

# Medial sural artery perforator flap in head and neck reconstruction

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**Abstract** Medial sural artery perforator (MSAP) flap is a relatively new flap which is a modification of medial gastrocnemius myocutaneous flap. Both radial forearm flap and MSAP has common benefits, such as thinness, long pedicle and pliability; however, MSAP has lower donor site morbidity when compared with radial forearm flap. Because of this reason, the MSAP flap has gained popularity during the last decade. The objective of this study was to determine clinical application results of this flap in reconstruction of post-oncologic defects in the head and neck region. 11 patients operated for head and neck post oncologic defects and reconstructed with MSAP between June 2014 and Dec 2015 were included in the study. Age, gender, histopathology, area of reconstruction, flap size, number of perforators were reviewed. Postoperatively recipient and donor site complications, hospital stay and additional surgical procedures were also analyzed. We had seven uncomplicated cases; one total flap failure due to arterial problem, in three cases due fistula formation and local wound healing problems additional surgeries were performed. All venous anastomosis were performed with 9/0 sutures, nine arterial anastomosis were performed with 9/0 and two arterial anastomosis were performed with 10/0 nylon sutures. Medial sural artery perforator flap is a good alternative in head and neck reconstruction, with the advantages of thin and pliable skin, a reliable vascular

pedicle, straightforward intramuscular dissection. But there are certain drawbacks like tedious pedicle and perforator dissection, small arterial pedicle size which complicates anastomosis and obscurities of anatomy. Surgical team must always be ready for a difficult micro anastomosis and an alternative flap choice must be prepared and counseled with the patient in case of inadequate perforators.

**Keywords** MSAP flap · Head and neck reconstruction · Microsurgical reconstruction

## Introduction

Microsurgical free tissue transfers are widely used following post-oncologic surgery defects of the head and neck region. Flap choice depends on reconstructive needs, such as defect diameter and depth, desired tissue composition as well as surgeon experience, preference and suitability of donor flap sources. Traditionally radial forearm free flap (RFFF) has been used as the first choice because of constant anatomy; thin, pliable skin island and also a long and reliable vascular pedicle [1]. However, due to significant cosmetic and functional donor-site morbidity; and sacrifice of one major artery, many reconstructive microsurgeons increasingly prefer perforator flaps. Different perforator flaps including the anterolateral thigh flap (ALT), superior/inferior gluteal artery perforator flap, deep inferior epigastric perforator flap, superficial circumflex iliac perforator flap, thoracodorsal artery perforator flap or medial circumflex femoral artery perforator flaps have been proposed [2–4]. In head and neck reconstruction only ALT flap have gained wide application whenever thicker and wider flap is needed. Although aggressive thinning have been shown to be possible, especially in obese patients

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significant bulkiness and cosmetic deformity is frequent [5].

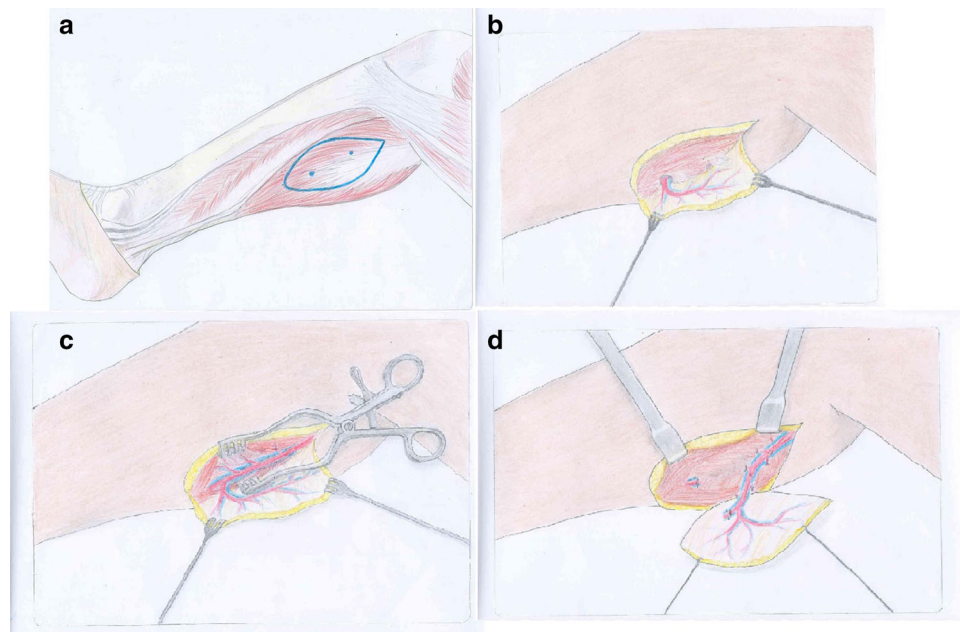
Medial sural artery perforator (MSAP) flap was popularized in the last decade as a possible alternative free flap choice to RFFF in especially head and neck reconstruction [6]. This relatively new and promising perforator flap has many advantages, such as its pliability and thinness of skin island, long and reliable pedicle, not sacrificing any major artery, lower donor side morbidity. Besides, sural nerve, plantaris tendon grafts can also be harvested from the same incision. However, main drawbacks that prevent this flap to gain more acceptances are; it needs extensive intramuscular dissection, variations of medial sural artery and also its perforators [7]. In this study we present our result of the medial sural artery perforator flap and its clinical application in reconstruction of post-oncologic defects in the head and neck region and also discuss the pros and cons of the flap.

## Patients and methods

11 patients operated for head and neck post oncologic defects and reconstructed with MSAP between June 2014 and Dec 2015 were included in the study. Age, gender, histopathology, area of reconstruction, flap size, number of perforators were reviewed. Postoperatively recipient and donor site complications, hospital stay and additional surgical procedures were also analyzed. With pre-operative Doppler and after exploratory incision perforators from the medial sural artery were determined. Post-operative monitoring of the flap is performed with clinical assessment.

We use a two-team approach, comprising an oncological resection team and a reconstructive team. The MSAP flap is, in general, raised from the left side because we think that for the right handed surgeon perforator and pedicle dissection is easier from right side of the table. Before Doppler examination, posterior midline and popliteal crease were marked. Another line is drawn from medial tibial condyle to the posterior midline at the level of malleoli. Usually, within 8 cm from the popliteal crease audible perforators have been searched with hand held Doppler. The perforating vessels were identified and marked; skin paddle of the flap was outlined as desired dimensions. For the flap dissection, the patient was placed in supine position, hip flexed and externally rotated and the knee was also flexed. An exploratory incision along the medial side of the flap was made and perforators of good caliber were identified. Flap was raised deep to the fascia. The retrograde dissection of the perforators under loupe magnification was performed. The gastrocnemius muscle was split to dissect out perforators. All the muscular small branches were clipped or cauterized. Both artery and vena comitantes were dissected until adequate size and caliber have been obtained to supply the flap and suitable for micro anastomosis. Tourniquet was deflated, adequate perfusion was granted. Flap was than harvested and donor side was closed primarily over a suction drain or skin grafted when necessary. Flap was adapted to the defect area with temporary stitches, artery and vein of the pedicle was anastomosed to recipient artery and vein (Fig. 1).

**Fig. 1** Drawings that demonstrate dissection of MSAP flap. **a** Flap is outlined over the substance of medial gastrocnemius muscle and the audible perforators are marked with hand-held Doppler. **b** Medial incision is carried out first and the sizeable perforators are identified. **c** Retrograde dissection of the flap is performed under loupe magnification. Medial sural artery and accompanying veins which lie generally 1–2 cm deep in the substance of gastrocnemius muscle have been deroofed and dissected. **d** All the branches are clipped or cauterized. The flap is islanded and the tourniquet is released to confirm circulation



## Results

There were nine male and two female patients with a median age of 60 years (range 28–80 years). All patients had head and neck squamous cell carcinoma (SCC). The most common sites were floor of mouth in three cases (Fig. 1). Other sites were less common. Seven cases were uncomplicated. In one case total flap failure due to arterial problem and in three cases fistula formation, local wound healing problems occurred. Additional surgeries were performed for these patients (Table 1). In two cases flap was abandoned intraoperatively after explorative incision as the perforators were extremely small and alternatively RFF flaps were performed. One total flap loss occurred due to arterial failure in which persistent arterial thrombosis could not be resolved. No donor site complications occurred. Mean operation time was 5.20 h. All venous anastomosis were performed with 9/0 sutures, nine arterial anastomosis were performed with 9/0 and two arterial anastomosis were performed with 10/0 nylon sutures. Eight flaps had one

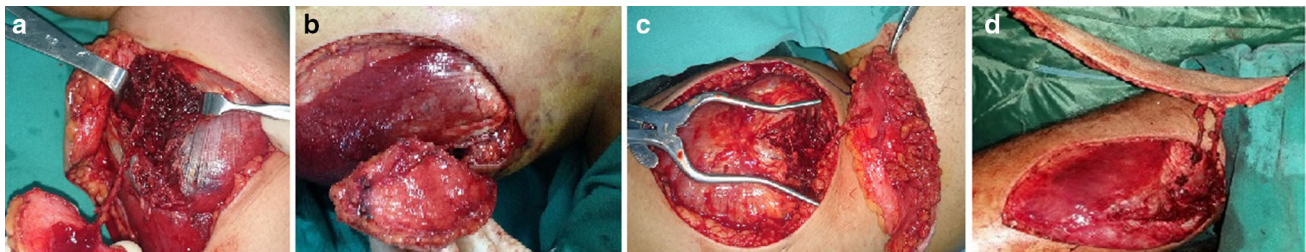
perforator and in two flaps there were two perforators and in one flap an anatomical variant, double pedicle has been observed. In one flap we have observed a perforator which had not entered the muscle, a median sural artery (Figs. 2, 3). In our series, all but one of the donor sites (10/11 cases) were closed primarily. Only in one patient a split-thickness skin graft was required (Fig. 4).

## Discussion

The medial sural artery perforator flap is useful and suitable for reconstruction for different pathologies requiring free flap reconstruction. The radial forearm flap, which is the workhorse flap for head and neck, oral cavity reconstruction in many units has some drawbacks like conspicuous donor side and frequent healing problems, also does require removal of a major feeding artery of a limb. ALT also has a long pedicle, giving the microsurgeon a multiple choice of options to choose their anastomosis relative to the

**Table 1** A summary of the patient demographics, their pathologies and the details of the medial sural artery flaps and post operative complications

Patient age	Gender	Indication	Donor site	Donor closure	Arterial anastomosis	Perforator number	Skin paddle size	Complications
80	F	Hemiglossectomi	Right	Direct	9/0	2	5 × 10	None
52	M	Left buccal and lower lip recurrent BCC	Left	Direct	9/0	1	5 × 9	None
72	M	Left recurrent infraorbital SCC	Left	Direct	10/0	1	4 × 7	None
67	M	Total glossectomi	Right	Direct	9/0	2	5 × 10	None
56	M	Right recurrent preauricular SCC	Left	Direct	10/0	1	4 × 6	Total flap loss (arterial failure)
68	F	Retromolar trigone SCC	Right	Direct	9/0	1	4 × 5	Fistula formation
72	M	Floor of the mouth	Left	Direct	9/0	1	5 × 8	Fistula formation
58	M	Floor of the mouth	Left	Direct	9/0	1	5 × 9	None
75	M	Gingiva and floor of the mouth	Left	STSG	9/0	Double pedicle	7 × 12	None
48	M	Lower lip	Left	Direct	9/0	1	4 × 8	Drooling, flap resuturing
65	M	Left buccal cavity SCC buccal mucosa	Left	Direct	9/0	1	3 × 4	None



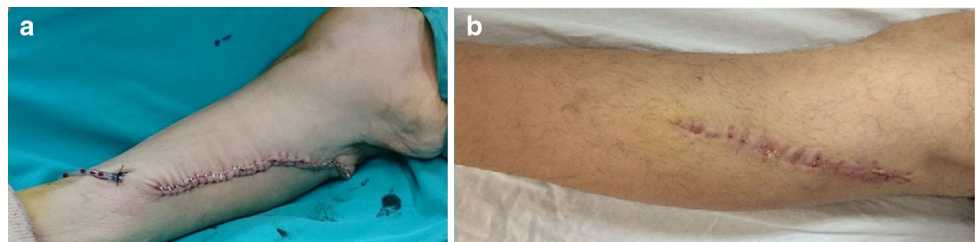
**Fig. 2** Intraoperative views after elevation of the flaps. **a** Pedicle can be as long as 16 cm when the dominant perforator is far from popliteal crease. **b** A median sural artery is observed in this case in which the vessel did not pierce the gastrocnemius muscle. **c** Pedicle

can be short when the dominant perforator is close to the popliteal crease. **d** An anatomical variation, double pedicle is observed in one case



**Fig. 3** Post operative views. **a** retromolar trigone reconstruction. **b** Lower lip and buccal region reconstruction. **c** Tongue and floor of the mouth reconstruction

**Fig. 4** Post operative views. **a** After donor site closure. **b** 2 month post op view



defect but is often bulky and needs aggressive thinning which may be tedious [8]. The major benefits of MSAP flap are its thin, pliable nature and its long pedicle. Several other advantages have been summarized in the literature like less hair bearing skin paddle, minimal damage to the medial gastrocnemius muscle during harvest, also the lesser saphenous vein, sural nerve, or plantaris tendon can be obtained from the same wound [9]. Concerning these we have been using MSAP flap as a choice in head and neck free flap reconstructions with relative success.

Anatomy of the MSAP flap was first outlined and clinical application was performed by Cavadas et al. in 2001 [10]. Subsequent papers elaborated the vascular anatomy of the flap, variations of the perforators and medial sural artery. Preoperative information of particular anatomical features of medial sural artery and its perforators is essential for the surgeon and can further facilitate planning and execution of surgery. Medial sural artery originates from popliteal artery and enters the gastrocnemius muscle from proximal end. Intramuscular anatomy of the medial sural artery has been outlined by several anatomical studies. The artery divides into medial and lateral row in the muscle and gives off several intramuscular and perforating branches which supply overlying skin territory. The rows generally unite long before the popliteal crease [11]. Whether cadaveric or clinical previous literature reveal that most perforators are located in the medial calf area within 9–18 cm from popliteal crease, number ranged from one to

four but generally two dominant perforators are identified [12]. Kao et al. founded the mean number of total perforators was 2.7–1.5 (range 1–5), and the mean number of large perforators was 1.6–0.7 (range 1–3) [13]. The mean numbers of branches were reported as 12.2 from main trunk and 10.1 from the perforators by He et al. [14]. In our series eight flaps had one perforator and in two flaps there were two perforators and in one flap an anatomical variant, double pedicle has been observed. In one flap we have observed a perforator which had not entered the muscle, a median sural artery also in two cases which were not included in the study, flap has been abandoned due to inadequate perforator size. Therefore, we think that surgeons should be aware of possible anatomical variations and a B plan must be kept in mind due to frequent perforator inadequacy.

The pedicle length is always adequate to reach the recipient vessels in the neck region which can be as long as 16 cm. But even though there are many side branches which are clipped, kinking and twisting is more of a concern. Intramuscular dissection of pedicle is long comparing other perforator flaps also number of side branches is more than other alternatives which makes dissection harder. But one advantage of MSAP flap is that the main trunk of the artery lies longitudinally close to the muscle surface which simplifies the dissection [7]. In all our cases we were able to harvest the flap successfully but importantly in two patients with planned MSAP after the exploratory incision

the size of the perforators were found inadequate and a radial forearm flap has been utilized. This shows that in certain patients we have to change our flap plan to radial forearm, therefore, we propose that the patient and surgical team should be aware of the possible plan change intra-operatively and an alternative donor site may be prepped and draped also. Although in the literature there are several reports in favor of this flap usage in head and neck reconstruction we believe that especially in clinics without enough perforator flap experience and microsurgical workload, reconstructive surgeons should be cautious in choosing MSAP flap.

Nine arterial anastomosis were performed with 9/0 and two anastomosis were performed with 10/0. Even the sizes were not calculated we assumed that diameter of the artery is between 1 and 2 mm. Therefore, technically the arterial anastomosis is demanding than alternatives and loupe anastomosis which we sometimes use in RFFF is generally impossible. One total flap loss occurred following arterial thrombosis after 4 h and reanostomosis was not successful. The defect is grafted and patient is scheduled for another free flap reconstruction. In our opinion, if the surgical team does not have enough perforator flap experience, this flap may be struggling or disappointing. In all our cases, we have elevated the flap under tourniquet control and used prilocaine washing routinely. However, after tourniquet deflation in three cases we did not observed brisk bleeding and used local papaverine and heating for about 20 min, than bleeding restored.

Some authors use routine pre-op CTA although some authors find it unnecessary and not helpful. Pre-operative hand held Doppler is helpful and routinely used to detect the dominant perforator and the literature shows that the success rate for locating perforating vessels with Doppler imaging is approximately 80 %. Therefore, we think that in healthy population prior CTA is unnecessary but in patients with peripheral vascular disease and diabetes we suggest pre op CTA because accompanying vascular disease and condition of perigenicular perforators can be examined and also location and reliability of the dominant perforator and anatomy of the source vessel can be assessed.

In an unpublished study performed by our team we have showed that in patients with severe peripheral arterial disease medial sural artery may be an important perigenicular collateral artery which has important function in distal circulation. Therefore, we strongly recommend pre-operative CTA in this population because we think, the benefits of this imaging is three folds in this patient group. First, location and reliability of the dominant perforator and anatomy of the source vessel can be assessed, second, accompanying vascular disease and condition of perigenicular perforators can be examined, and finally,

suitable extremity can be chosen in the light of this findings [14].

Venous problems are of primary concern in free flap surgery and most of the reported cases of flap loss are attributed to venous insufficiency and thrombosis in MSAP flaps. The flap is drained by two venae comitantes of the source vessel but inclusion of a superficial vein or vena saphena parva can be utilized to augment drainage. One another thing is if venous varicosities are encountered during dissection this causes prolonged intramuscular dissection and abnormal venous flow of flap and accepted as relative contraindication. Some authors suggest, if a large superficial vein is encountered during dissection, it should be included to the flap to enhance venous outflow [15]. However, our clinical experience with 11 cases show that, there are always good sized accompanying veins with good outflow that have been available for micro anastomosis. We believe that these additional maneuvers are not necessary as adequate drainage is possible with venae comitantes.

As a conclusion the medial sural artery perforator flap is a good alternative in head and neck reconstruction, with the advantages of thin and pliable skin, a reliable vascular pedicle, straightforward intramuscular dissection. But there are certain drawbacks like tedious pedicle and perforator dissection, small arterial pedicle size which complicates anastomosis and obscurities of anatomy. Therefore, even we use MSAP flap we advise a pre-operative CTA for flap planning in elderly diabetic patients and the surgical team must always be ready for a difficult micro anastomosis. Always an alternative flap choice must be prepared and counseled with the patient and the surgical team.

#### Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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