Efficacy of pedicled anterolateral thigh flap for reconstruction of regional defects – a record analysis

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Summary

Background: The anterolateral thigh (ALT) flap was described as the fasciocutaneous flap. It can be harvested as a pedicled and/or free flap. Majority of the free flaps are harvested as a fasciocutaneous flap. Their use in head and neck reconstruction and limb trauma is well established. Apart from these advantages, this flap has various applications which are less utilized. ALT flap can be used as a myocutaneous flap along with vastus lateralis muscle. When muscle and fasciocutaneous flaps are required, both can be harvested as a chimeric flap which can cover two different regions of the wound. Moreover, harvest of the pedicled flap procedure is less time-consuming than that of a free flap. Since it has a long vascular pedicle, when used as pedicled flap, it can reach up to the gluteal region. To evaluate these less applied advantages of pedicled ALT flap, our study was undertaken. This study aimed to evaluate the efficiency of ALT flap in terms of the surface area of coverage, arc of rotation and the advantages of including vastus lateralis muscle as part of the flap. **Methods:** A retrospective record analysis of all pedicled ALT flap reconstruction of trochanteric, upper thigh, gluteal and flank regions from 2016 to 2018 was undertaken; 7 patients with 8 defects were included. Results: All the flaps healed successfully. There was no major necrosis of the flap and minor complications like wound gapping were found in three patients. **Conclusion:** The ALT-vastus lateralis flap dimensions can be very large and can be easily harvested in a very short time. Vastus lateralis muscle harvested can be used to fill the defect or can be used as chimera to cover the defect. The use of muscle over long standing infective pressure sores can sterilize the wound bed and help in preventing recurrence. The vascularity of this flap is robust and highly reliable. Even after a maximum arc of rotation (up to 170°) all the flaps survived without any major complications.

Key words

pedicled ALT flap – reconstructive surgery – pressure sore – anterolateral thigh flap

Introduction

Anterolateral thigh (ALT) flap was first described by Song et al [1]. Since then, it has gained popularity as a free microvascular flap and currently it is the workhorse flap for soft tissue reconstruction in several regions of the body. Its flexibility follows from its long vascular pedicle, ability to use different tissues in composite nature, large size of skin paddle and minimal donor site morbidity [2]. The blood supply to the skin paddle of ALT flap is by septo-cutaneous or musculocutaneous perforators, which arise from the descending branch of lateral circumflex femoral artery (LCFA). The utilization of free ALT flap for soft tissue reconstruction in various regions of the body is well known [3]. However, reconstruction of in-depth onco-surgical defects of the lower trunk, perineum and upper thigh without the complexity of microsurgery may sometimes be a reconstructive challenge [4]. In those situations, pedicled ALT flap offers many advantages over other regional flaps [4]. However, it is less commonly reported [2]. The vascular pedicle of this flap (the descending branch of LCFA) passes through the septum between vastus lateralis muscle and rectus femoris muscle, towards the knee and anastomoses with lateral superior genicular artery or the profunda femoris artery perforators.

Hence, ALT flaps are often harvested based on its proximal circulation or the distal circulation. This property, alongside the long vascular pedicle, are often utilized to hide the varied soft tissue defects involving the abdomen, groin, perineum, and trochanteric regions proximally (proximally based circulation), and soft tissue defects around the knee distally (distally based circulation) [5]. Since pedicled ALT flap has many advantages and there is less literature regarding an equivalent, this study is undertaken to spotlight the usefulness of the pedicled ALT flap. This study aimed to review the efficacy of pedicled ALT flap in reconstruction of the regional defects.

Its objectives are to determine the efficiency of ALT flap in terms of the area of coverage, arc of rotation and therefore the distal reach of the flap and to determine the benefits of harvesting vastus lateralis muscle as a part of the flap.

Materials and methods

A retrospective record analysis of all pedicled ALT flaps from 2016 to 2018 was undertaken. Seven patients with 8 defects of the thigh, groin, gluteal and lower abdominal region requiring flap coverage were included in the study. Patients' demographic details like age, sex, site of the defect are noted. The details of the flap harvested are documented (laterality, size of the flap, island or the peninsular). While abstracting the details from the records, personal details like name, address etc. were not retrieved.

Operative technique

Under suitable anesthesia, patient was put in a supine position with a 20° medial rotation of the hip. Ipsilateral anterior superior iliac spine and supero-lateral border of the patella were marked. The line joining these points marked the intermuscular septum between vastus lateralis and rectus femoris muscle. The flap was designed keeping this line as the central meridian (Fig. 1). An anterior incision was made and deepened till the intermuscular septum and any septo-cutaneous perforators were preserved. A flap was harvested alongside the vastus lateralis muscle. The vascular pedicle was dissected proximally up-to-the origin at the lateral circumflex femoral vessels. Depending on the recipient site requirement, the vastus lateralis muscle was either separated as a chimera or used to fill the depth of the defect. The flap was completely islanded and inset into the defect. The donor site was closed primarily or with skin grafts.

Fig. 1. Anterolateral thigh flap marking.

Tab.1. Demographic profile of the patients.

Subject number	Defect number	Sex	Side	Site	Age (years)	Size of the flap	Size of the defect	Muscle used	Arc of rotation (degrees)	Co-morbidities
1	1	M	R	trochanter	54	14 × 8 (112 cm²)	14 × 8 (112 cm²)	filling the defect	130	paraplegia + NIDDM
	2		L	trochanter		12 × 8 (96 cm²)	11 × 7 (77 cm²)	filling the defect	120	
2	3	M	R	trochanter	42	15 × 10 (150 cm²)	14 × 9 (126 cm²)	filling the defect	130	paraplegia
3	4	F	R	gluteal	28	16 × 15 (240 cm²)	25 × 15 (375 cm²)	as a chimera	145	post-infective
4	5	M	R	trochanter	60	12 × 8 (96 cm²)	12 × 6 (72 cm²)	filling the defect	110	paraplegia + NIDDM
5	6	M	R	abdominal	46	16 × 11 (176 cm²)	16 × 10 (160 cm²)	filling the defect	160	post-infective + NIDDM
6	7	F	R	gluteal & ischeal	52	18 × 12 (216 cm²)	20 × 21 (420 cm²)	as a chimera	150	post-infective + NIDDM
7	8	M	L	trochanter	60	13 × 10 (130 cm²)	12 × 8 (96 cm²)	filling the defect	110	paraplegia + NIDDM

F – female, M – male, L – left, R – right, NIDDM – non-insulin dependent diabetes mellitus

Follow-up and outcome measures

The patients were followed up for immediate and late complications. Immediate complications like partial or complete loss of flap and minor complications like gapping of the wound, seroma, hematoma, and wound infections were studied. Late complications like recurrence of pressure sore, donor site scar and gait abnormalities (in ambulant patients) were studied on follow-up. The outcome of the flap was analyzed in terms of the area of the defect covered, arc of rotation and distal reach of the flap. The use of the vastus lateralis muscle with the flap was also analyzed.

Results

In our study, 7 patients with 8 defects were treated with a pedicled ALT flap. Out of these patients, 5 (71.4%) were males and 2 were females (28.6%). The age of the patients was 28–62 years. Among the 8 defects, 5 (62.5%) were in the trochanteric region, and 1 (12.5%) each in the gluteal, ischial and abdominal regions. The mean size of the defect was 179.75 cm^2 (72 cm^2 was the least size and 420 cm^2 was largest). Overall, 152 cm^2 was the mean size of the skin paddle. In 2 cases with large defects, the skin paddle and the vastus lateralis muscle were separated and used as a chimeric flap. The muscle component was resurfaced with skin grafts. Four out of 7 (42.85%) patients were paraplegic and 5 had non-insulin dependent diabetes mellitus as a comorbidity (Tab. 1). All flaps were successful. There was no partial or complete loss of the flap. Minor complications like wound gapping and hematoma were found in three patients. These were managed conservatively. There was no recurrence of the bedsore at one-year follow-up. The donor site scar was well settled in all patients. Ambulant patients did not have any functional deficit of gait. The complications and therefore the comorbidities were not statistically significant.

Discussion

ALT flap was described for the first time in 1984 [2]. Recently, ALT has been a popular flap among the reconstructive surgeons thanks to its various advantages [2]. The skin territory of the ALT flap has not been defined even today. However, in studies, more than half of the circumference of thigh [6] has been successfully harvested without any flap necrosis. Since the circumference of the thigh is a subjective measure, depending on the individual's physical habitus, large skin flaps can be harvested. This is a great potential for any flap donor site (Fig. 2A–C) [6]. Since the

Fig. 2. Right trochanteric pressure sore. A) Preoperative state; B) intraoperative state; C) postoperative state.

donor area is huge, large fascio-cutaneous flaps can be harvested from the thigh. In our study, the size of the largest flap harvested was 16 × 15 cm (240 cm²) (Fig. 3A, B). In the study conducted by Friji et al, the size of the largest flap harvested was 38 × 20 cm (760 cm²) [4]. In a Chinese study done by Chin et al, the largest flap harvested was 11 × 18 cm (198 cm²) in size [7]. In another study by Mojtaba [8], the size of the largest flap was 380 cm². In all studies, there were no major complications and the flaps survived completely. However, the different size of the flap can be explained by the fact that physical stature of the patient has an impact on the flap size harvested. Even in our study, the flaps from size 12 × 6 (72 cm²) to 16 × 15 cm (240 cm²) were successful without any major complications. Many factors contribute to this enormous capacity of the vascular pedicle to supply large flaps. Ligation of the muscular branches led to increased blood flow to the fasciocutaneous perforators and denervation causes increased flow due to loss of sympathetic tone [9]. Also, opening up the choke vessels in adjacent angiosomes helped to increase dimensions of the flap. Whenever the skin component is deficit, a flap can be harvested along with the vastus lateralis muscle as a chimeric flap (Fig. 4A–C) [10,11]. The separate vascular pedicle to fasciocutaneous and muscle components gives freedom for the operating surgeon to plan large flaps and to increase the distal reach of the flap [12]. The other major advantage
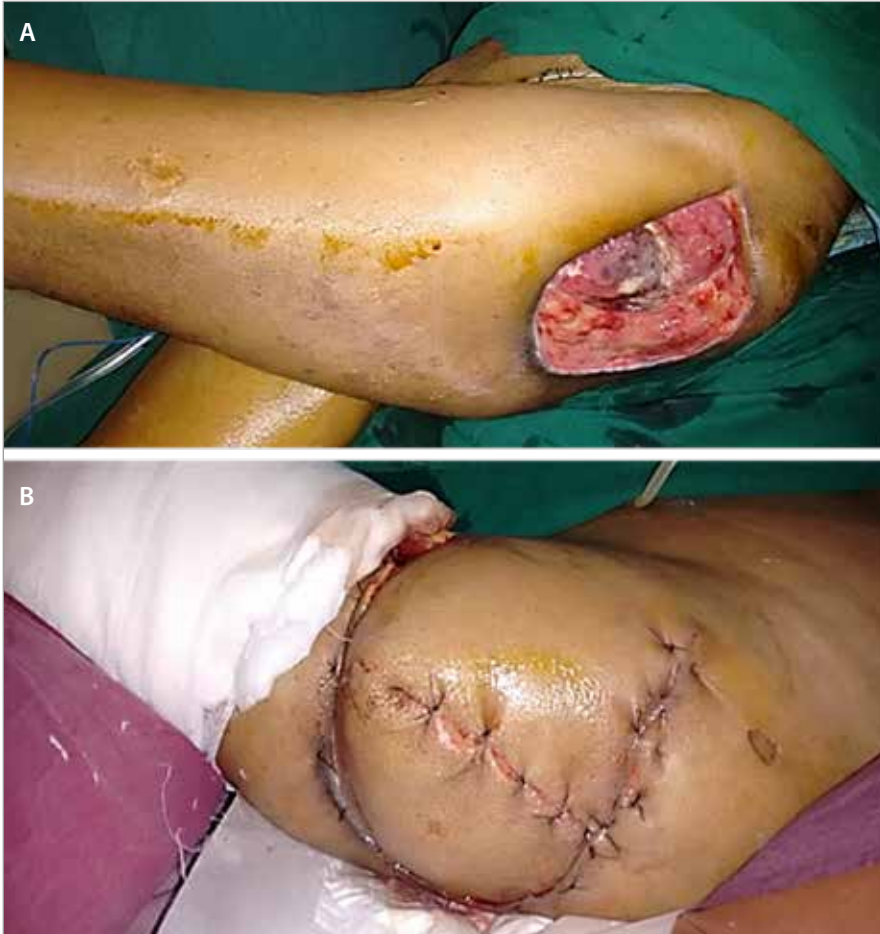

Fig. 3. Left trochanteric pressure sore. A) Preoperative state; B) postoperative state.

Fig. 4A. Right gluteal defect after thorough debridement.

Fig. 4B. After insetting of the vastus lateralis and anterolateral thigh chimeric flap.

Fig. 4C. One-month follow-up state.

of harvesting the vastus lateralis muscle as a musculocutaneous flap is the use of a muscle component to fill the cavity of the defects. In all our flaps muscle was harvested along with the fasciocutaneous component. This also reduced the flap harvest time as the dissection of the skin perforators through the muscle was avoided. Moreover, this procedure increased the vascularity of the overlying skin component [13] through musculocutaneous perforators; large flaps could be harvested with adequate reliability there. The muscle also provided plentiful vascularity to the recipient area and mopped up the infection [6] contributing to a faster healing of the wound. In two of our cases, the muscle was used as a chimeric flap and used to cover large gluteal defects. The vastus lateralis chimeric flap was used for reconstruction [14] and recommended as a first line reconstructive option for the defects following the excision of advanced and recurrent malignancies. Pedicled ALT with a vastus lateralis muscle flap was a good alternative to a vertical rectus abdominis myocutaneous flap for large defects associated with pelvic exenteration [15]. In these cases, the dead space could be obliterated by the bulk of the flap and vagina, the perineum could be reconstructed sparing the integrity of the abdominal wall. The descending branch of the lateral circumflex femoral artery runs along the septum from the upper third of the thigh till the knee region. Along its course, it gives many muscular as well as septo-cutaneous branches. The pedicle of the ALT flap is known to be advantageous thanks to its length. Zelken et al [15] reconstructed the mutilated hand injuries using pedicled ALT flaps together with a groin flap. In this study, ALT was used as an alternative to an abdominal flap. Vascular supply of the ALT flap is provided from these septo-cutaneous or musculocutaneous perforators [15–18]. The length of the pedicle depends upon the skin perforator selected [6]. In a situation when a greater length of a pedi-
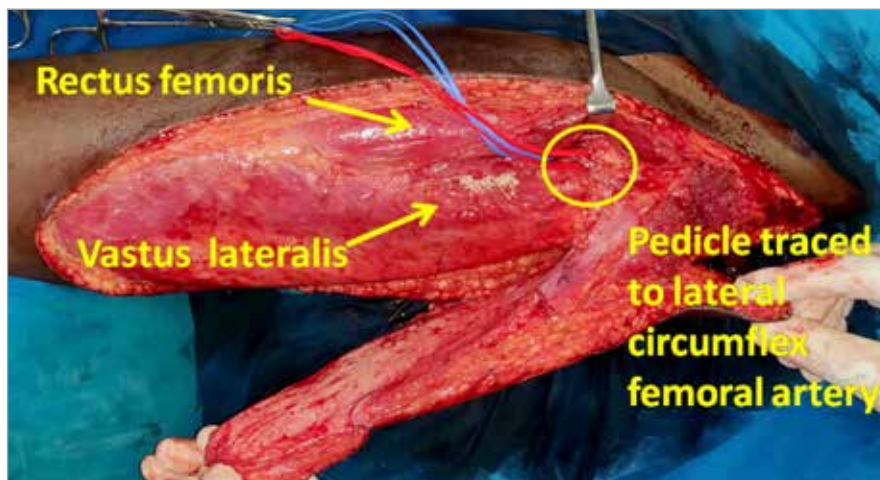

Fig. 5. Pedicle dissection till the lateral circumflex iliac artery.

cle is needed, the length can be further increased by ligation of the muscular branches and continuing dissection till the origin of the descending branch (Fig. 5) [19]. As majority of our flaps were harvested along with the muscle, the position of the skin perforator was not determined pre-operatively. Dissection of the skin perforator through the muscle is one of the time-consuming parts. In our study, since the muscle was harvested along with skin, this reduced the harvest time drastically [8].

The minimum arc of rotation was 110° and the maximum was 160° in our study. The distal end of the flap reached upto umbilical region when transferred cranially and reached the mid line, covering the gluteal region when rotated posteriorly.

In the islanded flap, the position of the lateral circumflex femoral artery was the pivot point. The extent of the dissection of the pedicle and the position of the skin perforator determined the arc of rotation [2]. In some studies, pedicled ALT flap were used to cover defects as high as epigastrium [20–23]. The authors suggested that if the most distal skin perforator is selected, the reach can be maximal [24]. In another study by Koustic et al, the reach of pedicled ALT was 360°, 180° clockwise and 180° anti-clockwise [14]. They also suggested choosing the most distal skin perforator to maximize

rotation of the flap without tension. They also concluded that if the vastus lateralis is also harvested as a chimera flap, the flap had large dimensions and wide arc of rotation.

Apart from these advantages, ALT flap has the least donor site morbidity. In majority of our patients, a primary closure was possible and few of them needed small skin grafts to cover the remaining area. Since the vastus lateralis was harvested in all cases, primary closure was much easier [14]. The donor site is in the concealed area and did not have any esthetic concern [6]. Although the majority of our patients were paraplegic, three were ambulant patients and they had no functional deficit even after muscle harvest. With so many advantages, a pedicled ALT flap is an ideal flap for loco-regional defects, especially in patients who need a large flap for reconstruction and cannot tolerate long operating times.

Conclusion

The ALT flap has been termed as the best free flap option for reconstruction since the time of its description. However, its pedicled counterpart has not been popular. The literature regarding the pedicled ALT, musculocutaneous flap and the chimeric flap is very limited. In our institutional experience, we could conclude that a pedicled ALT has many

advantages. The ALT-vastus lateralis myocutaneous flap dimension can be large and harvested easily in very short duration. The harvested vastus lateralis muscle can be used to fill the defect or as a chimera to cover the defect. Moreover, the use of muscle over long-standing infective pressure sores can sterilize the wound bed and help preventing recurrence. The vascularity of this flap is robust and highly reliable. Even after the maximum arc of rotation (up to 170°), all the flaps survived without any major complications. Hence, a pedicled ALT flap is equally advantageous as its microvascular counterpart. We highly recommend its use, especially in the elderly and frail patients requiring large wound reconstruction in a shorter operating time.

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