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Versatility of the pedicled anterolateral thigh flap for surgical reconstruction, a case series

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ABSTRACT

Background: The pedicled anterolateral thigh flap is a versatile flap that offers many advantages. These include a long and reliable pedicle that enables a wide arch of rotation, the possibility to harvest a large skin area, raising the flap with underlying fascia and muscle and minimal donor site morbidity.

Methods: From 2009 to 2018 nine patients were reconstructed with a pedicled anterolateral thigh flap. The flap was applied for coverage of knee infections, trochanteric defects, an abdominal defect, a gluteal defect, and a defect of the inguinal region. The patient group consisted of five males and four females. The age range was 30–90 years with a mean age of 61 years.

Results: Flap size ranged from 10 x 5 cm (50 cm²) to 15 x 30 cm (450 cm²) with a mean size of 222 cm². We experienced no flap loss. The donor site was closed directly in seven out of nine patients, and the remaining two patients were closed by split-thickness skin grafting. Satisfactory aesthetic and functional outcome was achieved in all patients.

Conclusion: Our experience illustrates the versatility in the clinical application of the pedicled anterolateral thigh flap. The many ad-

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vantages of the flap, such as the long and reliable pedicle, a large area of skin that can be harvested, the potential to supercharge the flap and the minimal donor site morbidity highlights the diversity of defects that can be reconstructed using this flap.

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Background/ introduction

The free anterolateral thigh (ALT) flap was introduced by Song et al. in 1984.¹ Since then the ALT flap has gained international popularity, especially after the publication from Wei et al.² The flap has become a workhorse for the reconstruction of soft tissue defects in the head and neck, extremities, and the trunk.^{3–6}

Kimata et al.⁷ were the first to use the flap as a pedicled flap for an abdominal reconstruction. Their work has led to an increased application of the pedicled ALT flap.^{8,9} There are many advantages to the pedicled ALT flap, the primary one being the wide arc of reach that is created by the long and reliable pedicle. The flap is supplied by the descending branch of the lateral circumflex femoral artery, a branch from the profunda femoris artery.¹⁰ The length of the pedicle is mostly reported to be between 4 and 20 cm. One case article reported a pedicle length of 37 cm.^{11–13} Due to the notable length of the pedicle, the ALT flap can reach several regional locations such as the lower abdomen, perineum, groin, gluteal region and thigh making it very versatile.¹⁴ In addition to the possibilities mentioned above, the pedicled ALT flap offers minimal donor site morbidity and can be closed primarily if the flap does not exceed 21×9 cm in size.¹⁵

In this series, we present our experiences with the flap in nine diverse patients. We describe the recipient site and the complexity of the reconstruction.

Patients and methods

In this case series, we have analyzed data from nine patients who underwent surgical reconstruction using the pedicled ALT flap at the Department of Plastic and Reconstructive Surgery, Odense University Hospital, Denmark, from 2009 to 2018. The patients had a broad variety of defects including, necrotizing fasciitis, gunshot wound, prosthetic infections, pyoderma gangrenosum, and pressure sores. The patient group consisted of five men and four women. The age range was 30–90 years with a mean age of 61 years. For further patient details regarding age, sex, underlying disease, flap size, donor site closure, and complications see [Table 1](#).

The same surgeon (senior author) performed all procedures.

Operative technique

The patient is placed in a supine position, which in most situations, allows a simultaneous two-team approach. A straight line is made from the anterior superior iliac spine to the lateral edge of the patella. The majority of perforators are located in a circle of 3–5 cm inferolateral around the midpoint of this line. The perforators are mapped by a handheld Doppler ultrasonography probe.

A medial incision is made 1–3 cm medial to the straight line, depending on what flap size is required. Skin and subcutaneous tissue are dissected off the fascia laterally until the perforators are located. The perforators can either be septocutaneous (12–15%) or musculocutaneous (85–88%). The perforators are dissected until the main pedicle is reached. When the perforator is septocutaneous, the dissection is straight forward and fast. The musculocutaneous perforators always give off many

Table 1

Patient:	Age (years)	Gender	Underlying disease:	Flap size (cm)	Donor site	Follow up*	Complications:
1	81	Female	Necrotizing fasciitis	26 × 13 (338 cm ²)	Primary closure	6 months	Prolonged healing
2	67	Female	Gun wound	10 × 30 (300 cm ²)	Primary closure	9 months	None
3	46	Male	Paraplegic pressure sore	7 × 20 (140 cm ²)	Primary closure	11 days	None
4	61	Female	Pyoderma gangrenosum	22 × 9 cm (198 cm ²)	Primary closure	9 months	Abscess under the flap, treated with antibiotics.
5	90	Female	Multiple sarcoma recurrence from clear cell carcinoma.	25 × 10 (250 cm ²)	Primary closure	30 days	None
6	46	Male	Recurrent infections in multiple hip replacements.	10 × 5 (50 cm ²)	Split skin Graft	8 months	None
7	58	Male	Post OP knee replacement infection	21 × 7 (147 cm ²)	Primary closure	13 days	Re-operation day two post-operative due to venous thrombosis.
8	69	Male	Staph. Aureus Infection	18 × 7 (126 cm ²)	Primary closure	10 days	None
9	30	Male	Recurrent metastasis in left inguinal region	15 × 30 (450 cm ²)	Split skin graft	0 days	None

* Follow up only refers to patients seen post OP at the department of plastic and reconstructive surgery. Patients with short follow up times were seen by other doctors or health care professionals that had the possibility to contact a plastic surgeon if necessary.

branches to the vastus lateralis muscle. These branches should be carefully cauterized. The main pedicle is the descending branch of the lateral circumflex femoral artery and is located in the intramuscular space between the rectus femoris and vastus lateralis muscles as seen in Fig. 1. Usually, a pedicle length of more than 8 cm can be achieved. If distally based it can be dissected up to 7 cm proximal to the patella. The flap size is determined by the defect that is to be covered. The lateral incision of the flap is made superficial to the fascia lata and dissected medially until the elevation of the flap completed. If desired, a substantial piece of vastus lateralis muscle can be included in the flap. The donor site can usually be closed directly (flap width less than 8 cm) or with a split-thickness skin graft (STSG). Proximally based flaps have a wide reach and can be rotated either medially or laterally depending on the defect that needs to be covered as seen in Fig. 2. Distally based flaps should be venous supercharged in order to prevent venous congestion and thereby necrosis.

Results

We reconstructed nine patients with a pedicled ALT flap. Two flaps were applied for coverage of knee defects (infections). Four flaps for trochanteric defects (gunshot wound, hip replacement surgery, pyoderma gangrenosum, and pressure sores). One flap was used for abdominal defect (necrotizing fasciitis). One flap was applied for a gluteal defect. Finally, one flap was used to cover a defect of the inguinal region (recurrent metastasis on the left inguinal region from clear cell carcinoma on the left foot).

Two patients (patient 7 and 8) were treated with supercharged distally based ALT flaps.

The flap size ranged from 10 × 5 cm (50 cm²) to 15 × 30 cm (450 cm²) with a mean size of 222 cm².



Fig. 1. A raised pedicled anterolateral thigh flap showing arterial supply and underlying muscles. 1: External iliac artery, 2: Descending branch of lateral circumflex femoral artery, 3: Transvers branch of lateral circumflex femoral artery, 4: Profunda femoris artery 5: Femoral artery.

Nine out of nine flaps survived. Minor complications occurred in two patients: prolonged healing time and an abscess under the flap, which was treated with antibiotics. One major complication occurred in one of the supercharged flaps. Temporary clotting of the greater saphenous vein used to supercharge the flap required re-operation day two post-operative, as seen in [Table 1](#). None of the complications resulted in flap necrosis, loss of function or poor aesthetic outcome.

Seven out of nine patients had their donor site closed primarily. The remaining two patients were treated with a split-thickness skin graft. Primary closure was not possible in one of the two patients because of the considerable flap size 15×30 (450 cm^2). The other patient could not be closed primarily because of the location of the defect in the trochanteric region where a primary closure would result in tension on the flap.

In all cases, satisfactory functional and aesthetic outcome was achieved.

Case reports

Abdominal defect

Case no. 1:

An 81-year-old female presented with a large defect on the right side of her abdomen due to necrotizing fasciitis. The patient was admitted to the intensive care unit (ICU) but was initially a general surgery patient. The defect included an area from the inguinal region to the costal curvature and from the anterior axillary fold to the midline of the abdomen ([Fig. 3a](#)).

This considerable defect included an area measuring $10 \times 15 \text{ cm}$ (150 cm^2) where the entire abdominal wall was excised and the intestines exposed. A pedicled ALT flap with a cutaneous area measuring $26 \times 13 \text{ cm}$ (338 cm^2) and underlying fascia measuring $26 \times 20 \text{ cm}$ (520 cm^2) was raised on the descending and the transverse branch of the lateral circumflex femoral artery ([Fig. 3b](#)). Tensor

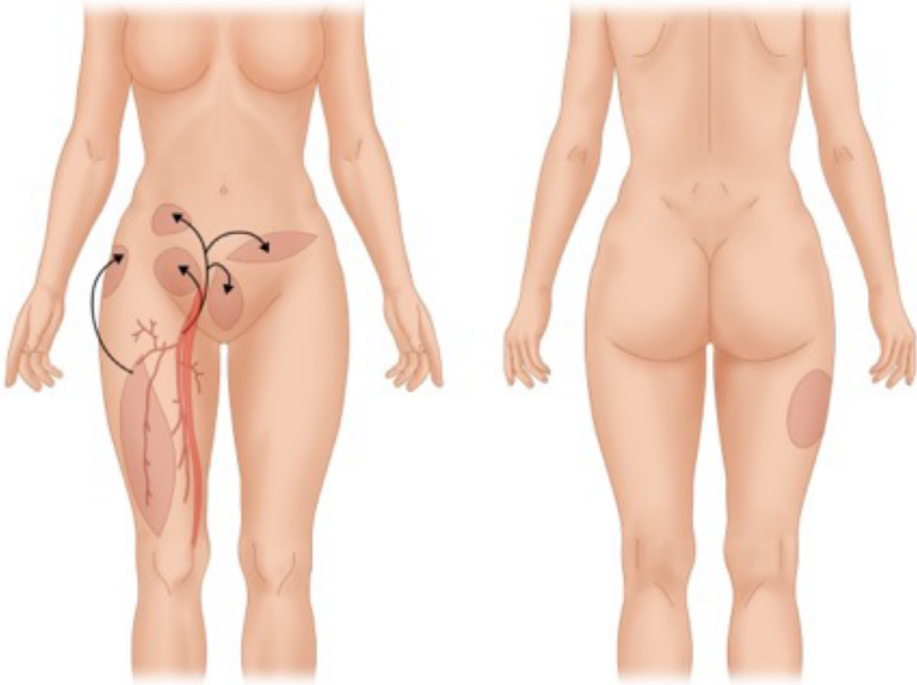


Fig. 2. The many possible recipient sites that the pedicled anterolateral thigh flap offers.

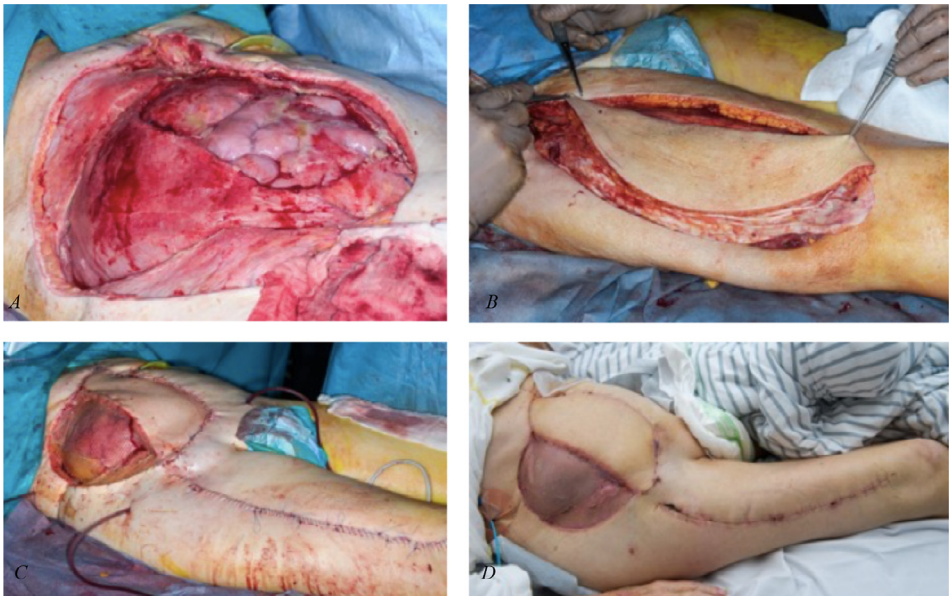


Fig. 3. A) The abdominal defect showing the area of exposed intestines measuring 10×15 cm. B) The pedicled ALT flap measuring 26×13 cm with additional underlying fascia. C) The flap is transposed to reach the exposed gut and cover the defect. The rest of the defect is covered by a split-thickness skin graft. D) The outcome at 23 days post operation follow-up.



Fig. 4. A) Gunshot wound in left trochanteric region after debridement. B) The flap is rotated into the wound to cover the defect. C) The patient at seven days post operation follow-up. D) The donor and recipient site at 15 days post operation follow-up.

facia lata was used to cover the exposed intestines (Fig. 3c). The rest of the defect was closed using split-thickness skin grafting from the other femur (Fig. 3d).

Trochanteric defects

Case no. 2:

A 67-year-old woman presented with a gunshot wound in her left trochanteric region. After debridement of the wound, it measured 15×12 cm (180 cm²). (Fig. 4a)

The flap measured 10×30 cm (300 cm²) and was based on the more distal of the two septocutaneous perforators. The donor site was closed directly. (Fig. 4b) The patient was discharged from the hospital seven days post-surgery (Fig. 4c). After 15 days, the flap was healed very well (Fig. 4d). The patient was satisfied with the aesthetic and functional outcome at follow up eight months after the operation, and no further consultations were scheduled.

Case no. 3:

A 46-year-old paraplegic male presented with a pressure sore in the right trochanteric region with an underlying peritrochanteric femur fracture. The pressure sore had a diameter of 7 cm. A 7×20 cm flap with a 12 cm long intramuscular pedicle was raised. The donor site was closed directly. The patient was discharged 11 days post-operative.

Case no. 4:

A 61-year-old female presented with an infection in her right prosthetic hip along with pyoderma gangraenosum. A pedicled musculocutaneous ALT flap was raised. A large portion of the vastus lateralis muscle was used for bulk. In order to cover the entire defect, a split skin graft was harvested



Fig. 5. A) A large defect of the right knee due to infection. B) The pedicled ALT flap raised from the right femur. C) The flap is tunneled to reach the defect and cover it. D) The flap at six days post-operative.

from the left femur in combination with the ALT flap. The donor site was closed directly. She was discharged 51 days post-operative and last seen at follow-up after seven months.

Case no. 5:

A 90-year-old female known with multiple sarcoma recurrences. Histology of the primary tumor showed malignant fibrous histiocytoma. She presented with a new sarcoma recurrence in her right gluteal region. A 10 x 25 cm ALT flap was raised. A 15 cm pedicled was dissected. In order to create such a long pedicle, the ascending branch of the lateral circumflex femoral artery was ligated. The donor site was closed directly. The patient was transferred from our department 14 days post-operative and last seen in our department 15 days later.

Case no. 6:

A 46-year old male with a long history of hip surgeries and re-operations presented with septic arthritis in the left hip. The patient had previously had a hip replacement surgery. The prosthetic material was removed because of infection, and the defect covered by a pedicled fasciocutaneous ALT flap measuring 10 x 5 cm. The patient was transferred to the orthopedic department after 18 days with no flap related complications. Four months later, the patient was operated at our department with V-Y flaps to increase range of motion. The patient was last seen at follow-up seven months post-surgery.

Patellar defects / distally based venous supercharged flaps

Case no. 7:

A 58-year-old man known with diabetes mellitus type II, hypertension and recurring rupture of the quadriceps tendon presented with a serious infection in his right knee along with necrosis of the quadriceps tendon (Fig. 5a). The patient was initially treated by the orthopedic surgeons who performed a knee arthrodesis. The defect was covered with a distally based pedicled ALT flap. The flap measured 21 x 7 cm and included a cuff of the vastus lateralis muscle measuring 5 x 4 cm

(Fig. 5b). The great saphenous vein was used to supercharge the flap. The donor site was closed directly (Fig. 5c). Six days post-operative the flap was healed sufficiently (Fig. 5d).

The patient was followed for five months after the operation with a satisfactory result.

Case no. 8:

69-year-old male known with chronic kidney disease initially presented with a patella fracture and infection, which resulted in necrosis of the quadriceps tendon and a skin defect. A distally based ALT flap of 7 x 18 cm was raised on two septomuscular perforators. The flap was supercharged using the great saphenous vein. The donor site was closed directly. The patient was discharged from the department of orthopedic surgery ten days post-operative.

Inguinal defect

Case no. 9:

A 30-year old male known with clear cell sarcoma on his right foot presented with sarcoma metastasis in the right inguinal region. After radical excision, a 15 x 30 cm pedicled ALT flap was raised to cover the defect. Two intramuscular perforators supplied the flap. The donor site received split skin grafting. The patient was discharged seven days post-operative with no complications.

Discussion

Since the introduction of the ALT free flap in 1984 by Song et al.,¹ the flap has gained popularity and is often described as the workhorse for the reconstruction of skin and soft tissue defects. The pedicled flap has since gained an increase in the application. The ALT flap offers a long and reliable pedicle. The flap is very versatile and can be designed to match the defect that requires reconstruction. There have been case reports of flap sizes up to 38 x 20 cm (760 cm²).¹² The flap can be raised as an adipocutaneous, fasciocutaneous or a myocutaneous flap, depending on the requirements of the defect being reconstructed. When harvested as a myocutaneous flap it is possible to use part of the rectus femoris muscle, the vastus lateralis muscle or the tensor fascia lata muscle. The muscle harvested with the myocutaneous flap depends on the individual anatomy of the patient and the requirements of the recipient site.

The pedicled flap is not as complex and significantly less time-consuming compared to a free flap that requires microsurgical anastomosis.¹⁶

Large soft tissue defects at or above the patella often represent a reconstructive problem due to paucity of soft tissue options in the region. Free flaps are a good option that provides sufficient coverage. However, they require surgical expertise, prolonged operating time compared to pedicled flaps, and deep location of recipient vessels in this region. The gastrocnemius flap has become a common choice when reconstructing large defects at in patellar region.¹⁷ The primary disadvantage is the volume of the distal part of the muscle is small and sometimes unable to provide enough coverage for large defects around the knee joint, which can result in a knee joint with decreased mobility. Furthermore, sensory deficits, the possible need for split-thickness skin grafting at the donor site, and suboptimal overall functional outcomes have been described.^{18,19}

We believe that the distally based anterolateral thigh flap is a valuable alternative. The ALT flap is technically more demanding, but offers a larger variety in size and shape, with better skin match and less bulkiness, in comparison to the gastrocnemius muscle flap. It has a longer arc of rotation which allows the flap to reach suprapatellar defects and is sufficient to cover significant defects affecting the entire knee.²⁰

Usually, the pedicled ALT flap is known for reliable blood supply. However, in the distally based flaps there is a risk of venous congestion. In general, the reverse-flow flaps are criticized for their predisposition to venous congestion. This problem occurs because veins rely on small interconnections (anatomical shunts) to bypass functional valves, whereas arteries function bidirectionally. Fortunately, antegrade drainage is possible with venous supercharging to the great saphenous vein (GSV).

We believe that venous augmentation improves the reliability of the distally based ALT flap. The ALT flap is larger than many other reverse-flow flaps; therefore, sufficient venous drainage is even

more crucial. Both our patients (no. 7 and no. 8) were reconstructed with a GSV supercharged distally based ALT flap. One of our patients (no. 7) experienced a venous thrombosis. We removed the thrombosis and redid the anastomosis. After the operation, there were no further complications. None of our patients suffered from any long-term venous congestion-related problems. Therefore, prophylactic venous supercharge is recommended for the distally based anterolateral thigh flap.

Despite the growing application of the pedicled anterolateral thigh flap, the literature on the use of the venous supercharged version is still minimal. Lin et al. have described their experience with the distally based, venous supercharged ALT flap.²¹ They also found that the reliability of the flap increased when supercharged.

Since Kimata⁷ presented his experience with the pedicled ALT flap for full-thickness abdominal wall reconstruction, it has become a flap of choice for many surgeons in the reconstruction of this type of defect.^{12, 15, 22, 23} We treated a patient (no. 1) for an abdominal defect in her right side that covered an area from the inguinal region to the costal curvature and from the anterior axillary fold to the midline of the abdomen. Inside this defect, there was a full-thickness abdominal wall defect measuring 10 × 15 cm (150 cm²). Fernandez-Alveraz et al.²⁴ describe that one of the advantages when using the pedicled ALT flap for complex abdominal defects is the possibility to harvest a great amount of fascia which in combination with prosthetic mesh can be used to cover the exposed intestines. This was one of the primary reasons we choose the pedicled ALT flap in this patient. Furthermore, the great size of the defect in this case limited our options in alternative flaps, since the ALT flap offers one of the largest designs. The flap components consisted of a cutaneous part measuring 26 × 13 cm (338 cm²) and underlying fascia measuring 26 × 20 cm (520 cm²). The possibility to harvest such an extensive amount of skin and fascia is favorable in abdominal reconstructions because it allows the surgeon to avoid using artificial mesh and thereby minimizing potential side effects of increased intraabdominal pressure.

Long-term bedridden patients often develop pressure sores as a complication to their immobility.²⁵ A common location is the trochanteric region. Instead of using the tensor fascia lata (TFL) flap which has become the primary choice for trochanteric pressure sore reconstruction since it was introduced by Nahai et al.,²⁶ we have reconstructed a pressure sore with the pedicled ALT flap (Patient no. 3). We have chosen this approach due to multiple factors. Chin et al.¹⁵ describe that the potential pitfalls of the TFL flap such as dog-ear deformity and the problem with the most distal part of the flap which is frequently poorly vascularized can be avoided by using the pedicled anterolateral thigh flap. Secondly, we saved the TFL flap for potential later use because recurrence of pressure sores is frequent in paraplegic patients, such as patient no. 3. The TFL flap is supplied by the ascending branch of the lateral circumflex femoral artery which is preserved when you raise the ALT flap,^{10, 22, 25, 27}

The TFL flap is not just a popular choice when reconstructing trochanteric pressure sores but also trochanteric defects in general. We have applied the pedicled ALT flap in this region to reconstruct defects caused by a gunshot wound (patient no. 2) and patients with infections after hip replacement surgery (patient no. 4 and no. 6). All patients had a satisfactory functional and aesthetic outcome.

In modern-day plastic surgery, we seek not only to create the best possible outcome for the patient in terms of function and aesthetics at the recipient site but also at the donor site. For these reasons, the pedicled ALT flap is a valuable flap with minimal donor site morbidity and a good functional outcome. When closing the donor site, it is possible to close primarily if the width of the flap is approximately nine cm or less. If the defect is wider than nine cm a split-thickness skin graft will be needed.¹⁵

To our knowledge, no randomized trials have been conducted yet. Many case series describing the different applications of the pedicled ALT flap have been published. However, due to the low level of evidence associated with a case series, the need for randomized studies is a crucial next step towards providing inferences on benefit. This would be a good objective for future studies.

Conclusion

Our experience with the pedicled ALT flap illustrates the versatility in the clinical application of the flap. The many advantages of the flap, including a long and reliable pedicle, the large area of skin

that can be harvested, the potential to supercharge the distally based flap and the minimal donor site morbidity highlights the diversity of defects that can be reconstructed using the pedicled ALT flap.

Declaration of Competing Interest

None.

Funding

None.

References

- Song YG, Chen GZ, Song YL. The free thigh flap: a new free flap concept based on the septocutaneous artery. *Br J Plast Surg*. 1984;37(2):149–159.
- Wei FC, Jain V, Celik N, Chen HC, Chuang DC, Lin CH. Have we found an ideal soft-tissue flap? An experience with 672 anterolateral thigh flaps. *Plast Reconstr Surg*. 2002;109(7):2219–2226 discussion 27–30.
- Lin DT, Coppit GL, Burkey BB. Use of the anterolateral thigh flap for reconstruction of the head and neck. *Curr Opin Otolaryngol Head Neck Surg*. 2004;12(4):300–304.
- Park CW, Miles BA. The expanding role of the anterolateral thigh free flap in head and neck reconstruction. *Curr Opin Otolaryngol Head Neck Surg*. 2011;19(4):263–268.
- Zhang Q, Qiao Q, Yang X, Wang H, Robb GL, Zhou G. Clinical application of the anterolateral thigh flap for soft tissue reconstruction. *J Reconstr Microsurg*. 2010;26(2):87–94.
- Di Candia M, Lie K, Kumiponjera D, Simcock J, Cormack GC, Malata CM. Versatility of the anterolateral thigh free flap: the four seasons flap. *Eplasty*. 2012;12:e21.
- Kimata Y, Uchiyama K, Sekido M, Sakuraba M, Iida H, Nakatsuka T, et al. Anterolateral thigh flap for abdominal wall reconstruction. *Plast Reconstr Surg*. 1999;103(4):1191–1197.
- Neligan PC, Lannon DA. Versatility of the pedicled anterolateral thigh flap. *Clin Plast Surg*. 2010;37(4):677–681 vii.
- Ng RW, Chan JY, Mok V, Li GK. Clinical use of a pedicled anterolateral thigh flap. *J Plast Reconstr Aesthet Surg*. 2008;61(2):158–164.
- Kimata Y, Uchiyama K, Ebihara S, Nakatsuka T, Harii K. Anatomic variations and technical problems of the anterolateral thigh flap: a report of 74 cases. *Plast Reconstr Surg*. 1998;102(5):1517–1523.
- Sananpanich K, Tu YK, Kraissarin J, Chalidapong P. Flow-through anterolateral thigh flap for simultaneous soft tissue and long vascular gap reconstruction in extremity injuries: anatomic study and case report. *Injury*. 2008;39(Suppl 4):47–54.
- Friji MT, Suri MP, Shankhdhar VK, Ahmad QG, Yadav PS. Pedicled anterolateral thigh flap: a versatile flap for difficult regional soft tissue reconstruction. *Ann Plast Surg*. 2010;64(4):458–461.
- Vijayasekaran A, Gibreel W, Carlsen BT, Moran SL, Saint-Cyr M, Bakri K, et al. Maximizing the utility of the pedicled anterolateral thigh flap for locoregional reconstruction: technical pearls and pitfalls. *Clin Plast Surg*. 2017;44(2):371–384.
- Gentilecchi S, Servillo M, Garganese G, Simona F, Scambia G, Salgarello M. Versatility of pedicled anterolateral thigh flap in gynecologic reconstruction after vulvar cancer extirpative surgery. *Microsurgery*. 2016.
- Lin CT, Wang CH, Ou KW, Chang SC, Dai NT, Chen SG, et al. Clinical applications of the pedicled anterolateral thigh flap in reconstruction. *ANZ J Surg*. 2017;87(6):499–504.
- Kayano S, Sakuraba M, Miyamoto S, Nagamatsu S, Taji M, Umezawa H, et al. Comparison of pedicled and free anterolateral thigh flaps for reconstruction of complex defects of the abdominal wall: review of 20 consecutive cases. *J Plast Reconstr Aesthet Surg*. 2012;65(11):1525–1529.
- Suda AJ, Cieslik A, Grutzner PA, Munzberg M, Heppert V. Flaps for closure of soft tissue defects in infected revision knee arthroplasty. *Int Orthop*. 2014;38(7):1387–1392.
- Bekarev M, Goch AM, Geller DS, Garfein ES. Distally based anterolateral thigh flap: an underutilized option for peri-patellar wound coverage. *Strateg Trauma Limb Reconstr*. 2018;13(3):151–162.
- Akhtar MS, Khan AH, Khurram MF, Ahmad I. Inferiorly based thigh flap for reconstruction of defects around the knee joint. *Indian J Plast Surg*. 2014;47(2):221–226.
- Gravvanis AI, Iconomou TG, Panayotou PN, Tsoutsos DA. Medial gastrocnemius muscle flap versus distally based anterolateral thigh flap: conservative or modern approach to the exposed knee joint? *Plast Reconstr Surg*. 2005;116(3):932–934.
- Lin CH, Zelken J, Hsu CC, Lin CH, Wei FC. The distally based, venous supercharged anterolateral thigh flap. *Microsurgery*. 2016;36(1):20–28.
- Lannon DA, Ross GL, Addison PD, Novak CB, Lipa JE, Neligan PC. Versatility of the proximally pedicled anterolateral thigh flap and its use in complex abdominal and pelvic reconstruction. *Plast Reconstr Surg*. 2011;127(2):677–688.
- Nthumba P, Barasa J, Cavadas PC, Landin L. Pedicled fasciocutaneous anterolateral thigh flap for the reconstruction of a large postoncologic abdominal wall resection defect: a case report. *Ann Plast Surg*. 2012;68(2):188–189.
- Fernandez-Alvarez JA, Barrera-Pulido F, Lagares-Borrego A, Narros-Gimenez R, Gacto-Sanchez P, Gomez-Cia T. Coverage of supraumbilical abdominal wall defects: the tunnelled-pedicled ALT technique. *Microsurgery*. 2017;37(2):119–127.
- Cushing CA, Phillips LG. Evidence-based medicine: pressure sores. *Plast Reconstr Surg*. 2013;132(6):1720–1732.
- Nahai F, Silvertown JS, Hill HL, Vasconez LO. The tensor fascia lata musculocutaneous flap. *Ann Plast Surg*. 1978;1(4):372–379.
- Saint-Cyr M, Uflacker A. Pedicled anterolateral thigh flap for complex trochanteric pressure sore reconstruction. *Plast Reconstr Surg*. 2012;129(2):397e–399e.