The Laryngoscope
Lippincott Williams & Wilkins, Inc.

Surgical Techniques and Results of Lateral Thoracic Cutaneous, Myocutaneous, and Conjoint Flaps for Head and Neck Reconstruction

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Background: **This paper aims at presentation of our surgical techniques and results of the lateral thoracic (LT) flaps for head and neck reconstructions.** ***Method:*** **There were seven LT cutaneous, seven LT myocutaneous, and two LT conjoint myocutaneous flaps for reconstruction of head and neck mucosal or cutaneous defects.** ***Results:*** **The largest flap size was 22 cm × 13 cm. All donor sites were closed primarily. The highest point of reconstruction was in the nasopharynx internally and zygoma externally. All flaps survived without major complication.** ***Conclusions:*** **The LT flap has the versatility of cutaneous, myocutaneous, and conjoint flaps with pectoralis major or latissimus dorsi myocutaneous flaps to reconstruct large surgical defects. It has a large, reliable surface area, a long pedicle to reach nasopharynx and zygoma, and has less bulky muscle to facilitate tubular reconstruction of circumferential pharyngeal defect, one-stage operation, esthetic hidden donor site scar in axillary region, and minimal donor site morbidity. It is an additional reliable pedicle flap in our armamentarium for reconstruction of both cutaneous and mucosal defects in the head and neck region.** ***Key Words:*** **Lateral thoracic flap, serratus anterior myocutaneous flap, axillary flap.**

Laryngoscope, **117:288–294, 2007**

INTRODUCTION

Large surgical soft tissue defects of the head and neck region are reconstructed with either pedicle or free flaps. Free flaps are frequently used, with the advantages of more choices of tissues to meet the functional, esthetic, and anatomic requirements including location, surface area, tissue volume, and functional reconstruction.[1] Free flaps, however, have the disadvantage of a 5% to 10% risk of total flap loss. Microvascular surgery may not be practiced routinely by a majority of otorhinolaryngologists. There are also occasional patients whom would be better reconstructed with pedicle flaps instead of free flaps because of various reasons, including poor surgical risk and unfavorable recipient vessels. Regional pedicle flaps continue to play an important role.

The commonly used regional pedicle flaps for major head and neck reconstruction are the pectoralis major (PM) myocutaneous flap, deltopectoral (DP) flap, and latissimus dorsi (LD) myocutaneous flap. The lateral thoracic (LT) flap (also known as the axillary flap or serratus anterior flap) has rarely been reported for head and neck reconstruction. The vascular anatomy of the LT flap has been studied extensively in cadavers and is found to have reliable vessels.[2,3] The LT flap has been used mainly as a free flap for the reconstruction of limb and trunk.[4] The applications of free LT flap for head and neck reconstruction have never gained popularity compared with the other free flaps, including for the anterolateral thigh, forearm, and rectus.[1,5,6] Godat et al.[7] and Pittet et al.,[8] however, have shown recently that the LT flap is in fact a reliable free flap for facial construction. The pedicle LT flap is used mainly for reconstruction of defects in the axilla and chest wall.[9–11] The pedicle LT flap is not commonly used by most head and neck reconstructive surgeons, and there are only two case reports in the literature by a group of Japanese surgeons.[12,13] The present paper aims at presentation of our surgical techniques and experiences of using the pedicle LT cutaneous, myocutaneous, and conjoint flaps for head and neck reconstructions.

METHODS

Patients

The first LT flap was performed by the first author at our hospital in February 2004 to cover a skin defect after radical laryngectomy. A consecutive 16 LT flaps were performed by the two authors (12 flaps by the first author, 4 flaps by the second

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Editor's Note: This Manuscript was accepted for publication October 6, 2006.

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DOI: 10.1097/01.mlg.0000250494.62826.6b

author) for head and neck reconstruction on 15 patients in the period of February 2004 to May 2006 at Queen Mary Hospital, Hong Kong. The details of these 16 flaps on 15 patients are listed in Table I. One patient (patient 4) had two LT cutaneous flaps. The 16 flaps were used to reconstruct 10 skin defects, 4 partial oral or pharyngeal mucosal defects, 1 circumferential pharyngeal mucosal defect, and 1 through-and-through pharyngeal mucosal and neck skin defects.

Of the 16 flaps in these 15 patients, there were 7 LT cutaneous flaps, 7 LT myocutaneous flaps, 1 conjoint LT/PM myocutaneous flap, and 1 conjoint LT/PM/LD myocutaneous flap. There were two patients (patients 6 and 8) who also had PM myocutaneous flaps harvested independently on the same side of chest at the same operation. One patient (patient 14) had conjoint LT/PM myocutaneous flap harvested in one piece for reconstruction of hypopharynx. On patient (patient 15) had conjoint LT/PM/LD myocutaneous flap harvested in one piece for reconstruction of a large cutaneous defect. In one patient (patient 12), the myocutaneous flap was used for reconstruction of two defects: patch reconstruction of hypopharynx and also the neck skin (a strip of skin was de-epithelialized in the skin island to divide it into 2 parts). In one patient (patient 13), a tubed LT myocutaneous flap was used for reconstruction of a long circumferential defect from the hypopharynx up to the nasopharynx.

Vascular Anatomy of Lateral Thoracic Flap

The vascular anatomy of the LT flap has been re-examined recently in cadavers by Godat et al.[7] The LT flap is supplied mainly by two arterial networks running in the subcutaneous plane. The supplying arteries are the LT artery arising from the axillary artery passing underneath the pectoralis minor muscle to the lower anterior chest wall and upper lateral chest wall and the anterior cutaneous branch of thoracodorsal artery passing underneath the lateral border of the LD muscle to the posterior-inferior part of lateral chest wall. Although there are variations in the position of these two vascular supplies, they are always present. The LT flap can be either a cutaneous flap or a myocutaneous flap. The myocutaneous flap includes the serratus anterior muscle, which has additional blood supply from branches of the intercostal arteries. The LT artery also supplies the lateral part of PM flap, and therefore the skin island can be safely extended to an area covering the lower and lateral part of the PM muscle. The thoracodorsal artery also supplies the skin covering the LD muscle. The skin island of the LT flap can therefore be extended to an area covering the LD muscle. The LT flap can be combined with the PM or LD myocutaneous flaps as a conjoint flap or separately for simultaneous reconstruction of multiple defects.

Surgical Techniques of Harvesting Lateral Thoracic Flap

The patient is in supine position with a sandbag in the ipsilateral buttock area. The LT flap can be harvested at the same time with the head and neck resection to reduce the operating time. There are variations in the position of the two supplying arteries, and this fact has been reported to be the major difficulty in harvesting of the LT flap in the past. This problem, however, can be easily solved these days with the use of an ultrasonic doppler, which can locate the course of the LT artery and cutaneous branch of the thoracodorsal artery. The flap is always designed within the rib cage with the supplying vessels mapped within the skin island in the lateral thoracic wall. The harvesting techniques are demonstrated using patient 2 as an illustrative case (Fig. 1). The skin island can be extended anteriorly to the lateral part of PM muscle and posteriorly to the lateral part of the LD muscle. The PM and LD myocutaneous flaps can be harvested separately or as a conjoint flap in conjunction with the LT cutaneous or myocutaneous flap. A ribbon tape is used to measure the requirement of the pedicle length based on a focal point in the axilla.

The flap is harvested from below and upward. The supplying vessels are carefully preserved and are traced upward to the axilla. The serratus anterior muscle can be included if a myocutaneous flap is needed. The upper serratus anterior muscle slips and long thoracic nerve are always preserved to prevent swinging of the scapula. It has been shown that there is extensive collateral anastomosis between the branches of LT artery and the cutaneous branch of the thoracodorsal artery. The cutaneous branch of the thoracodorsal artery may restrict the pedicle length in reconstruction of defects higher up in the head and neck, and it can be divided if the LT artery is large enough to supply the skin island. The LT artery is always preserved. The pectoralis minor muscle is exposed by retracting the lateral border of the PM muscle and is divided overlying the course of the LT artery to release the constraint to the vascular pedicle of the flap (Fig. 2). The clavicular head of the PM muscle is divided to create a tunnel for delivery of the flap to the neck. The flap is then passed underneath the pectoral part of the PM muscle and then through the tunnel created in the clavicular head to the neck (Fig. 3).

For simultaneous reconstruction of both internal mucosal and external cutaneous defects by a single LT flap, a large skin island can be harvested with a strip of skin de-epithelialized without damaging the vascular networks in the subcutaneous plane (as in patient 12). The pectoralis muscle and its overlying skin island can also be harvested at the same time based on the pectoral branch of thoracoacromial artery to create a conjoint LT/PM myocutaneous flap (as in patient 14). The PM myocutaneous flap can also be harvested separately from the LT flap as two independent flaps, each for reconstruction of a different defect during the same operation (as in patients 6 and 8) or later as necessary (as in patient 5). The LD, PM, and LT flaps can also be harvested in combination as a single triple conjoint flap (as demonstrated in patient 15).

The LT donor wound can be closed primarily with mobilization of surrounding skin (Fig. 4). More skin is available for mobilization inferiorly from the upper abdomen and flank than from the chest. In the postoperative period, the flap color and warmth are monitored clinically without use of special instruments.

RESULTS

Of the 14 LT flaps alone, the size ranged from 7 cm $\times$ 5 cm to 14 cm $\times$ 10 cm (data in Table I). A large, 14 cm $\times$ 10 cm LT myocutaneous flap was necessary for reconstruction of a long segment of circumferential defect from the hypopharynx up to the roof of the nasopharynx for patient 13. This circumferential defect could not be repaired by other regional pedicle myocutaneous flaps, including a PM flap or LD flap, because the defect was too large for these two conventional flaps.

The LT flap is adjacent to the PM flap and LD flap, and a large conjoint flap can be harvested joining the LT flap with the PM or LD flaps. In patient 14, the pharyngeal defect was repaired with a conjoint LT and PM myocutaneous flap. In patient 15, the cutaneous and soft tissue defect of 22 cm $\times$ 13 cm was created in the left neck and cheek after extensive resection of recurrence of tongue cancer (Fig. 5). The defect was reconstructed with a conjoint PM/LT/LD myocutaneous flap in one piece, with the skin island extending medially from 2 cm lateral to the sternum, superiorly just above the nipple, inferiorly 3 cm from above the costal edge, and posteriorly to the LD muscle.

TABLE I.
Sixteen Lateral Thoracic Flaps.

Patient No. Sex, Age	Diagnosis	Resection	Surgical Defects for Flap Repair	Type of Flap	Flap Size (cm × cm)	Supplying Vessels	Irradiation	Complication
1. M, 50	NPC, postRT; extensive neck recurrence	Extended RND including neck skin	Neck skin	Cutaneous flap	7 × 5	LT	Prior RT and postoperative BT	Nil
2. M, 47	NPC, postRT; extensive neck recurrence	Extended RND including skin	Neck skin	Cutaneous flap	12 × 6	LT	Prior RT and postoperative BT	Nil
3. M, 54	ca larynx extended to hypopharynx, postRT recurrence	TL, PP, extended RND including neck skin	Neck skin	Cutaneous flap	9 × 7	LT	Prior RT	Nil
4. M, 54	NPC, postRT; bilateral neck skin radiation induced necrosis and bleeding	Excision of necrotic skin both sides of neck	Bilateral neck skin	Bilateral cutaneous flaps	11 × 8, 11 × 8	LT and cutaneous branch of TD	prior RT	Nil
5. M, 79	ca larynx, postoperative paratracheal recurrence	Excision of trachea and surrounding skin	Neck skin	Cutaneous flap	10 × 6	LT	Prior RT	Wound infection, 20% flap necrosis
6. M, 66	Persistent pharyngocutaneous fistula after TL for RT failure of ca larynx	Excision fistula track	Neck skin (and hypopharynx)	Cutaneous flap for neck skin (ipsilateral PM flap for hypopharynx)	8 × 6	LT	Prior RT	Nil
7. M, 45	NPC, postRT extensive neck recurrence	Extended RND with excision of neck skin	Neck skin	Myocutaneous flap	11.5 × 11.5	LT and cutaneous branch of TD	Prior RT and postoperative BT	Minor skin necrosis of donor site
8. M, 71	ca hypopharynx with extensive neck node metastasis and neck skin infiltration	TL, PP, and extended RND	Neck skin (and hypopharynx)	Myocutaneous flap for neck skin (ipsilateral PM flap for hypopharynx)	12 × 9	LT	Postoperative chemoradiotherapy	Nil
9. M, 66	ca tongue base	PG	Oral cavity floor	Myocutaneous flap	7 × 6	LT	Postoperative RT	Partial skin necrosis, no leakage
10. M, 50	ca tongue base extended to larynx, nodal metastasis	TG, TL, RND	Oral cavity floor and hypopharynx	Myocutaneous flap	13 × 10	LT	Prior RT for NPC	Nil
11. M, 70	ca larynx extended to hypopharynx, postRT recurrence	TL, PP	Hypopharynx	Myocutaneous flap	8 × 6	LT	Prior RT	Nil
12. M, 49	ca hypopharynx, postRT local recurrence	TL, PP, extended RND including skin	Hypopharynx and neck skin	Myocutaneous flap	de-epithelialized with 13 × 6.5 for pharynx, 6 × 6 for neck skin	LT	Prior RT	Anastomotic leakage, healed on observation
13. M, 54	ca hypopharynx extended to nasopharynx, postRT recurrence	TL, circumferential TP up to nasopharynx	Circumferential defect from hypopharynx up to nasopharynx	Tubed myocutaneous flap	14 × 10	LT and cutaneous branch of TD	Prior RT	Nil

(*Continues*)

TABLE I.
(continued).

Patient No. Sex, Age	Diagnosis	Resection	Surgical Defects for Flap Repair	Type of Flap	Flap Size (cm × cm)	Supplying Vessels	Irradiation	Complication
14. M, 62	ca hypopharynx, postRT recurrence	TL, PP	Hypopharynx	Conjoint LT and PM myocutaneous flap	11 × 8	LT and pectoral branch of TA	Prior RT	Nil
15. M, 67	ca tongue, postglossectomy, and RND, neck recurrence	Wide excision of neck recurrence, parotidectomy	Neck skin	Conjoint LT, PM, and LD myocutaneous flap	22 × 13	LT, pectoral branch of TA, and cutaneous branch of TD	Prior RT	Nil

ca = carcinoma; NPC = nasopharyngeal carcinoma; RT = radiotherapy; PG = partial glossectomy; TG = total glossectomy; TL = total laryngectomy; PP = partial hypopharyngectomy; TP = total pharyngectomy; RND = radical neck dissection; LT = lateral thoracic; TD = thoracodorsal; TA = thoracoacromial, BT = brachytherapy.

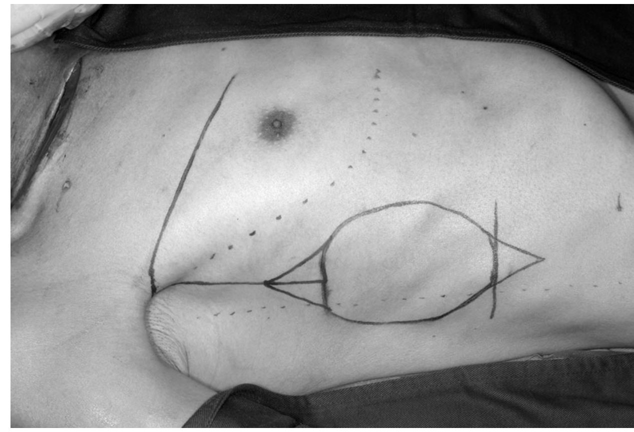

Fig. 1. Patient 2. Lateral thoracic flap skin island was designed within lateral thoracic rib cage.

In three patients (patients 6, 8, 12), there were through-and-through internal mucosal and external skin defects at the same time. In two of these patients (patients 6, 8), the PM flaps were harvested separately for reconstruction of the internal mucosal defect in the pharynx, and the LT flaps were used for skin reconstruction. With increasing experience of the LT flap, we were able to use a single LT flap to repair this through-and through defect. In one patient (patient 12), the LT myocutaneous flap was harvested to repair a through-and-through hypopharyngeal mucosal and neck cutaneous defect. A strip of skin was de-epithelialized on the skin island to allow patch repair on both surfaces with a single LT flap based on the LT artery alone.

All skin islands were designed within the thoracic rib cage. The highest point of reconstruction for a mucosal defect was in the roof of the nasopharynx (patient 13) and in an external skin defect in the zygoma (patient 14). The lowest point of donor skin island was designed at 3 cm above the lower border of the rib cage. All donor site wounds could be closed primarily without skin graft. One patient (patient 13) had a donor skin defect of transverse

Fig. 2. Patient 2. Pectoralis major muscle was retracted, and pectoralis minor muscle was divided to release constraint of vascular pedicle.

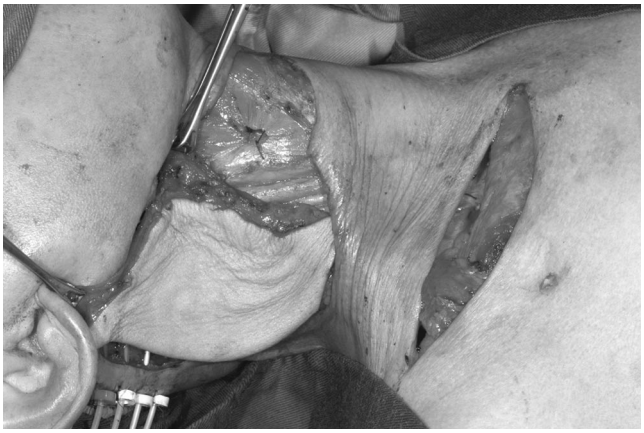

Fig. 3. Patient 2. Flap was delivered to neck through tunnel created in clavicular head of pectoralis major muscle.

Fig. 5. Patient 15. Surgical defect in left cheek and upper neck.

diameter (anteroposteriorly) of 11.5 cm. This patient had minor donor site skin necrosis of 2 cm diameter because of too much tension in the primarily closed wound because of pulling of the skin anteriorly and posteriorly over the chest wall. We had learned from this patient that the largest width that could be closed primarily with this method was 10 cm (patient 13). Instead of mobilizing the adjacent skin anteriorly and posteriorly in the chest wall, we subsequently designed a flap with its transverse axis in the direction from the axilla to the left upper abdomen to allow for mobilization of more abundant loose skin inferiorly from the upper abdomen and flank areas. We were then able to close the donor skin defect of 13 cm transverse diameter in patient 15 (Fig. 6).

Of the 16 LT flaps, 11 (69%) flaps were based on the LT artery, and 5 (31%) flaps were based on both the LT artery and the anterior cutaneous branch of the thoracodorsal artery. In the two conjoint LT flaps (patients 14, 15), additional blood supply from the pectoral branch of thoracoacromial artery was preserved.

In 13 (81%) flaps, there was prior radiotherapy to the site of reconstruction. One patient (patient 8) had postoperative chemoradiotherapy, and three patients (patients 1, 2, 7) had insertion of brachytherapy tubes for postoperative radiotherapy to the site of reconstruction. All flaps were viable without major complications despite all patients having had radiotherapy to the areas of reconstruction before or after operation.

One patient (patient 9) had skin island partial necrosis with viable underlying serratus anterior muscle in the floor of the mouth. This patient had no clinical leakage from the oral cavity, and the oral wound healed by mucosal re-epithelialization on conservative treatment. One patient had clinical anastomotic leakage (patient 12) after one single LT myocutaneous flap reconstruction of a through-and-through hypopharyngeal and cutaneous defect. The design of the skin island was found to be smaller than the required length, resulting in tension on the hypopharyngeal anastomosis by the skin island in the neck. The prior radiotherapy to the hypopharynx in this patient also increased the risk of anastomotic leakage. The minor hypopharyngeal anastomotic leakage healed on observation. One patient (patient 5) had initial viable healthy LT cutaneous flap, but the patient had subsequent methicillin resistant *Staphylococcus* infection of the neck wound surrounding the flap. The infection resulted in 20% flap skin necrosis with exposure of the carotid artery. A left PM myocutaneous flap was subsequently harvested on the

Fig. 4. Patient 2. Flap recipient and donor sites were closed.

Fig. 6. Patient 15. Primary closure of chest wall donor site by mobilization of skin from upper abdomen.

same side of the chest to replace the LT cutaneous flap and to cover the exposed carotid artery.

The upper serratus anterior muscle slips and long thoracic nerve were preserved in all patients, and there was no complication of swinging of the scapula. Of the six patients who had LT flap reconstruction of the oral cavity or pharynx, one patient (patient 9) was on normal diet, four patients (patients 11, 12, 13, 14) were on soft diet of mainly congee with minced meat, and one patient (patient 10) was on fluid diet because of the presence of severe trismus caused by prior radiotherapy of the nasopharyngeal carcinoma.

DISCUSSION

The LT cutaneous or myocutaneous pedicle flap is not used by most head and neck reconstructive surgeons. It is not described in the head and neck textbook and is scarcely published in the literature. It has been reported in early studies that the two supplying vessels have variable positions in the lateral thorax and that there is possible inconsistency of blood supply to the overlying skin. The cadaver studies in recent years by Erdogmus et al.,[3] Lifchez et al.,[2] and Petit et al.[8] have demonstrated that there is extensive vascular anastomosis of the vascular networks between the thoracodorsal and LT vessels to supply the muscle and skin island. The variable courses of the vessels make it difficult to design the correct flap location before the dissection, and therefore, there may be a need to readjust the flap location after identification of the supplying vessels. This problem is perhaps the most major unfavorable factor that has prevented it from gaining popularity since its discovery 30 years ago. These two supplying vessels are, however, always present, as has been shown by numerous case reports on its applications in free and pedicle LT flaps. The largest series of free LT flap was reported by Whitney et al.,[4] who demonstrated a 99% success rate of 100 free LT muscle flaps. Of the 100 free LT flaps, 36 were for head and neck reconstruction. They demonstrated that the LT flap has reliable and consistent vessels for free tissue transfer. With the development of ultrasonic Doppler, the course of these supplying vessels can be easily and accurately located in the lateral chest wall before dissection. It is no longer necessary to readjust the site of the flap during the harvesting procedure. Once the supplying vessels are mapped by ultrasound, the harvesting procedures are, in fact, straightforward.

Although we are using free flaps as our first choice in most major head and neck reconstructions and would not be able to provide large series' results of this pedicle LT flap, our experience are already the largest reports of the application of pedicle LT flap for head and neck reconstruction. The results demonstrate that pedicle LT flap has reliable supplying vessels and is a versatile flap to fit with the varieties of head and neck defects. It should be included in our daily armamentarium of pedicle flaps in addition to the more popular DP, PM, and LD flaps. Hopefully, more surgeons will attempt this pedicle flap in suitable patients and report their experiences so that we can have a better understanding of this almost forgotten pedicle flap.

The most popular conventional pedicle flap for a large-area head and neck skin replacement is the DP flap. We have demonstrated that the LT cutaneous flap can be an acceptable alternative flap in addition to the DP flap for reconstruction of neck and facial skin. In comparison with the DP flap, the LT flap has the advantages of a more cost-effective one stage operation, primary closure of large donor site defect without skin graft, esthetically hidden donor site location in an axillary area rather than the more exposed deltoid area of the DP flap, and a much larger available skin island. The LT flap also has versatility in the choices of cutaneous, myocutaneous, and conjoint flaps. When reconstruction of both cutaneous and subcutaneous soft tissue deficits are needed, as demonstrated in those patients with extensive neck resection, the LT myocutaneous flap can be harvested to replace the soft tissue volume loss in addition to providing coverage of the skin defect. The serratus anterior muscle fits in the neck subcutaneous soft tissue thickness more perfectly than the more bulky PM or LD myocutaneous flap. The LT flap can tolerate an unfavorable recipient bed that has been previously heavily irradiated and can survive without problems with additional postoperative brachytherapy. In one patient with prior radiotherapy and diabetes mellitus, the LT cutaneous flap failed to resist infection, resulting in partial necrosis. This confirms our knowledge that a myocutaneous flap can tolerate infection much better than a cutaneous flap. We have learned from this experience that the LT myocutaneous flap should be our choice rather than the LT cutaneous flap for those patients with high risk of severe infection or in the reconstruction of an infected wound.

The PM or LD flaps are the popular pedicle myocutaneous flaps for reconstruction of large oral and pharyngeal mucosal defects. The results in this study have shown that the LT myocutaneous flap is also a reliable alternative flap. The pedicle LT myocutaneous flap may be a better choice than PM or LD myocutaneous flap in selected patients. The PM flap is not particularly a good flap for women because it is too bulky and results in significant destruction of the female breast. The LT flap has the advantages of a longer pedicle length, a large, reliable surface area, and less bulky muscle compared with the PM and LD flaps. These advantages are particularly important, as demonstrated in patient 13, who needed a very large myocutaneous flap for reconstruction of a long segment of circumferential pharyngeal defect extending from hypopharynx up to the roof of the nasopharynx. Both PM and LD myocutaneous flaps are unable to reach the nasopharynx, and their muscles were too bulky for reconstruction of the tubular pharyngeal defect of this patient.

The LD flap and LT flap have been used as a conjoint free flap.[14,15] The LT and PM flap can be harvested at the same time either as two separate and independent flaps (as in patient 6 and 8) or as one single conjoint flap (as in patient 14). The triple conjoint LT/PM/LD myocutaneous flap can provide an enormous surface area and soft tissue volume replacement for large defect reconstruction, as demonstrated in patient 15. The large defect, which measured 22 cm $\times$ 13 cm, could not be provided by an LT, DP, PM, or LD flap alone. The possibility of using various combinations of the LT flap with PM and LD flaps can further enhance its versatility.

Another advantage of the LT flap compared with DP, PM, and LD flaps is the possibility to close a very large donor skin defect primarily. Donor skin defect of width up to 10 cm can be closed by pulling the skin anteriorly and posteriorly, as demonstrated in patient 13. Donor skin defects wider than 10 cm could only be closed primarily with mobilization of the loose skin over the upper abdomen and flank. Large LT flaps should therefore have their transverse axis along the line from the axilla to the umbilicus so that the donor defect can be closed primarily by pulling the abdominal skin upward, as shown in patient 15 (Fig. 6).

The LT flap has dual blood supplies, extensive vascular anastomosis between the two supplying vessels, and large, reliable skin island that can provide adequate surface area to cover a through-and-through mucosal and skin defect at the same time. As demonstrated in patient 12, a strip of skin can be de-epithelialized without cutting through the subcutaneous tissue to preserve the subcutaneous vascular networks supplying the two skin islands, one for internal and the other for external coverage. The PM flap can also be harvested separately with the LT flap for reconstruction of mucosal defect, as demonstrated in patients 6 and 8. The ipsilateral PM flap with its supplying vessel, the pectoral branch of the thoracoacromial artery, is still preserved as a backup flap after harvesting of LT flap. The preserved PM flap can be used subsequently in case it is necessary, as demonstrated in patient 5.

All the 16 flaps were designed within the rib cage. The highest point of reconstruction was in the roof of the nasopharynx internally (patient 13) and the zygoma externally (patient 14). Defects higher than this level can be reconstructed by extending the skin island beyond the rib cage, as described by Inoue et al.[12] There is, however, higher risk of flap necrosis at its distal tip. Because a skin island extending beyond the rib cage has a higher risk of ischemic necrosis, we suggest that defects higher than the zygoma in the temporal region preferably be reconstructed with a free flap unless this option is not available.

In conclusion, the LT flap can be used as a cutaneous, myocutaneous, and conjoint flap with PM and LD flaps. It has advantages of a large, reliable surface area, a long pedicle to reach the nasopharynx and zygoma, and has a less bulky muscle to facilitate tubular reconstruction of circumferential pharyngeal defect, one stage operation, esthetically hidden donor site scar in the lateral thorax, and minimal donor site morbidity. It is a versatile and reliable pedicle flap that is recommended to be included in our armamentarium for head and neck reconstruction.

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