

## Myocutaneous Flaps in General Surgery

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*In recent developments in the repair of large surgical defects where simple flap rotation may have been previously employed, myocutaneous flaps are being used because of functional advantages and to decrease the number of reconstructive procedures. The authors have employed myocutaneous flaps in 40 cases from January 1980 until April 1985 at Presbyterian Medical Center in Chonju. The primary disease was malignant in 31 cases and benign in 9 cases. Seven types of flaps were employed: The pectoralis major myocutaneous flap (20 cases); the trapezius myocutaneous flap (12 cases); the latissimus dorsi flap (2 cases); an osteomyocutaneous flap employing the sternocleidomastoid and clavicle (1 case); the gracilis myocutaneous flap (3 cases); the gluteus maximus myocutaneous flap (1 case); and a tensor fascia lata flap in one case. In more than 75% the skin island survived and an eventually successful result was obtained in 35 cases (87.5%).*

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Key Words: *Myocutaneous flaps*

### INTRODUCTION

**Reconstructive** surgical procedures have been developed to repair soft tissue defects resulting from a variety of causes in various anatomic sites. Since the 15th Century skin flaps have been used surgically, but in the 20th Century advances in head and neck surgery and a new understanding of the anatomical basis for the vascular supply of major skin flaps have led to advances in technic. The use of skin flaps not only avoids multiple staged procedures but is of great help from the functional and psychological viewpoint. Conventional skin flaps had the disadvantage of requiring staged procedures and lengthened hospitalization. In 1977 McCraw described the anatomic basis for the relationship between certain muscles, their blood and nerve supply and the skin covering them,

the neurovascular supply constituting independent myocutaneous vascular territories. As a consequence surgical technics for the use of one-staged myocutaneous flaps were extensively developed to allow correction of major defects. The authors report herein their experience with 40 cases of myocutaneous flap reconstruction since 1980 at Presbyterian Medical Center in Chonju, Korea; this includes 7 kinds of myocutaneous flaps of which three were osteomyocutaneous.

### CLINICAL ANALYSIS

*Analysis of the trends in employment of reconstructive flaps*

Prior to 1980 the reconstructive flaps employed at Presbyterian Medical Center for correction of soft tissue defects were principally random or axial skin flaps. In 1980 myocutaneous flaps were employed initially in the head and neck area and since that time have been used widely in other areas of the body. Of the 40 cases representing 7 varieties of myocutaneous flaps, 33 cases of 3 types were employed in

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head and neck reconstruction. The remaining 4 types comprising 7 cases were employed in anterior chest wall reconstruction (2 cases), perineum reconstruction (2 cases), 1 case each for defects of the buttock and inguinal area, and 1 case for correction of an intractable rectourethral fistula (See Table 1).

#### *Analysis in terms of surgical indication*

Of the 33 myocutaneous flaps employed in the head and neck, 6 were for benign situations and 27 were the means of reconstruction of defects resulting from cancer resection. The benign disease processes requiring myocutaneous flap reconstruction are shown in Table 2. Two trapezius flaps were employed in the composite repair of stricture of the hypopharynx and cervical esophagus; in each case the myocutaneous flap was used to reconstruct the hypopharynx and colon by-pass was employed to reestablish alimentary continuity. One of

the benign cases was a recurrent ameloblastoma which required flap-on-flap repair to reconstruct mucosa and cheek.

Seven patients required myocutaneous flap reconstruction at other sites as shown in Table 3. Two radiation necroses of the chest wall following radical mastectomy were repaired with latissimus dorsi flaps. Two gracilis flaps were employed to resect perineal recurrences after abdominoperineal resection for rectal cancer, and this flap was also used as an interposition repair of a large, intractable congenital rectourethral fistula.

#### *Reconstruction sites*

Table 4 shows the distribution of myocutaneous flaps tabulating the type of flap with sites reconstructed. Again, as previously noted, 33 were required in head and neck reconstruction, of which 20 were pectoralis, 12 were trapezius, and one was a

**Table 1.** Trend and distribution of flaps

Year	Skin flaps	Myocutaneous flaps							Total
		Pect.	Trap.	Latis.	SCM	Grac.	Glut.	TFL.	
1977	70	—	—	—	—	—	—	—	70
1978	6	—	—	—	—	—	—	—	6
1979	6	—	—	—	—	—	—	—	6
1980	7	4	1	—	—	—	—	—	12
1981	5	5	—	—	—	—	—	—	10
1982	10	—	6	—	1	1	—	—	18
1983	5	4	5	2	—	1	1	1	20
1985. 4	13	7	—	—	—	1	—	—	13
Total	122	20	12	2	1	3	1	1	162
					40				

**Table 2.** Surgical indication

Site	Indications	No.	Total
Head and Neck			
Benign	Recurrent Ameloblastoma in cheek	1	
	Spur formation of mandible	1	
	Fibrous dysplasia of maxilla	1	
	Pharyngostoma	1	
	Post laryngopharyngectomy state	2	6
Malignant	Squamous cell ca.	24	
	Basal cell ca.	1	
	Fibrosarcoma	1	
	Midline lethal granuloma	1	27
			33

Table 3. Surgical indication

Site	Indications	No.	Total
Chest	Post mastectomy radiation necrosis	2	
Perineum	Recurrent rectal ca.	2	
	Rectourethral fistula	1	
Buttock	Decubitus ulcer	1	
Inguinal	Scar contracture	1	7

Table 4. The distribution of flaps

Flap Site	Pect.	Trap.	Lati.	SCM	Grac.	Glut.	TFL.	Total
Head and Neck								
Oral cavity & oropharynx	17	6	—	1	—	—	—	24
Face and Neck	1	4	—	—	—	—	—	5
Cervical esophagus	2	2	—	—	—	—	—	4 (33)
Chest	—	—	2	—	—	—	—	2
Perineum	—	—	—	—	3	—	—	3
Buttock	—	—	—	—	—	1	—	1
Inguinal	—	—	—	—	—	—	1	1 ( 7)
Total	20	12	2	1	3	1	1	40

sternocleidomastoid osteomyocutaneous flap for successful mandible reconstruction.

The seven cases in other anatomical areas included 3 gracilis flaps for the perineal area, two latissimus flaps for chest wall and one each gluteus and tensor fascia lata flaps for buttock and inguinal areas respectively.

#### Flap survival

If survival of 75% or more of the transplanted skin is considered a criterion, 88% of the myocutaneous flaps were ultimately satisfactory. This implies that, although marginal necrosis occurred in 13 cases, minor debridement and conservative wound care resulted in satisfactory healing. The success rate was 18 of 20 petoralis myocutaneous flaps and 11 of 12 trapezius flaps. There was marginal necrosis in one of three gracilis flaps. Part of the skin island over the sternocleidomastoid osteomyocutaneous flap was lost but the bone graft succeeded. These findings are tabulated in Table 5.

#### Complications

A review of important complications reveals that partial or marginal flap necrosis occurred in 18

cases, infections in 11, fistula causing delay in planned post-operative radiotherapy in 9 cases, and wound separation in 7 procedures. However, in 14 cases the flap necrosis occurred in combination with other listed complications.

There was evidently an intimate relationship between complications such as partial skin necrosis, infection, fistula formation and flap survival. However, generally conservative management was effective. In two cases secondary repair was effected with local skin flap or using a new trapezius flap.

### SUMMARY AND DISCUSSION

This study includes a number of soft tissue defects resulting from trauma, deep burns, decubiti and radiation. However, the majority of the defects represented tissue loss resulting from radical surgery. Three points may be emphasized regarding radical cancer surgery:

- 1) the need for adequate margin around the tumor;
- 2) the importance of minimizing functional disability;
- 3) the desirability of a satisfactory cosmetic re-

Table 5. Flap survival

Survival Flap	100%	99-75%	74-50%	49%-	Total
Pect.	9	9	1	1	20
Trap.	9	2	-	1	12
Grac.	2	1	-	-	3
Latis.	1	-	1	-	2
SCM	-	1	-	-	1
Glut.	-	-	-	1	1
TFL.	1	-	-	-	1
Total	22	13	2	3	40

sult.

Of these three the most important is adequate margin around the resected tumor, and this creates the necessity to bring in transplanted skin. Conventional skin flaps, though simple, require multiple staging and their usefulness is limited in terms of size. These disadvantages are overcome by employing flaps designed to follow McCraw's principle of independent myocutaneous vascular territories, a concept which has provided radical progress in reconstructive surgery.

To review the history of regional skin flaps, Man-  
chot (1889), first called attention to the fact that all integument is supplied by blood from arteries which supply a field of subcutaneous tissue. In 1894 Tansini (as reported by D'Este 1912) first used a myocutaneous flap in reconstruction but a gap of some 60-odd years occurred before the use of this flap, based on the concept of blood supplying a specific skin area by means of vessels perforating underlying muscle, was re-employed. Owens (1956), used sternocleidomastoid osteo-myocutaneous flaps for facial defects, and Bakamjian used this flap in 1963 for palate reconstruction. In 1972 Orticochea popularized the use of the gracilis myocutaneous flap for penile reconstruction. In 1976, as mentioned, McCraw and Dibbell described independent vascular territories for several flaps in the dog. Mathes and Nahai, in their classical monograph, (1982) described 5 categories of myocutaneous flaps based upon arterial supply patterns. This has served to define pectoralis major, sternocleidomastoid and trapezius flaps for the face, head and neck, and upper trunk; the latissimus and rectus abdominis flaps for the anterior chest wall; the brachialis and flexor carpi ulnaris flaps for the upper extremity; and the gracilis, gastrocnemius, gluteus maximus, sartorius and tensor fas-

cia lata flaps for the lower extremity, buttock and perineum.

For the face, neck and oropharyngeal tract, the choice of donor site depends upon the size and location of the defect. The Demergasso anterior trapezius flap (1979) has the disadvantages of a donor site which requires split-thickness skin grafting in an area which is fairly exposed, and of a rather limited range for transfer; however the vascular supply is good, the survival rate has been favorable in our hands, and we have found it useful in some patients who have received radiotherapy when the transverse cervical vessels were not in the radiation field. The latissimus dorsi flap is inconvenient in head and neck surgery because the patient's position must be changed during the procedure and has been found by Quillen (1978) to have the disadvantages of limited range and bulkiness in head and neck reconstruction; however as pointed out by Mendelson (1977), infections and complications are few, and because it can be designed as a coverage for large defects, and yet the donor site can be closed primarily, it has great usefulness particularly in breast reconstruction and certain chest wall defects. The sternocleidomastoid musculocutaneous flap has limited value in cancer surgery of the head and neck primarily because the muscle is so intimately related to the jugular lymph node chain. The pectoralis major myocutaneous flap leaves a chest wall scar in men and may cause asymmetry in the contour of the breasts when employed in women; nevertheless, this flap, popularized by Ariyan in 1979 has many advantages. First, it has adequate blood supply and therefore a high success rate; second, it may be modified by leaving a rib attached to its undersurface to create an osteomyocutaneous flap for reconstruction of the mandible; thirdly, it can be employed over a wide range extending not only

Table 6. Complications of the flaps

	Partial necrosis	Infection	Fistula	Delayed XRT	Wound separation	Total
Pect.	11	6	9	6	4	33
Trap.	3	3	—	2	1	9
Grac.	1	—	—	—	1	2
Latis.	1	1	—	—	—	2
SCM	1	1	—	1	—	3
Glut.	1	—	—	—	1	2
TFL	—	—	—	—	—	0
Total	18	11	9	9	7	51

to reach the oropharynx and oral cavity but to the frontoorbital and temporoparietal areas; fourth, because a large graft can be designed it can be employed readily in repairing large defects resulting from radical neck dissection where skin sacrifice was required; finally, the donor site can generally be closed primarily. It has therefore become the most valuable myocutaneous flap in the head and neck area (Magee et al, 1980)

The pectoralis major flap has thus become the author's first choice for reconstruction in the head and neck, but the trapezius flap may be employed under the following circumstances:

1. In the reconstruction of oral or oropharyngeal cavities after Commando or composite resection
  - a) when "classical" radical neck dissection is not indicated, that is in by the Absence of positive nodes;
  - b) when preoperative radiotherapy has not been employed in the inferolateral part of the neck;
  - c) when the chest wall tissues are inflamed or the pectoralis muscles poorly developed;
  - d) in obese patients in which excessive fat separates muscles from the integument of the chest wall.
2. When the pectoralis major flap does not reach the defect area as satisfactorily as in the nuchal area.

The authors employ the trapezius myocutaneous flap in the 5 circumstances described above. The posterior trapezius flap has a wider arc of rotation, being supplied by the descending branch of the transverse cervical artery which extends along the medial aspect of the scapula for a distance of 10–15mm. below the scapula.

In the groin and perineum the tensor fascia lata,

gracilis, sartorius and rectus femoris may be employed. The "T.F.L." flap, supplied by the lateral femoral circumflex artery, reaches the groin or ischial area. It is most useful in correction of defects resulting from abdominoperineal surgery, or for vaginal reconstruction or penile reconstruction.

Decubiti of the trochanteric area are best corrected with the tensor fascia lata graft. Sacral decubiti are best treated employing gluteal myocutaneous flaps. The bulk of the muscle is useful in providing sufficient padding over the sacrum.

As Park and Seel (1983) have previously reported, factors influencing the survival of myocutaneous flaps include anemia, tuberculosis, leprosy, other chronic debilitating diseases and the effect of previous radiation therapy. Every effort has been made to correct such problems related to chronic illness prior to surgery and since 1983 no complications attributable to such cause have occurred. The effect of prior radiotherapy to the head and neck area was a factor in the marginal necrosis of 3 patients who underwent resection after prior efforts to control a tumor in the head and neck had failed. In such circumstances not only does radiation cause damage to microcirculation in the oral or oropharyngeal cavities resulting in anastomosis breakdown; the resulting infection in the wound taxes the peripheral circulation in the flap itself.

Two other technical comments are offered. We have learned to design the pectoralis major myocutaneous flap in such a way that the skin island does not extend beyond the pectoralis muscle. Technics which demonstrated this island extending inferiorly over the anterior rectus sheath have been abandoned and since then we have not had necrosis other than at the flap margin. Secondly, we often employ the concept of the "controlled fistula" when myocutaneous flaps are used in the head and

neck. Although every effort should be made to obtain a water-tight repair in the oral cavity, oropharynx, or hypopharynx, minor wound breakdown may occur, especially when suturing near the stump of the mandible or in post-radiation surgery. The suction catheter is therefore not removed at 5 days as in standard neck dissections, but allowed to remain in place until the myocutaneous flap is well attached, and the catheter tract is established. Post-operative wound care is evidently of great importance in all myocutaneous flaps, but particularly in reconstruction of the oropharyngeal passages.

To summarize, several factors must be considered in the selection of a myocutaneous flap. First, one must select the flap in the defect area which will cause least loss of function. Secondly, the distance to the defect, the arch of rotation, the size of flap required, and its design must be thought through. Thirdly, the patient's general condition, and the vascularity of the donor and recipient area tissues must be borne in mind in order to minimize the possibility of necrosis and encourage primary healing of transplanted skin to the defect margins. The possibility of complications is enhanced when these considerations are not given particular attention.

### CONCLUSIONS

Analysis of 40 myocutaneous flaps employed at Presbyterian Medical Center, in Chonju, in the reconstruction of soft tissue defects revealed the following:

1. Myocutaneous flaps are useful particularly after composite surgical resection of tumors arising in the head and neck, but have been found valuable in a variety of soft tissue defects related to burn scars, radiation ulcers, perineal recurrences, and decubitus ulcers.
2. The pectoralis major, trapezius myocutaneous flaps were most often employed and were over 90% successful.
3. Satisfactory results were obtained in 35 or 87.5% of the 40 cases.
4. Complications are not uncommon and require attention both for their prevention and to bring about

satisfactory result despite their occurrence.

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