Original Article

Reconstruction with free flaps in robotic head-and-neck onco-surgeries

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ABSTRACT

Aims and Objective: The aim of the present article is to highlight how reconstruction with free flaps is different and difficult in cases with robotic head-and-neck cancer surgery. It also highlights the technical guidelines on how to manage the difficulties. **Materials and Methods:** Eleven patients with oropharyngeal cancer having undergone tumour excision followed by free-flap reconstruction been reviewed here. Nine patients had tumour excision done robotically through intraoral route while neck dissection done with transverse neck crease incision. There is a problem of difficult flap inset in this group of patient. Two patients had intraoral excision of tumour followed by robotic neck dissection via retroauricular incision. With no incision directly on the neck, microvascular anastomosis is challenging in this set of patients. Free flap was used in all the cases to reconstruct the defect. **Results:** Successful reconstruction with free flap was done in all the cases with good outcome both functionally and aesthetically. **Conclusion:** Free-flap reconstruction is possible in robotic head-and-neck cancer surgery despite small and difficult access, but it does need practice and some technical modifications for good outcome.

KEY WORDS

Free flap; head-and-neck cancer; robotic free flap; robotic head-and-neck cancer surgery; robotic head-and-neck reconstruction; transoral robotic surgery

INTRODUCTION

Since the introduction of robotic surgery from the 1990s in the field of urology, the use of robot has expanded to many other specialities such as general surgery, gynaecology and cardiac surgery.^[1] Its use in the field of head-and-neck cancer surgery is comparatively

recent, but expanding rapidly. The indications for the use of robot in head-and-neck cancer surgery are mainly for, lesions of soft palate, base of tongue (BOT), supraglottis and other oropharyngeal and hypopharyngeal lesions, which have been traditionally accessed via lip-split incision.^[2] The associated morbidity and effect on the

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quality of life with these incisions are well known. Use of robot in such cases offers the advantage of magnification, good illumination and stereoscopic vision into difficult-to-access regions while avoiding big conspicuous scar on the face and neck.^[3] When robot is used for neck dissection, the incision is generally small in size and placed in post-auricular region with a possible extension into the posterior hairline.

After excision of the primary tumour, management of defect depends on various factors such as size and depth of defect, expected functional deficit (e.g., velopharyngeal incompetence in soft palate tumour excision) or exposure of vital structures (e.g., the carotid vessels). Small and superficial defects can sometimes be left open to epithelise on its own, but larger defects with subsequent functional deficit or exposure of vital structure will require reconstructive effort to fill the defect and restore anatomy as much as possible.

While the small and concealed scar offers great advantage to the patient, it poses a big problem to the reconstructive surgeon in terms of difficult access to the resection site for flap inset and difficult approach to the recipient vessels for flap anastomosis in robotic neck dissection cases.

There are very few articles on how to handle such cases from reconstructive surgeon's point of view, given the constraints of space and visibility. The number of plastic surgeons trained in robotic surgery is very limited at present. We present our experience of 11 patients with cancer of tonsil, soft palate, BOT and buccal mucosa (BM) who underwent robotic surgery and free-flap reconstruction and discuss the methodology we followed.

MATERIALS AND METHODS

Eleven patients treated in the head-and-neck unit of our cancer institute during the period of 2016–2017 have been included, who underwent either transoral robotic surgery (TORS) $\pm$ neck dissection or wide local excision + robotic neck dissection. All these patients required free-flap reconstruction for the residual defect after tumour resection. The demographic data and details are summarised in Table 1.

All the patients happened to be male, and age group ranged from 43 to 62 years. All of them had squamous cell carcinoma coinciding with the wide prevalence of this cancer in India. The primary tumour involved BOT in two cases, tongue (mobile) in two cases, BM in four cases, tonsil in one case, soft palate in one case and gingivo-tonsillar sulcus in one case. The cases where the primary tumour was involving BM and mobile tongue, the posterior spread was actually beyond the reach for regular excision without a lip-split incision, thus demanding robotic excision.

The set-up for robotic resection of tumour is slightly different from that of open cases. The chief operating onco-surgeon does not scrub and sits on the console of robot which is generally kept in one corner of the operation theatre (OT). One assistant and scrub nurse stand at the head end of the table and all trolleys are also near the head end. The robot is placed on one side of the patient (right side in our OT). The contralateral side of the patient including both the upper and lower limbs is relatively free. If plan is decided, plastic surgeon can start the harvest of flap simultaneously from the other side along with another scrubbed nurse. The usual docking time for robot is around 3 min [Figures 1 and 2].

Table 1: Robotic surgery time, flap harvest times, defect and flap size and duration of stay

Age/sex	Surgery	RST (min)	Flap used	Flap harvest time (min)	Defect size (cm)	Flap size (cm)	Length of stay
58/male	TORS	25	FRAFF	40	3×4	4×6	7
54/male	TORS	40	Rectus femoris	40	5.5×4.5	7×6	6
57/male	TORS	35	ALT	55	4×2	5×5	8
60/male	TORS	30	ALT	70	3×4	5×8	8
62/male	TORS	25	ALT	50	5×5	7×8	7
51/male	TORS	40	FRAFF	35	3.5×3.5	4×5	5
48/male	TORS	30	FRAFF	45	5×4	7×6	7
46/male	TORS	45	ALT	60	4×3	7×6	10
60/male	TORS	25	ALT	50	5×3	8×6	7
45/male	WLE + RSND	56	FRAFF	35	3×3	5×4.5	6
43/male	WLE + RSND	70	FRAFF	45	5×4.5	7×6	7

TORS: Trans oral robotic surgery, WLE + RSND: Wide local excision + robotic selective neck dissection, FRAFF: Free radial artery forearm flap, ALT: Anterolateral thigh flap, RST: Robotic surgery time

Patients have been broadly divided into two categories. The first group underwent TORS and then neck dissection with traditional neck incision. The problem with this group of patients is of difficulty in flap inset in the posterior and deeper parts of the oral cavity and pharynx through the narrow mouth opening in the absence of lip split [Figure 3].

The second group underwent primary excision of tumour via oral access. The two patients of this group had tumour involving the BM without much posterior extension, and the resection or flap inset in these patients did not pose any technical challenge. Robotic neck dissection was done in these patients because of the patients' demand for minimal scar on their neck or face. Problem with free flap in these patients is the difficult access to the recipient vessel for anastomosis in the absence of a conventional neck incision used for neck clearance [Tables 2 and 3].

For the first group, transoral robotic resection of tumour was done in the standard manner (Da Vinci Si surgical system, Intuitive Surgical, Sunnyvale, CA, USA). Margin of 1 cm from tumour is the standard practice here by onco-surgery team. A transverse crease incision in the neck was utilised for neck clearance as per oncologic principles. These patients in the end have only one scar in the neck that falls in the natural crease line which heals to leave an inconspicuous scar. Nine out of 11 patients belonged to this group. The free-flap harvest in all these patients was done in the usual fashion. The flap was designed based on template from the defect. Recipient vessels were prepared in the neck under 4X loupe magnification. Pedicle of each flap was harvested to give the maximum possible length since the exact requirement is not known always. Tunnel was created from the intraoral surgical site to the neck for passage

of flap pedicle. The flap was then transferred to the oral cavity and pedicle was brought to the neck through the tunnel. In most cases, complete inset of the flap was achieved by combined approach through neck incision

Figure 1: Onco-surgeon sitting on console in one corner of the operation theatre. Robot docked over the patient can be seen in the background

Figure 2: Robot on the right side of the patient, assistant on head end and flap harvest ongoing from the free left side

Figure 3: Tumor base of the tongue. Defect involves base of tongue, lateral pharyngeal walls and gingivo-tonsillar sulcus. Flap inset through oral route in such cases without lip-split incision is challenging

Table 2: 1st Group - tumor excision with robot + open neck dissection

Age	Sex	Primary site	Surgery	Flap	Vein	Artery
58	Male	GT sulcus	TORS	FRAFF	CFV	STA
54	Male	Tongue	TORS	Rectus femoris	IJV	FA
57	Male	Soft palate	TORS	ALT	CFV	FA
60	Male	BOT	TORS	ALT	IJV	LA
62	Male	BM	TORS	ALT	IJV	FA
51	Male	tonsil	TORS	FRAFF	CFV	FA
48	Male	Tongue	TORS	FRAFF	CFV	FA
46	Male	BM	TORS	ALT	CFV	FA
60	Male	BOT	TORS	ALT	CFV	FA

FRAFF: Free radial artery forearm flap, ALT: Anterolateral thigh flap, CFV: Common facial vein, FA: Facial artery, IJV: Internal jugular vein, LA: Lingual artery, STA: Superior thyroid artery, BM: Buccal mucosa, GT: Gingivo-tonsillar, BOT: Base of tongue, TORS: Transoral robotic surgery

and intraoral route. Flap inset was done with the FK-WO TORS retractor (Olympus) in place. Most of the proximal part suturing was possible orally, but for the caudal end of the flap which is difficult to be sutured due to lack of vision and working space as well as instrument constraints, approach through the neck incision was useful. Good neck extension and FK-WO TORS retractor did the trick for us in gaining access. Another method used while insetting the distal end of the flap (and proximal end in few cases) was to take multiple bites through the mucosa, utilising multiple sutures and leaving the threads with the needle. Then, to take bites through the corresponding part on the flap with each needle, while the flap is still outside and followed by pushing the flap intraorally and tying the knots one by one. Otherwise as you tie the first knot, taking further bites is nearly impossible [Figures 4 and 5].

Anastomosis was done in all these cases in the usual manner under microscope using nylon 9-0 sutures, and one artery, one vein protocol has been followed in our institute.

The second group of patients included two patients with primary in BM. The resection of primary was done intraorally in conventional manner without much difficulty as the lesions were quite anterior (no skin incision required). Robotic neck dissection was done using post-auricular incision because of patients' demand for better post-operative cosmetic appearance [Figure 6].

The technical challenge in these patients from reconstruction point of view was the difficult access to the recipient vessels in neck for microvascular anastomosis. While normally we use facial artery

(in most cases) for anastomosis, in robotic cases, the usual choice is superior thyroid artery (STA). Facial artery is generally divided by the onco-surgeons to various lengths, while the STA is generally untouched in many. It has a long tortuous course and can be divided in a manner to provide good vessel length. For the venous anastomosis in robotic cases, the usual choice is external jugular vein or common femoral vein. The use of robotic tumour resection is often indicated for early-stage tumours resulting in limited volume loss. These cases generally need thin flap with less bulk which can be contoured well as per need, making Free radial artery forearm flap (FRAFF) our first choice. Another advantage with FRAFF is the long pedicle. We also separate the *vena comitans* from artery for some distance before actually ligating the vessels while harvesting the flap. This helps us in venous anastomosis even when the recipient artery and vein are not very close to each other as in most cases of robotic neck dissection [Figures 7 and 8].

The Chung retractor was utilised for maintaining retraction, while anastomosis was done in the usual manner under microscope. The presence of retractor places the vessels in a deep location, which again makes anastomosis very difficult. Here, the use of long-handle micro-instruments saved the day for us. In one case, the anastomosis was

Table 3: 2nd Group - selective neck dissection done with robot

Age	Sex	Primary site	Surgery	Flap	Vein	Artery
45	Male	BM	WLE + RSND	FRAFF	EJV	STA
43	Male	BM	WLE + RSND	FRAFF	EJV	STA

WLE + RSND: Wide local excision+robotic selective neck dissection, FRAFF: Free radial artery forearm flap, EJV: External jugular vein, STA: Superior thyroid artery, BM: Buccal mucosa

Figure 4: Flap inset after transoral robotic surgery

Figure 5: Flap inset: Posterior margin is difficult to be seen through intraoral route

done not looking through the microscope but using the on-screen projection through the robotic camera.

The post-operative period for all these patients was uneventful. We did not have any complication fortunately

Figure 6: Marking for robotic neck dissection leaves inconspicuous scar but quite away from neck vessels commonly used as recipient vessels in free-flap reconstruction

Figure 7: Chung retractor *in situ* provides deep retraction

Figure 8: Chung retractor *in situ* provides deep retraction allowing for visualisation and dissection of recipient vessels. The retractor however makes it difficult to work with small-handle instruments as well as positioning of microscope for anastomosis

in any of our cases related to resection or reconstruction. Oral liquids were allowed from the 5th post-operative day. Drains were removed after an average of 6 days. The mean duration of hospital stay for these patients was 7 days. None of the patients had any leak in the immediate or late post-operative period.

RESULTS

Free flap survived in all the patients with no case of partial loss or second look surgery being needed. On follow up, all patients had satisfactory functional and aesthetic outcome.

DISCUSSION

Robotic surgery has given a new dimension to the technical capability of surgeons while working in limited-access regions. Stereoscopic vision, higher magnification, controllable dexterity, good illumination and enhanced range of movement of the robotic arm provide an unmatched conducive atmosphere for the surgeon while working in a narrow confined field.

Robotic surgery has provided onco-surgeons the ability to surgically manage early-stage cancers of soft palate, hypopharynx, BOT and pharynx. Early-stage tumours of difficult-to-reach regions were earlier reserved for chemoradiation as the benefit versus risk ratio was heavily disfavoured any surgical exercise with the expected morbidity from surgery. The onset of robotic surgery has however now made surgery as a strong alternative or even the first choice for such early-stage/difficult-to-access tumours because of the very low associated surgical morbidity.

The problems with lip-split incision and mandibulotomy are manifold and well documented in literature.^[4] Robotic surgery has ameliorated the use of these morbid incisions just for the sake of gaining access. The smaller incision used in robotic resection has positive outcome on the quality of life, as documented in the literature.^[5] Park *et al.* have analysed the outcomes in robot-assisted neck dissection and found better scar and better wound healing.^[6]

The small high-placed neck incision and absence of access via lip split, however, make the work of reconstructive surgeon very difficult. Once the resection

is over, the need to reconstruct the anatomy arrives. Inset of flap in the narrow regions of hypopharynx and oropharynx is challenging due to limited access, rigid conventional instruments and their limited movement capability. We utilised access from both the transcervical (when the neck was open) and oral route to reach up to the defect and suture the flap in place. Similar methodology has also been reported in one of the largest case series on reconstruction in TORS by Biron *et al.*^[7] [Figures 9 and 10].

Suturing the flap with robot is another option as more plastic surgeons are becoming familiar in handling the robot and are attempting flap inset or anastomosis with robotic arm as has been reported in many articles, but in our case, we did it manually.^[8] Deeper parts are particularly difficult to be sutured and the flap can also be left unsutured posteriorly to heal on itself. We were however able to do complete flap inset in all our cases. Long-handle instruments are particularly helpful.

While the docking of robot and initial setup may take some extra time, the time taken to access the tumour which may include lip-split incision or mandibulotomy in open surgery is completely spared. We have noted that compared to open surgery, use of robot for inaccessible-area tumours saves precious OT time (considering the onco-surgeon has crossed the learning curve). The final closure of lip-split incision or mandibulotomy takes up plenty of time which is completely avoided with the use of robot, and small neck incisions definitely save a lot of time in the end.

Preservation of velopharyngeal competence, watertight seal between pharynx and neck and adequate tongue volume (in the BOT tumour) are some of the goals for a functional oropharyngeal reconstruction.

CONCLUSION

The volume of patients undergoing robotic head-and-neck cancer surgeries with free-flap reconstruction is on the rise. It therefore puts a demand on the plastic surgeons to handle the constraints thrown by the new incision and access routes used while using the robot for tumour excision. Multiple simultaneous bites through flap and inset margin using multiple sutures before actual inset, deeper retraction and dual access from oral and transcervical routes help in flap inset in relatively inaccessible areas. Use of Chung retractor, long-handle micro-instruments, early separation of *vena comitans* from artery and choosing suitable vessels are some of the key techniques we recommend for robotic neck dissection cases to make the reconstructive work easy. We are currently shifting to robotic flap inset and anastomosis wherever applicable, and believe it would be useful for all reconstructive surgeons who find themselves in similar scenario for better outcomes.

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Conflicts of interest

There are no conflicts of interest.

Figure 9: Flap in partial inset can be accessed from both oral and neck sides in case of open neck dissections

Figure 10: Pharyngeal part sutured from the neck side

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