Free Thoracodorsal Artery Perforator Flap for Head and Neck Reconstruction: An Indian Experience

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Abstract

Background We describe our experience with use of free thoracodorsal artery perforator (TDAP) flap for head and neck (H&N) cancer reconstruction, with respect to the patient and disease profile, suitable defect characteristics, the reconstructive technique, and complications.

Methods Consecutive patients ($N = 26$) undergoing free TDAP flap for H&N onco-reconstruction, in a single center, were included from January 2015 to December 2018 and the data were analyzed.

Results Perforator(s) were reliably predicted preoperatively, using handheld Doppler. Lateral position was comfortable for the harvest. Twenty flaps were harvested on a single perforator, more commonly musculocutaneous ($n = 16$). The thoracodorsal nerve and latissimus dorsi muscle could be preserved, completely in almost all cases. The skin paddle was horizontally ($n = 5$) or vertically ($n = 21$) oriented, both giving a satisfactory scar. The flap was used as a single island or two islands by de-epithelializing intervening skin. Pedicle length was sufficient in all cases. Four cases were explored for suspected venous insufficiency. Two had thrombosis, of which one was salvaged, while the other necrosed. One flap had minimal partial necrosis, which was managed with secondary suturing. The 5-year follow-up showed good oral competence, mouth opening, and cosmetic satisfaction among patients.

Conclusion TDAP flap provides all the advantages of a perforator-based free flap and of back as a donor site with close color match to the face, relatively hairless, and thickness in between the thigh and the forearm. It can be a useful tool to provide an ideal functional and aesthetic outcome, with a hidden donor site and minimal donor site morbidity in selected cases.

Keywords

- thoracodorsal artery perforator flap
- TDAP flap
- TAP flap
- head and neck reconstruction
- perforator free flap
- head and neck cancer

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Introduction

The head and neck (H&N) region is the most common site of cancer in India, constituting 25 to 30% of the cancer burden. Of these, oral cavity cancers are the commonest, comprising 40 to 70%.[1] Surgical resection is the primary treatment modality for most operable oral cavity cancers. Reconstruction of the resultant defects is obligatory. The bar is now set to not only cover the defect and heal in time for radiation therapy but also to provide the best possible functional and aesthetic outcome with minimum morbidity to the donor site. Our tertiary cancer care center performs a large number of free tissue transfers for H&N reconstruction. Radial artery forearm flap (RAFF) and anterolateral thigh (ALT) flap are the workhorse flaps for soft-tissue reconstruction. Occasionally the need for a flap having an intermediate thickness between the forearm and the thigh (RAFF and ALT) is felt. The thoracodorsal artery perforator (TDAP/TAP) flap, wherein the back skin is harvested based on the perforator from the thoracodorsal pedicle, provides this alternative (►**Fig. 1**).

Aims

- To study the utility of free TDAP flaps for H&N cancer reconstruction in Indian patients.
- Assess early and late postoperative complications.
- Assess donor site morbidity.

Materials and Methods

Data of consecutive patients undergoing TDAP flap for H&N reconstruction from January 2015 to December 2018 were collected from hospital electronic medical records and department case record forms and were analyzed, with respect to the preoperative patient and disease profile, intraoperative defect characteristics and reconstructive technique, and early and late postoperative outcomes.

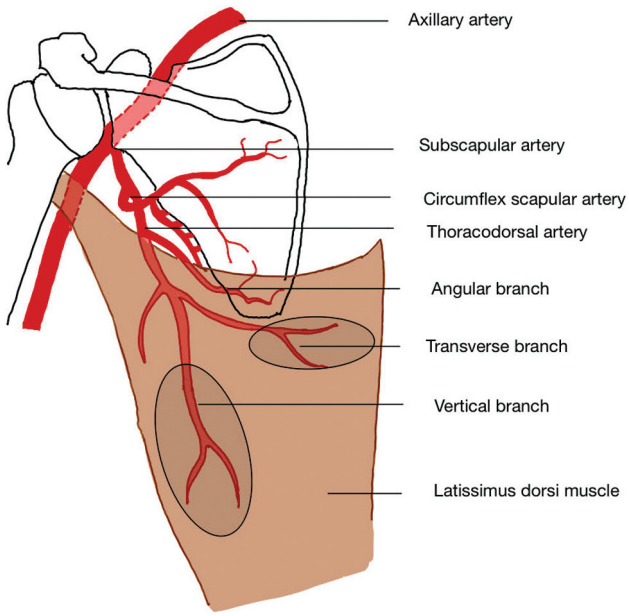

Fig. 1 Anatomy of the thoracodorsal vasculature.

Patient Selection

Patients undergoing resection for H&N cancers, requiring only soft-tissue reconstruction, having back thickness favorably matching the thickness of the defect and where the donor area was amenable to primary closure after harvest of the desired size of the flap, were selected to undergo reconstruction with TDAP flap.

Perforator Localization

A handheld Doppler examination was performed preoperatively, using an 8-MHz probe to locate the perforator. The primary guiding landmarks used were 8 to 10 cm below the apex of the axilla and 2 cm posterior to the posterior axillary fold.[2] Search was extended to a wider adjacent area as needed.

Operative Technique

All flaps were harvested with the patient in a lateral position.

The choice of paddle design, vertical or horizontal, and size was case dependent.

Standard perforator dissection techniques, employing 4× loupe magnification, bipolar forceps, microinstruments, a wet field, and minimal handling of the perforator, were used. The dissection proceeded from the perforator to the pedicle.

The donor site was closed over a suction drain. The patients were placed supine, and flap contouring, inset, and microvascular anastomosis (MVA) were done.

Postoperative Protocol and Follow-Up

The flap was monitored clinically by needle pricking every 2 hours for the first day and every 6 hours for the next 5 days.

Patients were mobilized on the first postoperative day, and drains were removed once the output was less than 20 mL for 24 hours. Oral liquids were started on the fourth postoperative day, and discharge from in-hospital care was given on the sixth postoperative day for all patients without any complications.

The patients were followed up twice a week for 2 weeks after discharge, once a fortnight for a month after and once in 3 months thereafter, for a year. Following this, patients were advised two 6-monthly follow-up visits and annual visits subsequently.

Results

Twenty-six patients underwent free TDAP flaps for H&N reconstruction, from January 2015 to December 2018.

The patient and cancer characteristics are detailed in ►**Table 1**.

Intraoperative Course

The resection was performed with appropriate margins, along with neck node dissection, as indicated.

All 26 flaps were harvested in the lateral position, with the patient strapped to the table and with facility to tilt the table.

Table 1 Demographic and cancer characteristics

$N = 26$	
Characteristic	**No. of patients (%)**
Sex	
Male	19 (73.07)
Age (y)	
Mean	44.46
Range	27–63
Pathological diagnosis	
Squamous cell carcinoma	25 (96.15)
Dermatofibrosarcoma protuberans	1 (3.85)
Recurrent tumors (undergone prior surgery with adjuvant radiotherapy)	2 (7.69)
Neoadjuvant chemotherapy	7 (26.92)
TNM classification	
T1	1 (3.85)
T2	8 (30.77)
T3	3 (11.54)
T4	14(53.85)
N0	13 (50)
N1	4 (15.38)
N2	9 (34.62)
M1	0

We designed a vertical paddle in 21 patients, and a horizontal paddle in 5 patients.

The average size of the flap harvested was 18 × 7 cm, the largest flap dimension was 27 cm × 9 cm, and the smallest flap harvested was 11 cm × 6 cm (►**Table 2**).

With regard to the perforator configuration of the flaps, 20 of 26 flaps were harvested on a single perforator, of which 16 flaps were harvested on a single musculocutaneous perforator and 4 flaps had a single septocutaneous perforator. Six of 26 flaps were harvested on 2 perforators each, of which in 4 flaps, both perforators were musculocutaneous, while the other 2 flaps had 1 septocutaneous and 1 musculocutaneous perforator each (►**Table 2**).

The thoracodorsal nerve was preserved intact in 24 cases. Primary coaptation was done in the two patients in whom the thoracodorsal nerve was cut inadvertently.

In 19 of 26 cases, the dissection involved splitting of the muscle along its fibers, which was later approximated with sutures. In 4 of 26 cases where the flap was harvested solely on septocutaneous perforators, the muscle did not need to be split. A cuff of about 2 cm of muscle around the perforators was harvested in 3 of 26 patients, as the perforator was small, and a complete dissection posed a high risk of injury to the perforator.

Seven of 26 flaps were used to reconstruct only the buccal mucosa and as soft-tissue filler (►**Fig. 2**).

Fifteen flaps were used to reconstruct both mucosal and skin defects (►**Fig. 3**); here the single island harvested flap was converted to two islands by de-epithelializing a skin strip and folding the flap. In 5 of these 15 patients, even though the flap was harvested on 2 perforators, owing to their close proximity to each other, the skin paddle was not divided into 2.

In 14 of 26 patients, the flap was also used to reconstruct a part of or the whole lower lip, in addition to buccal mucosal defects (►**Fig. 4**). In one patient, the flap was used only for skin resurfacing of the submandibular region, with no intraoral defect (►**Table 2**).

In four cases, the flap needed partial surgical thinning of the deep fat for better contouring.

MVA was done in the ipsilateral neck in 25 patients. In one patient, contralateral neck was used as ipsilateral vessels were deemed unsuitable due to prior surgery and radiation (►**Table 2**).

The average time for flap harvest (excluding position change) was 70 minutes. The total average duration of reconstructive surgery, from patient position change to lateral to final closure after MVA, was 6.2 hours (►**Table 2**).

Early Postoperative Period

We compiled the early postoperative complications using the Modified Clavien–Dindo classification for free flaps in H&N reconstruction (►**Table 3**). On postoperative day (POD) 0, four patients underwent reexploration under general anesthesia for suspected venous insufficiency. Of them, two had a venous thrombosis, of which one was revised, and the flap was salvaged (grade IIIb), while the other flap could not be salvaged and had to be debrided, followed by a pectoralis major myocutaneous (PMMC flap) for reconstruction (grade IIIc). The two other flaps had no thrombosis and only inflow–outflow mismatch, which resolved on its own within postoperative day 2 (grade IIIb). One patient had partial flap necrosis of 1 cm × 3 cm of flap requiring debridement and re-suturing (grade IIIc; ►**Table 3**).

Two more patients faced grade IIIb complications, requiring surgical intervention under general anesthesia. These included an orocutaneous fistula requiring re-suturing, and a native neck flap skin necrosis requiring debridement and skin grafting. One patient required secondary suturing under local anesthesia for gap of inset (grade IIIa). Two patients had parotid collections, and one patient had a chyle leak. These three patients required pharmacological intervention for uneventful amelioration (grade II). Two patients had an excessive serous collection in the neck, which subsided with conservative care (grade I; ►**Table 3**).

No significant donor site complications were noted in the early postoperative period.

Late Postoperative Period

Nineteen patients underwent adjuvant radiotherapy, and 11 of them also received adjuvant chemotherapy. All the patients who required adjuvant radiation and chemotherapy received it within the optimum time window of 6 weeks postsurgery.

At the 5-year follow-up, 15 patients survived with no recurrence, while 3 patients had passed away and 8 were lost to long-term follow-up. Of the 15 patients who were

Table 2 Details of patient and tumor profile, intraoperative and post-operative details, and follow-up

Sl. no.	Age (y)	Sex	Diagnosis	Prior HN surgery and RT	Defect components BM/lip/ bone/skin	Side of TDAP harvest	Paddle orientation	Flap size (cm × cm)	Perforator	Nerve to LD preserved	Vascular anastomosis (artery/vein)	Time for reconstruction (min)	Complications	Follow-up (mo)	Status at 5-y follow-up
1	58	M	SCC LT BM	N	BM/Lp/–/S	LT	V	27 × 9	1 MC	Y	LT FA, IJV TRIB	420	Excess serous collection	3	D
2	38	M	SCC LT BM	N	BM/–/PSM + ISM/S	LT	V	23 × 9	2 MC	Y	LT STA, IJV	400	Chyle leak	4	L
3	30	M	SCC LT BM	N	BM/Lp/-/S	LT	V	14 × 6	1 MC	Cut, coapted	LT FA, IJV	400	–	60	A
4	56	M	SCC LT BM	N	BM/Lp/BTMar/S	LT	V	16 × 8	1 MC	Y	LA FA, IJV	420	Partial flap necrosis, re-suturing under GA	73	A
5	35	F	SCC RT BM	N	BM/Lp/PSM + UA/S	LT	V	21 × 8	1 MC	Y	RT FA, IJV	450	Native neck skin necrosis, STSG under GA	10	L
6	63	F	SCC LT BM	N	BM/–/BTMar/–	LT	H	20 × 8	1 MC	Y	LT STA, IJV TRIB	450	–	94	A
7	37	M	SCC RT BM	N	BM/Lp/BT Mar/–	LT	H	17 × 7	1 MC	Y	RT FA, IJV TIB	490	–	93	A
8	40	M	SCC LT BM	N	BM/–/BTMar/S	LT	V	23 × 7	1 MC	Y	LT FA, EJV	450	Excess serous collection	91	A
9	46	F	SCC LT lower alveolus	N	BM/–/BTMar/–	LT	H	14 × 7	1 MC	Y	LT STA, EJV	390	Gape of inset, re-suturing under LA	2	L
10	43	M	SCC lower lip	N	BM/Lc/MM/S	LT	V	21 × 7	2 MC	Y	LT FA, EJV	300	–	7	L
11	30	M	SCC LT BM	N	BM/–/BTMar/–	LT	V	15 × 5	2 MC	Y	LT FA, EJV	450	Parotid collection	73	A
12	45	M	SCC RT BM	Y	BM/Lp/MM/–	LT	V	20 × 6	1 SC	Y	LT STA, EJV	400	–	33	L
13	37	M	SCC LT BM	N	BM/Lp/MM/S	LT	V	17 × 5	1 MC	Y	LT FA, IJV TRIB	340	Reexplored, inflow–outflow mismatch	79	A
14	27	M	SCC RT BM	N	BM/Lp/–/–	RT	V	16 × 7	1 SC	Y	RT FA, IJV	320	–	76	A
15	58	M	SCC RT BM	Y	BM/–/MM/S	Rt	V	20 × 7	1 MC	Y	RT STA, IJV	300	Reexplored, inflow–outflow mismatch	4	D
16	52	F	SCC LT BM	N	BM/Lp/BTMar/S	LT	V	21 × 7	1 MC	Y	LT FA, IJV	380	–	2	L
17	47	F	DFSP LT submandibular region	N	–/–/–/S	LT	V	20 × 9	1 MC	Y	LT STA, IJV TRIB	300	–	66	A
18	47	F	SCC RT BM	N	BM/–/–/–	RT	V	12 × 6	1 SC	Y	RT STA, IJB TRIB	380	Parotid collection	70	A
19	55	M	SCC LT BM	N	BM/–/MM/–	LT	V	12 × 6	1 MC	Cut, coapted	LT FA, IJV	320	–	66	A
20	36	M	SCC RT BM	N	BM/–/MM/S	RT	V	23 × 7	2 MC	Y	RT FA, IJV	370	–	17	L
21	40	M	SCC LT LOWER LIP	N	BM/Lp/BTMar/S	LT	V	22 × 7	1 MC	Y	LT STA, IJV	360	OCF, suturing under GA	58	L
22	41	M	SCC RT BM	N	BM/–/MM/–	RT	H	11 × 6	1 SC	Y	RT FA, IJV	320	Reexplored, venous thrombosis, revised	65	A
23	57	M	SCC LT BM	N	BM/–/BTMar/–	RT	H	15 × 6	1 MC	Y	LT FA, IJV TRIB	320	–	64	A
24	39	M	SCC RT BM	N	BM/Lp/BTMar/S	RT	V	22 × 7	1 MC, 1 SC	Y	RT STA, IJV	300	–	57	A
25	39	M	SCC LT BM	N	BM/Lp/BTMar/S	LT	V	18 × 7	1 MC, 1 SC	Y	LT FA, IJV	300	Reexplored, venous thrombosis, not salvaged Flap debrided, PMMC	11	D
26	60	F	SCC LT BM	N	BM/P/BTMar/S	RT	V	17 × 7	1 MC	Y	LT FA, IJV	370	–	56	A

Abbreviations: A, alive; BM, buccal mucosa; BTMar, bite marginal resection (marginal resection of the upper and lower alveolus); D, deceased; EJV, external jugular vein; F, female; FA, facial artery; GA, General anesthesia; H, horizontal; IJV trib, internal jugular vein tributary; IJV, internal jugular vein; L, lost to follow-up; LA, local anesthesia; Lc, Complete Lower Lip excision; Lp, partial lower lip excision; LT, left; M, male; MC, musculocutaneous; MM, marginal mandibulectomy; OCF, orocutaneous fistula; PMMC, pectoralis major myocutaneous flap; PSM, posterior segmental mandibulectomy; RT, right; S, skin excision; SC, septocutaneous; SCC, squamous cell carcinoma; STA, superior thyroid artery; STSG, split-thickness skin graft; UA, upper alveolectomy, V, vertical.

Fig. 2 A 32-year-old man, T2N0M0, with carcinoma of the right buccal mucosa. (**a**) Preoperative photograph. (**b**) He underwent right buccal mucosal wide local excision with bi-alveolar marginal resection and right supraomohyoid neck dissection. (**c**) A 17 cm × 7 cm, left-sided, horizontal paddle, free thoracodorsal artery perforator (TDAP) flap was harvested, based on a single musculocutaneous perforator (*white arrow*) and with preservation of the motor nerve to latissimus dorsi (LD; *black arrow*). (**d**) The flap was used as a single island to reconstruct the defect with de-epithelialization of a part, to use as soft-tissue filler. (**e,f**) Postradiotherapy follow-up images at 6 months show good cosmesis of the face, as well as the donor site.

surviving at the 5-year follow-up, 13 patients had an acceptable mouth opening of greater than 3.5 cm, 13 patients had good oral competence with no drool and all of them rated their overall cosmetic outcome as good or fair.

None of the patients had weakness of the latissimus dorsi (LD) muscle. Late donor site complications included scar stretching in four patients and scar hypertrophy in one case. One patient developed lymphedema of the upper limb on the side of the TDAP harvest, 2 years postsurgery. Since some part of the pedicle dissection extended into the axilla, postoperative fibrosis could be the probable cause for lymphedema. He was being managed conservatively for the same, before he was lost to follow-up.

The mean follow-up duration of our patients was 47.46 months (2–94 months).

Discussion

The TDAP or TAP flap, was first described in 1995 by Angrigiani et al.[2] The anatomical basis of the TDAP flap has been well described in the literature by cadaveric studies, in vivo descriptions, and by Doppler studies.[3,4] The flap is supplied, most commonly, by musculocutaneous and occasionally by fasciocutaneous perforators from the thoracodorsal artery. These perforators arise from either the descending or the transverse branch of the thoracodorsal artery (►**Fig. 1**).[5]

Uses

The use of pedicled TDAP flap has been well documented for partial and total breast reconstruction.[6–8] It is also described for defect of the shoulder, axilla, lower neck, arm, upper back, and ipsilateral lateral chest wall, that is, all along its natural arc of rotation.[6]

The use of free TDAP flaps has been described for limb reconstruction to cover exposed bone or implant and after soft-tissue sarcoma resection, where this thinner flap allows for approximation of skin edges over convex surfaces.[9–12]

Free TDAP flaps have also been utilized for reconstruction in the H&N region, as in, post-tumor resection, trauma, postburn contracture, and congenital anomalies.[13–16]

Very few studies exist for its use as a free flap in the Indian population.[17]

Intraoperative Technique

Preoperative perforator localization is a crucial element in planning as it confirms the presence of a perforator. We performed Doppler examination in the lateral position itself. Bach et al have described their technique of performing Doppler examination a day prior, in a supine position with the arm in 90-degree abduction and found it to be reliable.[18]

We preferred to harvest the flap in the lateral position because it allows us to orient the skin paddle vertically or transversely. It gives us adequate exposure of the thoracodorsal trunk. It also provides the liberty to convert a vertical skin paddle to a parascapular flap in case of perforator unavailability or injury. Skin closure, with either the horizontal or the vertical paddle, is easier in the lateral position, as the back skin is not splinted to the table by the body weight.

The drawback of the lateral position is an increase in the duration of surgery. This position change takes approximately 20 minutes each, in our experience. The inability to harvest the flap simultaneously with cancer resection is balanced off by the opportunity to assess the defect better and hence have realistic planning of the flap.

It has been reported that, with the lateral decubitus position, the perforators entering the skin have a more perpendicular course, thus producing more discrete Doppler signals.[6]

Several studies have described the harvest of the TDAP flap in the supine position, to facilitate a two-team approach, in case of H&N reconstruction, as well as breast reconstruction.[7,17,18]

In designing the skin paddle, it must be noted that the vertical design allows exposure of a larger area over the muscle to search for perforators on either side of the initial incision. It also permits the harvest of a larger flap. In vertical paddles, the medial incision must be made first, perforator and pedicle dissection completed, and then lateral incision

Fig. 3 A 40-year-old man, T4aN0M0, with postneoadjuvant chemotherapy, carcinoma of the left buccal mucosa. (**a**) Preoperative image. (**b**) He underwent left buccal mucosa wide local excision with 8 cm × 6 cm skin excision, bi-alveolar marginal resection with left supraomohyoid neck dissection. (**c**) A 23 × 7 cm, vertical paddle, free left thoracodorsal artery perforator (TDAP) flap was harvested, based on a single musculocutaneous perforator. (**d**) The intervening portion of the flap was de-epithelialized to reconstruct the buccal mucosa and the skin, by folding the flap. (**e,f**) Postradiation follow-up at 6 months shows good cosmesis and color match, with good mouth opening. (**g,h**) Donor site shows a stretched scar, but it is well hidden.

committed. Conversion to a parascapular flap is thus feasible in case of accidental perforator injury or the absence of a suitable perforator. The scar is, however, against the resting skin tension lines (RSTLs) and is prone to stretching.[18]

The horizontal paddle aligns with the RSTLs, and the resultant scar stretches less. We preferred a horizontal paddle when there was the presence of a good Doppler signal and relatively less flap requirement.

It must be noted that the perforators sometimes emerge from the muscle and travel over its surface longitudinally for a few centimeters before entering the deep fascia, subcutaneous fat, and reaching the dermis. This may create a discrepancy in the site of the Doppler signal and the actual point perforator entry into the fascia.[18] If the planned flap is not too wide, the skin incision might be inadvertently placed just over the perforator, and injury might occur with the

Fig. 4 A 43-year-old, man, T4aN2M0, with carcinoma of the lower lip. (**a**) Preoperative image. (**b**) He underwent total lower lip excision with part left buccal mucosa, 6 cm × 4 cm skin excision bi-alveolar marginal resection and left modified radical neck dissection. (**c**) A 21 cm × 7 cm, left-sided, vertical paddle, free thoracodorsal artery perforator (TDAP) flap was harvested. (**d**) Dissection of the musculocutaneous perforators. (**e**) Primary closure of the donor site. (**e**) The flap was used to reconstruct the mucosal, lip, and skin defects. (**f**) Postradiotherapy follow-up images at 6 months show good color match and oral competence.

Table 3 Modified Clavien–Dindo classification for postoperative complications

Grade	Definition	No. of patients
I	Any deviation from the normal postoperative course WITHOUT the need for pharmacological or surgical, endoscopic, or radiological treatment	2
II	Requiring pharmacological treatment (blood transfusions/ total parenteral nutrition [TPN])	3
IIIa	Requiring surgical, endoscopic, or radiological intervention NOT under general anesthesia (GA)	1
IIIb	Requiring surgical, endoscopic, or radiological intervention under GA	5
IIIc	Partial/total flap failure	2
IVa	Life-threatening complication: single organ failure	–
IVb	Life-threatening complication: multi-organ failure	–

initial cut. Hence, keeping the skin paddle marking well centered on Doppler marking and beveling the incision away after the dermis is incised is vital. These precautions are even more relevant if a relatively small flap is planned.

Flap Advantages

TDAP provides relatively hairless skin, suitable for intraoral reconstruction.[18] The thin pliable flap makes it easy for contouring.[18]

Chimeric flap designs are also possible, especially with the scapular or parascapular flaps based on the subscapular axis.[19,20]

Intramuscular dissection allows long pedicle lengths of 12 to 15 cm.[3]

The thoracodorsal pedicle is relatively less prone to atherosclerosis when compared with that of the lower limbs, hence making the MVA easier and more reliable.[21]

Donor Advantages

There is either full recovery or minimal functional loss, by sparing the innervated LD muscle. LD preservation also reduces the dead space and subsequent seroma formation.[22]

The transverse scar parallels the RSTLs, while the vertical scar is hidden in the posterior axillary fold. Either way the scars are invisible to the patient. Good patient satisfaction scores are reported with the scars.[23]

Large surface area of the back allows sizable flaps to be harvested while ensuring primary closure of the donor site.[24]

Drawbacks

There is a learning curve associated with a relatively difficult perforator flap dissection and nerve preservation.

If lateral position is needed, it precludes simultaneous harvest, increasing operative time.

Flap size is restricted by the ability to primarily close the donor site. However, a larger flap harvest and use of Pac-Man design or another perforator flap or keystone flap for donor closure can be considered.

Flaps may appear suffused in some cases due to stronger arterial inflow than outflow, giving a false impression of venous insufficiency. In our experience, this problem settles due to autoregulation of blood flow. To prevent this initial congestion, flap design techniques with supplementary measure, including a "T-anastomosis" have been recommended to improve results.[25]

Conclusion

TDAP flap allows the use of the back as an alternative free flap donor site, with thickness between the forearm (RAFF) and thigh (ALT). It allows the surgeon to offer the patient a choice of the back as a donor site, in suitable cases. The perforator(s) is(are) sizable and well localized with the handheld Doppler, making it a reliable flap. With free tissue transfer now being established as the standard of care for reconstruction after oral cancer extirpation, TDAP is a desirable arrow in a reconstructive surgeon's quiver.

Author Contributions

D.J. and V.K.S. performed the surgeries. M.M. and S.M. assisted in the surgeries. A.B. and V.K. followed up the patients. S.J. and D.J. had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. They also wrote the manuscript. P.Y. and A.B. reviewed the manuscript.

Declaration of Helsinki

The study was done in adherence to the Declaration of Helsinki protocol. Proper preprocedure consents were taken for surgery, documentation, and research purposes. The study was approved by the Institutional Ethics Committee. Data storage was performed consistent with the good clinical practice guidelines.

Conflict of Interest

None declared.

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