on the other hand, receive a much more significant blood supply from the periosteal vessels; such a bone is the scapula. The most successful method of transferring bone today is via a free flap in which the nutrient artery to the bone is maintained. With pedicled osteomyocutaneous flaps the trapezius flap, using the acromion of the scapula, has been shown to be useful. Other authors have reported success with the sternocleidomastoid and clavicle or the pectoralis major and rib. Obviously these latter flaps depend on the nondominant periosteal supply.

All the pedicled flaps in the head and neck region are dependent on blood supply from either the external carotid or the subclavian arterial system. Many of these arteries can be injured during radical neck dissection, and this fact should be taken into consideration when planning any flaps. The subclavian system gives rise to vessels supplying most of the large myocutaneous flaps commonly used. The otolaryngologist should be familiar with the anatomy of these vessels, as well as the relevant anatomy of the axilla. It is important to note that anteriorly the pectoralis minor muscle protects the axillary contents.

Delay Phenomenon

Skin flap necrosis, when present, usually occurs on the distal end of a flap. This is undoubtedly a result of poor blood supply to that area. The surviving length of a flap has long been thought to be directly proportional to the width of the base. Although this may be true for random flaps, Milton demonstrated that when flaps are based on known vessels, the surviving length remained constant regardless of width.

The surviving length of a flap can be improved by elevating the flap in two stages (delaying). In the initial stage the flap is outlined and elevated but is left in position as a bipedicle flap. Two weeks later it is elevated as a single-pedicle flap and placed into position. This feature applies only to cutaneous flaps and not to myocutaneous flaps.

The reasons for the improved length available have not been fully elucidated. The hypotheses include:

1. Conditioning of the tissue to ischemia-induced hypoxia.

2. Closure of arteriovenous (AV) shunts.

3. Improved blood flow due to sympathectomy.

Pang and colleagues demonstrated that blood flow in the delayed flap reaches its maximum at 3 days, and also provided experimental evidence to suggest that neovascularization and sympathectomy are not factors. They proposed that the trauma of flap elevation releases neurohumoral substances that cause vasoconstriction. When the flap is bipedicled, vascularity is maintained, and after 2 to 3 days the neurohumoral substances are cleared. When the flap is converted to a unipedicle flap, vasoconstriction does not occur.

Delaying may be particularly necessary when extra length is needed in deltopectoral, temporal, or nape of neck flaps.

Common Flaps

The choice of flap depends on the situation involved. Myocutaneous flaps obviously provide more tissue bulk than just cutaneous flaps, which may be required in certain circumstances. Myocutaneous flaps are extremely useful in allowing single-stage closure of oropharyngeal defects, and subsequent early rehabilitation. Table 1 classifies the common flaps in terms of their content and blood supply.

Table 1. Commonly Used Flaps and Their Blood Supply

	Blood Flow	**Blood Supply**
Cutaneous		
Deltopectoral	Axial	Internal mammary perforators
Temporal	Axial	Superficial temporal
Forehead	Axial	Supraorbital, supratrochlear
Nape of neck	Random	Postauricular, occipital, vertebral
Thoracoacromial	Random	Transverse cervical, suprascapular, thoracoacromial, lateral thoracic
Cervicofacial	Random	Facial, superficial temporal
Cervicopectoral	Axial and random	Internal mammary perforators, transverse cervical, facial
Myocutaneous		
Pectoralis major	Axial	Thoracoacromial, lateral thoracic
Sternomastoid	Random	Occipital
Superiorly		Superior thyroid
Inferiorly		Transverse cervical
Trapezius	Axial	Upper, occipital; lower, transverse cervical
Superiorly		
Lateral		
Lower		
Latissimus dorsi	Axial	Thoracodorsal.

Cutaneous Flaps

Cutaneous flaps were the mainstay of head and neck reconstructive efforts before the advent of myocutaneous flaps. Their main use now is in the reconstruction of skin loss. Such loss often occurs in the head and neck secondary to infection, malignancy, or radiation. In many of these situations, split-thickness skin grafts should be considered as the initial reconstructive

choice.

Cutaneous flaps have an added bulk as well as their own vascularity, which not only adds protection but enables them to survive in difficult recipient sites. These flaps also have the advantage of not producing contraction and of providing good color match, often important in the head and neck. A cutaneous flap is indispensable as an outer lining in the closure of fistulas.

Deltopectoral Flap

The deltopectoral flap is an axial pattern cutaneous flap. This medially based chest flap receives its blood supply from the first four perforating branches of the internal mammary artery. Although the thoracoacromial and lateral thoracic arteries make contributions to the skin distally, these vessels are routinely severed during elevation of the flap and should not be considered part of the blood supply. Once considered the workhorse of head and neck surgery, this flap is being replaced in many areas by the myocutaneous flap. It is, however, a very reliable and durable skin flap, located outside the operated or irradiated field, which should be in the armamentarium of all head and neck surgeons.

Indications. The common indications for use of the deltopectoral flap are:

1. Replacement of neck and facial skin. Loss of cervical skin after severe necrotizing infections, chronic fistulas, or radiation therapy is not uncommon. When coverage for these areas is needed, the deltopectoral flap provides an excellent source of viable, disease-free skin.

2. Closure of pharyngeal cutaneous fistulas. Occasional oral and pharyngeal cutaneous fistulas do not close spontaneously and require the introduction of additional tissue. When the deltopectoral flap is used for this purpose, it requires the addition of an extra layer of skin to provide an internal covering. Such internal skin coverage may be provided by a skin graft, inversion of local skin, or a separate flap.

3. Reconstruction of the pharynx. Although the deltopectoral flap was once commonly used for this procedure, it is currently being replaced by such methods as the gastric pull-up and the free jejunal graft.

Technique. The medial portion of the flap should include the first four intercostal spaces. The superior incision should be outlined just below, and parallel with, the lower border of the clavicle, and extend out to the level of the acromion. The lower incision is then outlined by beginning below the fourth intercostal space and extending the incision parallel with the superior incision and out to the same level. The flap is elevated so that it includes the fascia of the deltoid and pectoralis major muscles. Dissection is carried medially, care being taken not to injure the perforating arteries, which are usually located one fingerbreadth lateral to the sternum. If the flap is being used for pharyngeal reconstruction, hair-bearing areas should be avoided. If such a problem arises, the flap may be directed into the axilla below the hair-bearing region. The flap can usually be raised in a one-stage procedure, but if further extensions of skin beyond the limits

described are necessary, a delaying procedure should be employed. Since it is always necessary to skin graft the donor defect, a split-thickness skin graft should be taken at the same time.

When the flap is used to repair a cutaneous cervical defect, one of two situations may arise: either there is an intervening bridge of normal skin or there is no healthy skin between the defect and the flap. In the latter situation the deltopectoral flap is merely transposed into position in the neck. In the former case the following options are available:

1. The pedicle can be tubed with the skin externally and the distal portion of the flap sewn into the defect. The pedicle is then ligated 3 to 6 weeks later.

2. A flap can be tunneled underneath the skin with the tunneled portion needing to be deepithelialized.

3. The intervening skin can be incised, skin flaps elevated medially and laterally, and the deltopectoral flap merely transposed into position.

We prefer the latter technique because of its simplicity and the elimination of the need for a second stage.

When the flap is used to close fistulas, both inner and outer linings must be provided. This can be performed in any of the following ways:

1. Lining the undersurface of the flap with a skin graft as a first stage procedure, and then 2 weeks later rotating the flap with the skin graft into position.

2. Local skin surrounding the fistula can be inverted on itself to provide internal lining, and the deltopectoral flap then placed in position for the external lining.

3. The distal edge can be folded on itself and the folded edge deepithelialized. This may compromise the flap and should probably be reserved for a second procedure.

4. A second flap can be used to provide the internal lining.

When used to reconstruct the pharynx, the flap can be tubed on itself with the skin forming the lumen. The upper end of the flap is sutured to the posterior pharyngeal mucosa and the base of the tongue. The pedicle is then tubed and cervical skin sutured into position over the flap. The lower end of the pedicle is sutured end to side to the upper end of the esophagus. A controlled salivary fistula exists and is closed 3 to 6 weeks later. Stenosis commonly occurs at the esophageal junction, and this method is currently being replaced by such techniques as gastric pull-up and free jejunal grafts.

Temporal Flap

The temporal flap is an axial pattern cutaneous flap based on the superficial temporal artery. It is essentially a forehead flap based on the temporal region.

Indications. The major uses of this flap include:

1. Repair of oropharyngeal defects.

2. Orbital and base of skull coverage with craniofacial defects.

3. Nasal reconstruction.

Technique. The flap is outlined so that it is based on the temporal region at the level of the tragus. The inferoanterior limb of the incision is carried just above the eyebrow and extended horizontally across the forehead beyond the midline to a point dependent on the length needed. The posterosuperior incision is first carried vertically, care being taken to stay posterior to the superficial temporal artery and above the auricle to include the postauricular artery. It is then carried horizontally at the level of the hairline and parallel with the lower incision. If extra length is necessary a delay procedure should be considered. The flap is elevated in a subfascial plane to ensure that the artery is included. The periosteum should not be violated in order to allow a satisfactory bed for skin graft to "take".

If the flap is being used for intraoral reconstruction, it can be brought into the oral cavity either below or above the zygomatic arch. If the inferior route is chosen, a skin incision is made just beneath the zygomatic arch and the tunnel created toward the upper buccal sulcus. If the flap is carried above the zygomatic arch, the temporalis muscle is removed, and again a tunnel is created toward the upper buccal sulcus. When using this latter technique, one must make sure there is not excessive compression of the base of the pedicle by the zygomatic arch, otherwise it may be necessary to outfracture the zygoma. When used in this way, the flap is best designed for posterior oral cavity and oropharyngeal defects, including the lateral tongue, floor of the mouth, alveolus, tonsillar region, and buccal mucosa. The flap is sewn to the defect circumferentially except superiorly, where a small salivary fistula is created. A split-thickness skin graft is placed on the donor site, and after 3 weeks the pedicle is ligated and the bridge segment returned to the forehead. This allows the distal portion of the flap to be used to complete the intraoral closure. Although the use of this flap is being replaced by other techniques, it should be relied on as a viable source of tissue for defects in this region.

When used to reconstruct orbital and nasal defects, the flap is merely elevated and rotated into position. Reconstruction of nasal defects, however, requires intricate planning and experience to obtain good results.

The major disadvantages of this flap are the cosmetic defect produced at the donor site and the potential facial nerve injury when it is used for intraoral reconstruction.

Midline Forehead Flaps

These axial pattern cutaneous flaps are based on the supratrochlear vessels.

Indications. The uses of this flap include:

1. Reconstruction of medial canthal region defects.

2. Reconstruction of nasal tip defects.

Technique. This flap is outlined so that two parallel incisions extend from the hairline down to the root of the nose. Elevation begins in a subgaleal plane to ensure preservation of the supratrochlear vessels. Once elevated the flap can be rotated into position to reconstruct the nasal defect, and the donor site can usually be closed by advancement of tissue. The flap can be combined with cartilage grafts, in which case the graft can be placed beneath the distal end of the flap as a first stage, and then the flap, along with the cartilage graft, transferred to the nasal defect together. This flap is indispensable for repair of nasal and medial canthal defects.

Nape of Neck Flap

This is a random pattern cutaneous flap based on the postauricular, occipital, and vertebral arteries.

Indications. The major indications for use of this flap are:

1. Resurfacing of cervical cutaneous defects.

2. Closure of pharyngeal cutaneous fistula.

Technique. The flap should be designed so that the most anterior incision begins posterior to the auricle to include the postauricular artery, and the posterior incision should extend across the midline to include the opposite occipital artery. Two parallel incisions are then continued down toward the shoulder tip, with an anterior incision extending along the anterior border of the trapezius muscle. The flap is then elevated in a subfascial plane. If there is any question as to the viability of the flap, a delayed procedure should be undertaken.

For resurfacing skin defects the flap can usually be rotated into position. If a dog ear is created at the superior margin, this should be sewn on itself and resected at a later date so as not to risk injury to the blood supply.

If the flap is being used to aid in the closure of a fistula, it can be either lined with a skin graft as a first stage, or combined with another flap, such as a sternocleidomastoid myocutaneous flap. Another option is to use the local skin around the fistula in a trapdoor fashion and then use the flap to cover this.

This flap is a rich source of viable tissue that is usually outside the operated or irradiated field.

Thoracoacromial Flap

The thoracoacromial flap is a large random pattern cutaneous flap. It is a laterally based chest flap that receives its blood supply from the transverse cervical, suprascapular, thoracoacromial, and lateral thoracic arteries.

Indications. The major indications for use of this flap are:

1. Replacement of cervical cutaneous defects.

2. Replacement of peristomal skin, particularly that associated with stomal recurrence.

Technique. The flap is outlined so that it is based laterally. The superior incision begins above the clavicle and 2 to 3 cm medial to the coracoid process. The incision then extends medially and follows the lateral border of the sternum in an inferior direction. The lower limb of the incision essentially follows the lateral and inferior border of the pectoralis major muscle. The flap is elevated in a subfascial plane, care being taken not to injure the lateral thoracic and thoracoacromial contributions to the flap at its base. The flap can then be rotated into position into the neck or face, and the donor site closed with a split-thickness skin graft.

This flap produces a significant cosmetic defect on the chest but is a major source of viable skin.

Cervicofacial and Cervicopectoral Flaps

These are large, random pattern, medially based cervical cutaneous flaps. The cervicopectoral flap does have some axial contributions in its lower portion from the internal mammary perforators.

Indications. The major uses of these flaps are:

1. Repair of cervical cutaneous defects.

2. Repair of facial cutaneous defects.

Technique. This flap is outlined so that the superior incision extends from the lower border of the cutaneous defect toward the postauricular region, and then follows the anterior border of the trapezius muscle. The lower limb of the incision is carried horizontally along the level of the clavicle far enough to allow rotation of the skin into the cervical or facial defect. The lower limb of the incision can also be extended inferiorly to include the skin supplied by the first four internal mammary perforators, in which case it becomes a cervicopectoral flap. The flap is

elevated in a subcutaneous plane, and when it is extended onto the chest the fascia of the underlying muscle is included.

These flaps are a good source of skin for large facial defects and produce an acceptable cosmetic result. The donor site can often be closed primarily without using a split-thickness skin graft. The cervicofacial flap can also be laterally based.

Myocutaneous Flaps

Myocutaneous flaps are essential in any head and neck surgical practice. Their role is paramount in the reconstruction of oropharyngeal defects. These flaps are consistently reliable and have allowed single-stage restoration of function. The attached muscle provides protection for the carotid artery and adds contour to the neck and jaw. Conversely, the added bulk makes these flaps unacceptable in certain situations. Although primarily used in the oropharynx, they may also replace large facial defects.

The myocutaneous flaps to be described incorporate a relatively small island skin paddle. It should be remembered, however, that most of the skin overlying the particular muscle is available for use, particularly the skin overlying the course of the supplying vessel.

Pectoralis Major Flap

This is an axial pattern myocutaneous chest flap based on the thoracoacromial and lateral thoracic arteries.

Indications. The major indications for use of this flap are:

1. Closure of oropharyngeal defects.

2. Repair of oropharyngeal fistula.

3. Repair of facial defects, including the orbit.

The ease of elevation of this flap, combined with its reliability and the one-stage closure of defects, has made it the most commonly used flap in head and neck surgery.

Technique. The first stage in the planning of this flap is to outline a standard deltopectoral flap. We always attempt to design our skin paddle below the fourth intercostal space so as to preserve the deltopectoral flap. Outlining the skin paddle inferior to the lower border of the deltopectoral flap, and lateral to the sternum, an incision is made laterally toward the axilla along the lower border of the deltopectoral flap. Skin is then elevated from the muscle superiorly to the level of the clavicle, and laterally to identify the lateral border of the pectoralis major muscle. We attempt to outline the skin paddle below the inferior border of the potential deltopectoral flap, but if the lower portion of the skin extends well beyond the lower border of

the pectoralis major muscle, the skin paddle is outlined in a more superior position. It is thus important not to make the incision for the skin flap before the lateral incision has been made and the muscle identified. At this point the skin surrounding the proposed flap is incised down to the level of the fascia, and tacking sutures are then placed from the fascia to the skin to prevent shearing of the musculocutaneous arteries. The superior skin flap is then further elevated so as to identify the lateral border of the sternum, care being taken not to injure the perforating vessels of the internal mammary artery. The pectoralis muscle is then removed from its origin along the ribs and lateral border of the sternum, and elevated so as to include the fascia overlying the pectoralis minor muscle. During elevation of the flap laterally, the lateral thoracic artery will be encountered. Although this artery may have contributions to the flap, it usually is not possible to preserve it because it limits further elevation of the flap. At this point the thoracoacromial artery can usually be identified, and the pectoralis major muscle is removed from its insertion into the humerus, care being taken not to injure the vascular pedicle. Medially the muscle is divided lateral to the internal mammary perforators. The whole flap is then elevated to the level of the clavicle and tunneled subcutaneously, and the skin paddle is sutured into the defect to be repaired. The donor site can usually be closed primarily, but with large flaps split-thickness skin grafts may be necessary.

The significant bulk of this muscle allows restoration of contour when composite resections are being performed, and also provides protection for the carotid artery and internal jugular vein. Although the skin portion of the flap can be extended beyond the lower border of the pectoralis major muscle, the skin will have a random pattern blood supply and we try to avoid this situation whenever possible.

Potential early complications of the flap include chest wall hematoma or abscess formation, flap necrosis, and neck abscess or fistula formation. An additional late complication encountered is osteomyelitis of the underlying rib, which may require resection and debridement of the rib. Although a complete loss of the flap is uncommon, superficial epithelial slough occasionally occurs. This, however, does not compromise the flap.

Sternocleidomastoid Flap

This is a random pattern myocutaneous flap receiving blood supply from the occipital, superior thyroid, and transverse cervical arteries. The flap may be superiorly or inferiorly based, but in both instances the whole muscle must be elevated with the skin paddle since blood supply to the muscle is random.

Indications. The major indications for use of this flap are:

1. Reconstruction of oral and pharyngeal resection.

2. Closure of chronic cervical fistulas.

Techniques. The decision whether to base the flap superiorly or inferiorly depends on the site of the defect. A skin paddle is outlined over one end of the muscle, the incision is carried down to the fascia, and tacking sutures are inserted. The remainder of the muscle can be exposed by using a routine neck dissection incision, or by making a vertical incision directly over the muscle and elevating skin flaps laterally and medially. The muscle is then transected at one end and elevated away from the underlying tissues. If a superiorly based flap is used, care must be taken not to injure the occipital artery. If an inferiorly based flap is used, injury to the transverse cervical artery must be avoided.

The main argument against the use of this flap is the need to use muscle and skin from a potentially malignant field, as well as from a surgical and radiation field. Although the flap has been shown to be viable, there are other excellent alternatives that do not introduce these concerns. A high incidence of superficial slough has also been reported. This flap should be remembered for its potential use in the repair of esophageal and pharyngeal fistulas. For that purpose it may be combined with other myocutaneous or cutaneous flaps to produce inner and outer lining.

Trapezius Flap

The trapezius muscle receives an axial pattern blood supply from the occipital, transverse cervical, and suprascapular arteries. The major blood supply comes from the transverse cervical artery. This vessel runs beneath the fascia of the deep surface of the muscle. A myocutaneous flap may be designed over the lateral portion at the tip of the shoulder, or over the inferior portion of the muscle overlying the medial border of the scapula.

Indications. The major uses of this flap are:

1. Resurfacing of defects of the lower two-thirds of the face, neck, and temporal fossa.

2. Reconstruction of oral and pharyngeal resections.

3. Reconstruction of esophageal defects and repair of chronic cervical fistulas.

Technique. When the lateral trapezius myocutaneous flap is used the acromioclavicular joint is selected as the midpoint of the cutaneous paddle. The vertical limb of a neck dissection incision can often be incorporated into the design of the flap, in which case skin must be elevated posteriorly off the deltoid and trapezius muscles. After the skin paddle is outlined laterally, the incisions are carried down to muscle and tacking sutures inserted to prevent shearing. The trapezius muscle is then elevated off the scapular spine. During elevation the suprascapular artery usually needs to be ligated. The accessory nerve is also encountered during the elevation and may need to be sacrificed. The transverse cervical artery is identified on the undersurface of the muscle and preserved. If necessary, however, this vessel may be ligated, in which case blood supply for the flap will arise solely from the occipital artery. The flap can then be rotated into position to fill the desired defect.

If the flap is based over the lower portion of the trapezius muscle, the patient is positioned on his or her side with the arm abducted. A skin paddle is outlined so that it is not lower than the lower border of the scapula, and located between the medial border of the scapula and the vertebral spine. A paraspinal vertical incision is made, the skin paddle is outlined, and tacking sutures are inserted. The attachments of the trapezius muscle to the vertebra and scapula are released, and the muscle is elevated off the rhomboid muscles. The transverse cervical artery is identified on the undersurface of the muscle. If the spinal accessory nerve has been preserved, the flap can be tunneled under the fibers of the upper end of the trapezius so as to maintain some shoulder function. The flap is rotated into position, and the donor site can usually be closed primarily. When using the lateral flap it is often necessary to apply a split-thickness skin graft to the donor site.

This flap provides a reliable source of healthy tissue and should be considered a viable option for most head and neck defects. The disadvantage is the change of position necessary for its elevation.

Latissimus Dorsi Flap

This is an axial pattern myocutaneous flap based on the thoracodorsal artery.

Indications. The common applications of this flap in the head and neck include:

1. Reconstruction of scalp and craniofacial defects.

2. Reconstruction of temporal bone defects.

3. Reconstruction of large cervical facial defects.

This flap is particularly indicated whenever large amounts of skin and muscle are needed.

Technique. The patient is placed in a mid-lateral position with the arm abducted. The distance from the defect to the axilla is measured using a gauge, and the distance is measured from the axilla in a line directed toward the medial portion of the iliac crest. This places the skin paddle over the midportion of the muscle. The skin paddle is outlined and an oblique incision is carried superiorly toward the axilla until the anterior border of the latissimus dorsi muscle is reached. Subcutaneous skin flaps are elevated laterally and medially. The upper border of the latissimus dorsi muscle travels from the vertebral spine along the lower border of the scapula to insert into the humerus. The muscle is separated from the scapula and teres major muscle at this site. The muscle surrounding the skin paddle is incised inferiorly, and the flap, along with the fascia of the underlying muscle, is elevated in a superior direction. When the serratus anterior muscle is encountered, it is necessary to incise the fascia along its lower border to allow continued elevation of the flap. Elevation continues until the thoracodorsal artery is identified superiorly. The insertion of the muscle onto the humerus may then be removed. The muscle can be brought into the neck by tunneling it subcutaneously over the pectoralis major muscle, or

tunneling it underneath the pectoralis major muscle, but above the pectoralis minor. The latter technique usually allows more length and causes less kinking of the pedicle, but care must be taken not to injure the thoracoacromial artery. The flap is then sutured into position, and the donor site can usually be closed primarily. Occasionally a split-thickness skin graft is necessary.

This flap is an excellent source of large amounts of tissue and is particularly indicated when length and bulk are needed.

Osteomyocutaneous Flaps

The myocutaneous flaps that have been successfully used with bone are the sternocleidomastoid with clavicle, pectoralis major with rib, and the trapezius with scapular spine. The bone from clavicle and rib, being long bone, lose the blood supply from their nutrient vessels once they are resected. These flaps thus depend on their periosteal supply to maintain them. Although success has been reported, these flaps are generally unreliable, and other excellent alternatives in the form of free flaps are available.

The most reliable pedicled osteomyocutaneous flap is the trapezius flap utilizing the scapular spine. This bone receives a large part of its blood supply from the periosteal vessels and because of this tends to be more reliable. Once again, however, free flaps are superior to this technique because of the amount and quality of bone available.

It is obvious that a vast array of flaps are available to the head and neck surgeon. Choice of the appropriate flap requires careful planning and experience. When a myocutaneous flap is necessary, we employ the pectoralis major whenever possible and use the other flaps in selected circumstances. The trapezius myocutaneous flap is an excellent alternative to oropharyngeal reconstruction, particularly in females, in whom a chest deformity is undesirable. Our most commonly used cutaneous flap is the deltopectoral.

One must always plan flaps carefully and be sure that the vascular supply to the proposed area has not been compromised by current and any previous surgery. Careful thought will achieve successful reconstruction of most head and neck defects.