



ANTEROLATERAL THIGH FLAP IN RECONSTRUCTION OF COMPOSITE FACIAL DEFECTS

Maxillofacial Surgery

Dr. Somangshu Chakraborty

Post Graduate Trainee, Department of Oral and Maxillofacial Surgery, Haldia Institute of Dental Sciences and Research, Banbishnupur, Balughata, Haldia, West Bengal 721645.

Prof. Dr. Rajarshi Banerjee

Professor and Head, Department of Oral and Maxillofacial Surgery, Haldia Institute of Dental Sciences and Research, Banbishnupur, Balughata, Haldia, West Bengal 721645.

ABSTRACT

The anterolateral thigh myocutaneous flap is one of the most commonly used flaps for reconstructive procedures in maxillofacial surgery. First described by Song et al. in 1984 this soft tissue flap can be easily obtained providing good amount of muscle for filling dead space and fascia lata. This viable flap can be prepared into a separate fat flap, multi-island fascia with iliac bone or other composite pedicle flaps to serve to requirements of various head and neck defects. The varying subcutaneous fat thickness and skin can repair defects seeking different flap thickness. Reconstruction of composite oral and maxillofacial defects is challenging. It pivots around evaluating the defect in all dimensions and filling it with a versatile flap. The paper discusses the basic characteristics of anterolateral thigh flap along with its multi-faceted application in reconstructing types of composite maxillofacial defects.

KEYWORDS

Anterolateral Thigh myocutaneous flap (ALT Flap), Composite Oral and Maxillofacial Defect, Reconstruction

INTRODUCTION

The faciomaxillary area is a region of prime value for aesthetic as well as functional reasons. Surgical resection of a malignant tumour in the head and neck region as part of complex oncological management has a significant impact on the clinical outcome.^[1] These procedures often result in severe defects not only in the craniofacial bones, but also in the soft tissue coverage and function of the mimetic muscles. If defects at these regions are not promptly repaired compromised phonation, mastication and deglutition may occur along with anatomic disfigurement. The complexity of these lesions necessitates use of various types of tissues with different functions for reconstruction. Multiple factors viz. related anatomical sites, types of missing tissues and sometimes even two separate defects, often cause these composite defects to be variable and complicated to reconstruct.^[2] Depending on defect size and location in some cases of penetrating defects of the lower face, floor of the mouth and anterior tongue, the mandible or osseous chin, and the soft tissue components of chin and lips a combination of two or more flaps is required for achieving best possible results.^[3] Reconstruction of these complicated defects are difficult, calling for not only restoring the anatomy but also replacing the exact amount and types of missing tissue.

With the development of microsurgical techniques, more than a dozen of free flaps have become commonly used tissue source for repair of maxillofacial defects.^[4] The ideal free flaps for maxillofacial defects should have the following features: simple preparation, constant vascular anatomy, a sufficient amount of diverse tissues, few donor site complications, and vascular diameter similar to that of head and neck vessels.

The application of anterolateral thigh flap was first reported by Song et al. in 1984.^[5] Anterolateral thigh flaps offer many features and can be prepared as perforating flaps, fat flaps, fascia flaps, muscle flaps, various chimeric flaps and others.^[6] Therefore, these flaps have earned due popularity for the repair of defects in the head and neck and other body parts.

A difficult vascular situation for flap anastomoses is often seen in patients where previous radical neck surgery has been performed. Therefore, multi-flap surgery is often accompanied by the necessity for long flap pedicles or techniques of pedicle elongation. A composite ALT flap serves beneficial in these cases.

Xi Yu Yao et al. recently in 2020 classified the types of composite oral and maxillofacial defects and ALT Flap or composite/modified ALT flap was chosen as a viable option for reconstruction of soft tissue as well as hard tissues in almost all of these defects. Single perforator based ALT flap has shown to be advantageous than most of other free flaps like radial forearm flap, rectus abdominis flap etc. The varying subcutaneous fat thickness and skin in ALT can repair defects seeking different flap thickness.

Anterolateral Thigh flap

Characteristics and flap modifications

The ALT flap is fundamentally a soft tissue flap that is supplied by the spetocutaneous descending branch of lateral circumflex femoral artery (LCFA). In a longitudinal direction, the vascular territory extends from the level of the greater trochanter of the femur superiorly to just above the level of the patella inferiorly. The donor thigh is placed into a neutral position without internal or external rotation, and an elliptical skin paddle with a width that permits primary closure of the donor site wound is designed.

The flap is centered around the long axis being parallel to and a few centimeters lateral to a line that is drawn from the anterior superior iliac spine (ASIS) to the lateral border of the patella. A territory of up to 20 cm in width and 30 cm in length providing a significant amount of bulk is available for transfer based upon cutaneous branches of the LCFA. The motor branch of the femoral nerve innervates the vastus lateralis running close to descending branch of the LCFA. This nerve should be preserved if possible.^[7]

ALT flaps have been applied for reconstruction of a wide variety of soft tissue defects. The most common indication for ALT flap reconstruction is after resection of tumours of the oral cavity, with defects of the tongue, buccal mucosa, palate and lips accounting for more than half of all cases.

The largest clinical series published to date included 1,284 cases, including 911 cases of head and neck reconstruction, performed between 1991 and 2001 at the Chang Gung Memorial Hospital in Taiwan.^[8]

Yu examined the characteristics of ALT flaps in 72 patients of Western ethnicity. He found that ALT flaps were consistently thicker in the proximal thigh and became progressively thinner in the distal thigh. Mean flap thickness in women (19.9 mm in the mid thigh) was significantly thicker than mean flap thickness (12.9 mm) in men. Yu found that flap thickness did indeed correlate well to body mass index.^[9]

Harvest techniques of ALT flap can also greatly influence the volume of subcutaneous tissues that are transferred. Some surgeons prefer performing *thinning of ALT flap* for improved visualization of the cutaneous blood supply to the flap and for clinical assessment of the flap skin vascularity after thinning is completed. Kimura et al. reported outcomes in 31 patients who underwent primary thinning of ALT free flaps. They concluded that cutaneous circulation was reliable within a radius of 9 cm of cutaneous perforators after primary ALT flap thinning.^[10]

This flap can be harvested as a *sensate flap* including the lateral femoral cutaneous nerve. The lateral femoral cutaneous nerve pierces

the fascia approximately 10 cm caudal to the anterior superior iliac spine and divides into two or three branches. Farace et al. examined 20 patients who underwent tongue reconstruction after hemiglossectomy using either ALT free flaps or radial forearm free flaps. Speech and swallowing outcomes were not significantly different between the two groups of patients.^[11]

Agostini and Agostini described a method for oral reconstruction using an **adipofascial ALT flap**.^[12] A standard fasciocutaneous ALT flap was harvested, and then the skin and superficial subcutaneous tissues were excised, leaving a flap that consisted of vascularized fascia lata covered by a variable amount of subcutaneous fat that was used to reconstruct oral defects. Advantages of this technique include the ability to precisely match the ALT flap's volume to that of the defect while avoiding the risk of skin paddle devascularization that is seen with primary ALT flap subcutaneous thinning. The vascularized fascia lata graft has been reported to prevent scar contraction after reconstruction, and the remucosalized adipofascial flap provides a hairless reconstruction that mimics the physical appearance and function of native oral mucosa.

ALT flaps provide an ample **source of skin** for pharyngoesophageal reconstruction in patients who undergo laryngopharyngectomy. Two methods of ALT flap inseting are possible to achieve reconstruction of the pharyngoesophageal segment, which involves use of either a linear tubed flap or a spiral tubed flap. Genden reported desired results of ALT flap pharyngoesophageal reconstruction in 12 patients.^[13]

Yu and Robb reported the outcome of ALT flap pharyngoesophageal reconstruction in 41 patients. A linear tubed flap inseting was used in all patients. In his initial nine patients, a small segment of flap skin was separated by de-epithelialization and used for postoperative flap monitoring.^[14]

However, use of the flap monitoring skin paddle was abandoned after this technique resulted in a high incidence. Successful tracheoesophageal speech was achieved in most cases. Ultimately, 88% of patients were able to consume a regular diet. Murray et al. reported the outcome of ALT flap pharyngoesophageal reconstruction in 14 patients. Reconstructions were done using flaps that were stented during the postoperative period using salivary bypass tubes. There were no postoperative salivary fistulas, and 14% of patients developed neopharyngeal stenosis.^[15]

Zoltan Loderar et al. in 2018 published a case report on basal cell carcinoma where the tumour and parts of the involved facial muscles and nerve were excised surgically from a 42-year-old patient after a third relapse of basal cell carcinoma in the left midface. The tissue defect was reconstructed with an anterolateral thigh chimeric type I fascio-myocutaneous flap, where the facial palsy was restored with segmental branch of the femoral nerve and the involved mouth elevator muscles were restored from the segmented vastus lateralis muscle. The 6-month follow-up revealed a good aesthetic outcome, the soft tissue defect reconstruction with good functional activity of the reconstructed facial nerve and with acceptable mimic movements. There has been no subsequent recurrence.

Zhen Hu Ren and associates summarised the application of 1212 anterolateral thigh myocutaneous flaps in the repair of oral and maxillofacial defects and examined their benefits.^[16] Among the 1212 transferred flaps, 1176 survived and 36 showed necrosis, a survival rate of about 97.0%. The common complications at flap donor site were poor wound healing (10.1%), localized paraesthesia (50.1%), and altered quadriceps force (11.0%). No cases presented with local serious complications, and 90% of patients achieved good functional recovery and aesthetically acceptable results after reconstruction of maxillofacial defects at various locations using anterolateral thigh flaps.

Gaggl et. Al in 2007 documented the technique of lower anterior facial reconstruction using a combination of an anterolateral thigh flap (ALTF) and a microvascular iliac crest flap in 18 cases.^[17] The pedicle of the ALTF was used for elongation of the iliac crest pedicle. There were no problems with the pedicle length and anastomoses even in patients who had received previous surgery and irradiation of the neck. There was no flap loss or complications.

The **ALTF and vascularized iliac bone flap combination** is useful in reconstruction of the lower face. The main advantage is the elongation

of the iliac flap pedicle by the ALTF pedicle in patients with previous surgery in the neck. The **pedicled flap** can be based proximally, with the most proximal pivot point located just distal to the origin of the LCFA off the profunda femoris artery, usually about 2–3 cm below the inguinal ligament.

When **bulk is required**, the anterolateral thigh skin flap can be harvested larger than the recipient site dimensional requirement and partially de-epithelialized to add bulk. A part or all of the vastus lateralis or rectus femoris muscle, the tensor fascia lata or other skin flaps in the thigh can be harvested along with the anterolateral thigh flap as a chimeric flap to add bulk or muscle tissue to fill a defect.

When **thin flap with no skin** is desired, an adipofascial flap can be elevated while keeping at least 3 mm of fatty tissue around the perforator.

The anterolateral thigh flap can be used as a **flow-through flap** for a variety of indications. The pedicle can be used to bridge a vascular gap in the extremity or the distal end can serve as the blood supply to another free flap.

In defects requiring **wide skin flap**, flap can be harvested in its usual longitudinal pattern, while maintaining a width that allows for primary closure of the donor site, and split into two skin islands. The **two skin islands** are then placed side by side and used to close a wide defect.

Using the fascial component, the fascia lata can be included to reconstruct tendon, fascia, and dura defects, as well as oral commissure defects, by providing a fascial sling.

The vastus lateralis can be harvested independently based on the muscular perforators arising from the descending branch of the LCFA.

Anterolateral Thigh Flap In Composite Defects

Composite oral and maxillofacial defects after ablative oncological surgery, such as typical through-and-through oral defects, are challenging clinical problems for maxillofacial surgeons.^[18] Flaps like perforator-based ALT flaps, branch-based ALT flaps and composite ALT flap combined with iliac crest in a chimeric design are well suited for reconstruction post oncological surgery. The key problem is that multiple layers of the missing tissues need to be reconstructed simultaneously. In addition, three-dimensional reconstruction requires donor tissue with a flexible folding capability and several islands of tissues. A well-designed free ALT composite flap could provide flexible and multiple blocks of tissue to replace the missing tissue in these complicated defects.

Case Report

In the following case, a 72 year old man diagnosed with moderately differentiated squamous cell carcinoma of oral cavity was operated under general anaesthesia twice and received radiotherapy post both the surgeries. Upon recurrence for the third time, he was again operated. Selective Neck dissection involving level I-IV lymph nodes of the right side was done previously. In the third surgery, selective neck dissection involving level I-IV lymph nodes from the left side along with composite resection of lower lip, alveolus, part of tongue and anterior floor of mouth was performed. The entire defect involving multiple anatomic landmarks at varying levels was reconstructed with a chimeric anterolateral thigh flap with a portion of anterior iliac crest attached to it (to serve as the missing mandibular component) harvested from the patient's left thigh. The result observed was satisfactory.

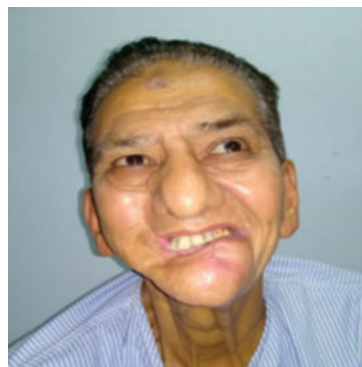


Figure 1: Preoperative profile

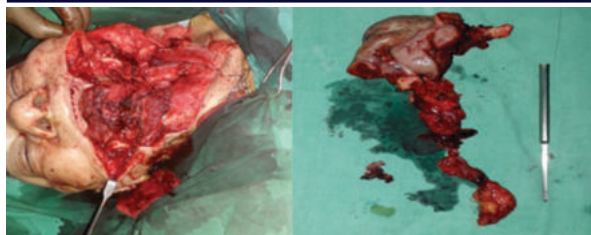


Fig. 1: Large defect after resection in multiple layers of hard and soft tissue



Fig. 2: The resected mass consisting of hard tissue, soft tissue and lymph nodes



Fig.3: Harvesting the ALT flap

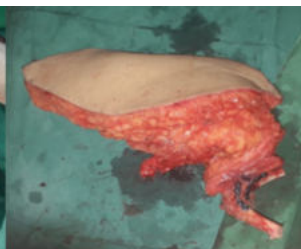


Fig. 4: The composite flap with anterior Iliac crest bone component



Fig.5: Placement of the flap



Fig 6: Immediate postoperative state

SUMMARY

For many surgeons workhorse anterolateral thigh flap has become the flap of choice owing to numerous advantages like reduced donor site morbidity, aesthetically hidden donor site with primary closure being possible in most cases. This flap can be easily harvested with good amount of tissues and different levels of defect can be filled. The reconstruction of the anterior mandible and chin region with the use of microvascular iliac crest flaps in combination with anterolateral thigh perforator flaps is a successful reconstructive technique which has several advantages beside a good aesthetic outcome. The ALT flap is of good dimensions and tissue quality. Its pedicle can be used for elongation of the short iliac bone flap pedicle, which is very useful in previously operated and irradiated necks. The microvascular iliac crest transplant has good bone quality for mandibular reconstruction and is well suited for implant placement. The thickness of the subcutaneous fat in the anterolateral area can be modified in order to achieve the necessary flap thickness, which makes it highly suitable for the surgical treatment of oral and maxillofacial defects. The quadriceps function is not commonly affected.

CONCLUSION

The anterolateral thigh myocutaneous free flaps are more suitable for oral and maxillofacial defects than other flaps. Oncological surgery in the head and neck region can often lead to complex functional and aesthetical defects. The management of these extensive impairments often involves therapeutic difficulties, and the surgeon may have to seek new opportunities to achieve acceptable results. In general, single-stage surgery is associated with fewer complications and better neural regeneration. The chimeric type ALT flap can be certainly considered a workhorse flap and a viable option for facial dynamic reconstruction, but the surgeon must also consider individual anatomical variation and other potential therapeutic solutions with a view to obtaining a satisfactory clinical outcome.

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