Anterolateral Thigh Flap for the Head and Neck defects… Kurdekar RS et al

Journal of International Oral Health 2016; 8(12):1069-1075

Received: 15th June 2016   Accepted: 18th September 2016   Conflicts of Interest: None

Source of Support: Nil

Anatomic Variations, Technique, and Clinical Applications of Anterolateral Thigh Flap for the Reconstruction of Head and Neck Defects

Raghavendra S Kurdekar1, Jeevan Prakash2, K Gopalkrishnan3, Jemee Patel4, Ramiz Vohra5, Harsimran Singh6

Contributors:
1Associate Professor, Department of Oral and Maxillofacial Surgery, Jodhpur Dental College & General Hospital, Jodhpur, Rajasthan, India; 2Professor and Head, Department of Oral and Maxillofacial Surgery, Vyas Dental College and Hospital, Jodhpur, Rajasthan, India; 3Professor, Department of Oral and Maxillofacial Surgery, SDM College of Dental Sciences, Dharwad, Karnataka, India; 4Consultant Oral and Maxillofacial Surgeon, Jodhpur, Rajasthan, India.

Correspondence:
Dr. Kurdekar RS. Department of Oral and Maxillofacial Surgery, Vyas Dental College and Hospital, Kudi Haud, Jodhpur - 342 005, Rajasthan, India. Email: rkurdekar@yahoo.co.in

How to cite the article:

Abstract:
Background: Anterolateral thigh flap (ALTF) even though has been around since 1984 when it was first described by Song et al. did not enjoy the wide acceptance as its other contemporary free flaps received in the reconstructive surgeries. The main reason being the anatomic variations in its vascular pedicle and bulky nature. This study aims to evaluate the anatomic variations, technical details and to elucidate the plethora of clinical applications of free ALTF in the reconstruction of head and neck malignancy defects.

Materials and Methods: A total of 20 patients who underwent reconstruction of post malignancy defects in the head and neck region in the Department of Oral and Maxillofacial Surgery, SDM College of Dental Sciences, Dharwad, India, were included in this study. Their records were analyzed to evaluate the technical details, vascular pedicle, clinical applications, and the associated complications. The patients were followed up for not <1-year postoperatively.

Results: All the ALTF in our study had skin perforators with the majority being musculocutaneous. There were no flap failures and the flaps were used to reconstruct different composite defects successfully with least complication rates.

Conclusion: ALT Fl meets most of the requirements of reconstructive surgeons as it can provide a large skin paddle which is fed by a long and wide caliber pedicle. The flap finds its appeal in minimal donor site morbidity and can be harvested by a two team approach. The disadvantages of anatomic variations can be negated by Doppler mapping and retrograde perforator dissection.

Key Words: Free flaps, head and neck tumors, resection, soft tissue reconstruction

Introduction
Head and neck reconstruction after tumor resection has always been a challenging problem. In the past, most oral defects were closed primarily using mucosal or cutaneous local or regional flaps. The anterolateral thigh flap (ALTF) was first described by Song et al., in 1984, since when it has gained in popularity and has become an important flap in head and neck reconstruction. This is mainly due to its low donor site morbidity, its versatility, pedicle length, and excellent reliability particularly while reconstructing large composite defects. It is based on perforators from the descending branch of the lateral circumflex femoral artery and its vena comitans in 90% of cases, and the perforators are musculocutaneous in about 80%. The anatomy of the ALTF donor site combines many advantages, such as the long and high caliber vascular pedicle, the possibility of simultaneous flap raising at the time of tumor resection in the head and neck region, and the exceptionally wide range of flaps which can be designed.

The ALTF has a few disadvantages, and some have considered it the “ideal soft tissue flap.” The original description of the ALTF suggests that the skin paddle was supplied by septocutaneous perforators (SCPs). This led to a poor initial experience with this donor site. Subsequently, it has been determined that most ALTF skin paddles are supplied by musculocutaneous perforators (MCPs). While this did not limit the application of this donor site, the anatomical variations should be recognized. In some patients, the ALTF may be thick, making it difficult to tube the skin paddle, this may represent a problem in an obese patient.

Many studies have been carried out to know the anatomic variations of this flap and to make its clinical applications much more feasible and predictable. Keeping this in mind, this study has been undertaken on 20 patients who underwent resections of the tumors in the head and neck region. The resultant defects were reconstructed using ALTF. Based on the technique of harvesting anatomic variations of the vascular pedicle and clinical applications, the results were analyzed.

Materials and Methods
Clinical data
After obtaining Ethics and Research Committee approval, a prospective clinical trial was carried out on totally 54 patients who underwent resection of malignant tumors in the orofacial region from September 2001 to January 2004. Out of which, 28 patients were reconstructed using free flaps. In 20 patients, the defects were reconstructed using free ALTFs.

Inform
consent was obtained, and patients of both the genders were included in the study. A standardized data sheet was formulated, and relevant clinical, demographic, pre-operative, and post-operative findings were noted. A total of 20 patients with a history of malignancy were included in the study. Among the 20 patients, 13 were males and 7 females. All the patients were in the Stage 4 disease. The selection criteria included patients who were reconstructed using ALTFTs; these patients had established biopsy proven malignant tumors (squamous cell carcinoma or verrucous carcinoma) of the oro-facial region. The size of the lesion was not less than 4 cm × 4 cm, and all the lesions were involving the skin. (Figure 1) Patients who did not follow-up for a minimum of 1 year and patients who had immunocompromised status or debilitating systemic illnesses were excluded from the study. All the patients underwent reconstruction after resection of the tumor (carcinoma of buccal mucosa (BM) 13 patients, tongue and floor of the mouth (FOM) 2, lower lip 2, alveolus 2 patients, both maxilla and mandible were involved in 1 patient). Routine blood investigations and anesthetic evaluation were done for all the patients.

**Technique**

**Patient position**

The patient was placed in supine position, with the patients thigh rotated medially and elevated with a roll under the knee. All the patients underwent elective tracheostomy to maintain the airway both intraoperatively and immediate postoperatively. A two team approach was followed to reduce the operating time.

Some of the technical details we followed were mapping of the skin vessels, dissection of the perforators under the microscope, inclusion of small fascia cuff around the perforators, and intermittent topical use of xylocaine during the intramuscular dissection of the perforators as described by Celik et al. (2002).

**Technique of harvesting the flap**

After the position of the perforators is confirmed by marking (Figure 2), blunt dissection is done toward the intermuscular space between the vastus lateralis and rectus femoris muscles. The rectus femoris is retracted medially, and the descending branch of the lateral circumflex femoral artery and the origin of the septocutaneous or MCPs can be seen. If several perforators are seen, the distal most perforators are selected to obtain the longest pedicle. After the perforators are selected, the incision is extended proximally to gain a wide operative field for dissection of the pedicle (Figure 3). The dissection of the perforators is done as described below.

**Dissection of septocutaneous and MCPs**

If the perforators are septocutaneous pattern, in which they arise from the intermuscular space between the rectus femoris and the vastus lateralis muscle and run above the vastus lateralis muscle, dissection is easy to perform. If the perforators are musculocutaneous pattern in which they pass through the vastus lateralis muscle a slightly more complicated procedure is necessary to dissect them. First, the vastus lateralis muscle immediately above the perforator is incised sharply to confirm the course of the perforator from the distal part toward its origin from the descending artery, whereas the perforator is elevated 2-3 places with the vessel loop and several branches are carefully ligated with nylon or an auto vessel clip or electrocoagulated with a bipolar instrument, leaving a small cuff of the vastus lateralis muscle attached behind the perforators helps to protect it from damage.

**Dissection of the descending branch of the lateral circumflex femoral artery**

Dissection of the descending artery is not difficult. If the rectus femoris is retracted medially and the vastus lateralis muscle is retracted laterally, the distal end of the descending branch and large branches into the neighboring muscles are ligated until a pedicle of sufficient length is obtained. The motor nerve from the femoral nerve to the vastus lateralis muscle is exposed and preserved. The descending artery is always accompanied by two large veins that can be used to anastomose with a tributary of the internal jugular vein in the neck.

**Excision and installation of the flap and microvascular anastomosis**

The size and shape of the defect were determined after the resection of the primary tumor. The flap was harvested corresponding to the size of the defect. The flap was installed to the defect site and fixed by suture followed by microvascular anastomosis. Finally, the defect in the thigh is closed using split-thickness skin graft.

**Recipient artery**

The recipient artery used for anastomosis was the facial artery in 14 patients, superior thyroid artery in 4 patients, and the lingual artery in 2 patients. An end to end anastomosis was done in all the 20 patients.

**Recipient vein**

The recipient vein used for anastomosis was the tributaries of the internal jugular vein. An end to end anastomosis was done in all the patients.

**Donor artery**

Perforators were derived from the descending branch of the lateral circumflex femoral artery in all the 20 patients.

**Monitoring after flap operation**

Closed observation for at least 72 h after flap transplantation is necessary. The patency of vessels after anastomosis was judged by examining the color, elasticity, and capillary filling of the skin as well as capillary hemorrhage after acupuncture.
Results
Application and anatomy of ALTF: Application and anatomy of ALTF are shown in Table 1. The length of dissected vascular pedicle ranged from 5 to 10 cm with an average length of 7 cm. The area of the ALTF cut was \((4 – 15 \text{ cm}) \times (5 \text{ cm} \times 10 \text{ cm})\). All the flap had skin perforators. The types of skin perforators included 5 cases of septocutaneous (25%) and musculocutaneous in 15 cases (75%). All the patients had Stage 4 disease. The majority of the patients had Stage 1 nodal involvement. Metastasis was not seen in any of our patients. The ALTF was used in all the 20 cases for repairing head and neck defects including BM defects 13 cases, tongue and FOM 2 cases, alveolus in 2 cases, lower lip 2 cases, alveolus of both maxilla and mandible 1 case. The operating time varied from 8 to 13 h with a mean of 10.5 h (Figures 4-6). All the patients received positive pressure ventilation under sedation for an average of 12 h. Tracheostomy was performed in all the 20 patients, and tracheostomy tube was kept for a minimum of 4 days to maximum period of 8 days with an average of 6 days.

The maximum size of the flap taken from anterolateral thigh was \(21 \text{ cm} \times 9 \text{ cm}\). Anastomosis was done with facial artery in 14 patients, superior thyroid artery in 4 patients, and lingual artery in 2 patients. In 1 patient, the flap was planned in the left thigh, but because of the inadequate perforator, it was harvested from the right thigh. Detailed steps for a case is shown in Figures 7-12.

Success ratio and complications
All the 20 cases with ALTF were successful, except for 1 case was wound dehiscence of donor site was observed. Dehiscence at the recipient site was seen in 2 patients, which was between the native neck skin and the flap. This was due to marginal necrosis of the native neck skin which led to breakdown and dehiscence with this flap. Reexploration was done in 2 patients

| Table 1: Reconstruction of head and neck defects using free ALTF (n=20). |
|-----------------|----------------|----------------|-----------------|
| Sex | Age | Primary disease | Flap size | Pedicle length | Perforator type |
| Male | 55 | BM | 4x6 | 7 | MCP |
| Male | 45 | LL | 4x5 | 6 | MCP |
| Female | 61 | BM | 6x7 | 6 | SCP |
| Female | 56 | BM and A | 5x8 | 7 | MCP |
| Male | 44 | A | 5x6 | 6 | MCP |
| Male | 46 | BM | 4x5 | 8 | MCP |
| Male | 41 | BM | 5x7 | 7 | SCP |
| Female | 54 | BM | 4.5x7 | 7 | MCP |
| Female | 58 | BM | 5x6 | 5 | MCP |
| Male | 43 | BM | 6x10 | 8 | MCP |
| Male | 58 | BM | 7x7 | 9 | MCP |
| Male | 34 | BM | 5x7 | 7 | MCP |
| Male | 45 | LL | 4x6 | 8 | MCP |
| Male | 42 | A | 6x9 | 7 | MCP |
| Female | 56 | T and FOM | 21x9 | 10 | SCP |
| Male | 43 | BM | 15x8 | 9 | SCP |
| Female | 52 | A (both jaws) | 11x9 | 7 | MCP |
| Female | 48 | T and FOM | 12x9 | 9 | MCP |
| Male | 38 | BM | 5x6 | 7 | MCP |
| Female | 63 | BM | 6x8 | 7 | SCP |

BM: Buccal mucosa, T and FOM: Tongue and floor of the mouth, A: Alveolus, LL: Lower lip, SCP: Septocutaneous perforator, MCP: Musculocutaneous perforators, ALTF: Anterolateral thigh flap

Figure 1: Case 1: Pre-operative photograph of the patient showing squamous cell carcinoma of buccal mucosa and lips on right side.

Figure 2: Case 1: Surface marking on the thigh for anterolateral thigh flap.

Figure 3: Case 1: Identifying the perforator.
to evacuate the hematoma near the external carotid artery in the immediate post-operative period (within the first 2 days). In the first case, the hematoma was below the free flap which was reexplored to control the bleeding. In the second case, the hematoma was at the lower part of the neck which was from the branch of the transverse cervical artery, and hematoma was evacuated and bleeding vessel ligated after reexploration. Recurrence was seen in 1 patient (histology - squamous cell carcinoma) 1 month following the surgery who was treated with local excision and reconstructed with rotational flap. No complications of skin flap necrosis were noted. In terms of microvascular complications, there was no failure with a success rate of 100%. No patients had motor or sensory dysfunction of the lower extremity.

Discussion

Song et al. first described the ALTF for the reconstructive purpose, and he concluded this flap to be based on the SCPs. Based on this concept, he said that the thigh which is the most common conventional donor site for split thickness skin grafts can also become a donor area for skin flaps. The thigh flap with its large and long neurovascular pedicle can be used either as a free flap or as an island flap as an alternative to the lower abdominal flap, groin flap, tensor fascia lata myocutaneous flap, sartorius myocutaneous flap, or the gracalis myocutaneous flap. He has discussed the anatomic basis, operative technique, and characteristics of the thigh flap. 5

Usually, the lateral circumflex femoral artery which supplies the ALTF arises from the profunda femoris either as a common trunk or from any other branch. However, one more variation can be noticed, wherein this artery can arise directly from the femoral artery and give rise to an ascending and descending branches. It was noticed that the MCPs were much common than the septocutaneous ones, and perforators were concentrated near the midpoint of the lateral thigh. We included several perforators with this flap whenever possible since the perforators are extremely small and tend to thrombose. It was also noticed that lateral circumflex femoral artery was always accompanied by two veins with different backflow strength, which correlates with the studies of Kimata et al. 6

Figure 4: Case 1: Harvested flap.

Figure 5: Case 1: Intraoperative view of the excisional defect.

Figure 6: Case 1: Post-operative view showing uneventful healing.

Figure 7: Case 2: Pre-operative photograph of the patient showing squamous cell carcinoma of buccal mucosa and alveolus on left side.
Xu et al. have used ALTF in 24 patients with satisfactory results and also they have done a cadaveric study to detect the vascular supply to the ALTF on 42 limbs. They found that the descending branch of the lateral circumflex femoral artery was an ideal axial vessel. They found constant perforating branches of the myocutaneous artery or cutaneous branches from the intermuscular space to the anterolateral femoral skin and the area extends about 12 cm × 30 cm. The flap has been widely used for free transplantation in China since 1983.

Zhou et al. used ALTF for reconstruction of various defects in 32 patients. They found that the course of the vascular pedicle was relatively constant and in their series of study the vascular pedicles were divided into three types: Fasciocutaneous perforator (37.5%), vertical MCP (56.2%), and horizontal MCP (6.6%). They had a good flap survival rate and satisfactory results.

Urken et al. in their respective study reviewed the records of 184 patients who underwent free flap reconstruction. They had a success rate of 93.5% and concluded that continued experience and pre-operative vigilance, reduce the incidence of complications, and expand the application of free tissue transfer in head and neck region.

Yamamto et al. (1996) describe their clinical experience with 32 combined flaps based on a single vascular pedicle; they included combined flap bases. They conclude that combined flap based on the lateral circumflex-Profunda femoris system is useful for reconstruction of large defects in the groin, perineal, and lower abdominal regions.

Kimata et al. (1997) in their study used ALTF in 38 patients for reconstruction of the head and neck defects. Form the study of anatomic variations of perforators, septocutaneous pattern was recognized in 10 cases and musculocutaneous pattern in 28 cases. 36 flaps survived, partial necrosis was noted owing to the excessive thinning procedure in 1 patient, and total necrosis was noted owing to venous thrombosis at the site of anastomosis in other patients. The authors conclude that ALTF is appropriate to use for the reconstruction of the wide range of head and neck defects.

ALTF is a reliable flap that supplies a large area of the skin. The flap can be harvested irrespective of whether the skin vessels are septocutaneous or musculocutaneous. It is a versatile soft tissue flap in which thickness and volume can be adjusted for the extent of defect, and it can replace most soft tissue free flaps in most clinical conditions as reported by Wei et al.

The variations of the course of the main cutaneous perforator were described in detail by Shieh et al., who found vertical MCPs in 57% and horizontal myocutaneous perforators in 27%, whereas vertical SCPs were only found in 11% and horizontal SCPs in 5% of all of their 36 clinical cases. The length of the cutaneous perforating vessels varied between 3.6 and 7.7 cm. Besides the variability of the course and location of the main cutaneous perforator, absence of any cutaneous branch is possible (Koshima et al., 1989; Wolff et al., 1998; Kuo et al., 2002; Wei et al., 2002) and was described as occurring in up to 5.4%. The branching pattern of the skin
vessels was classified into eight categories in a series of 74 clinical cases, but no variation was found that made flap raising impossible.3

Due to its thinness and pliability, ALTF has proven to be perfectly adaptable to the structural peculiarities of the resected areas and has enabled us to considerably reduce the cosmetic and functional complications in the donor site observed with other flaps as described by Cipriani (2002).1

Some of the technical details which we followed were mapping of the skin vessels, dissection of the perforators under the microscope, inclusion of small fascia cuff around the perforators, and intermittent topical use of xylocaine during the intramuscular dissection of the perforators as described by Celik et al.12

There are many anatomic variabilities in the perforators of ALTF, which is one of the reasons the flap cannot generally be used, the results from this article revealed that the intermuscular perforators account for 20%, while MCPs account for 80%. Although the proportion of type of perforators is different as reported, it is more complicated to harvest the flap with MCPs.13

Shieh et al. transferred 37 free ALTFs for the reconstruction of head and neck defects following cancer ablation, with a success rate of 97% with one flap lost due to twisted perforator. They noticed that the cutaneous perforators were either musculocutaneous or septocutaneous in nature. They classified the perforators into four types based on the derivation and the direction, in which they traversed the vastus laterals. In Type 1, vertical MCPs from the descending branch of lateral circumflex femoral artery found in 56.8% of cases. In Type 2, horizontal MCPs from the transverse branch of lateral circumflex femoral artery were found in 7%. In Type 3, vertical SCPs from the descending branch of the lateral circumflex femoral artery were found in 10.8%. In Type 4, horizontal SCPs from the transverse branch of the lateral circumflex artery were found in 5.4%. The authors conclude that with increasing knowledge of anatomy and refinements of surgical technique, the ALTF can be harvested safely to reconstruct complicated defects of head and neck following cancer ablation with only minimal donor site morbidity.14

**Conclusion**

A high success rate of 100% was achieved with the ALTF. Functional and esthetic results were excellent. Perforators were most commonly musculocutaneous in nature and were coming from the vastus lateralis muscle. We were able to reconstruct various complex defects successfully with this free flap. We modified this flap as a folded flap to reconstruct two surface defects, i.e. skin and the mucosal defects.

The results of this study clearly demonstrate that free ALTF can be used successfully for the reconstruction of the head and neck defects with a high degree of consistency with minimal complications. Variations in vascular pedicle should not be a problem if the regional anatomy is thoroughly understood. Since this was a small study on 20 patients, a study with a larger sample size would answer many questions unanswered related to this flap.

**References**