Single service otolaryngology head and neck surgery free flap reconstruction of head and neck ablative defects—a retrospective single centre review of our initial 6-year experience

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Background: Conventionally, head and neck free flap reconstruction performed as a shared responsibility of otolaryngology and plastic surgeons. The purpose of this study is to evaluate outcomes and identify factors that contribute to complications of free flap reconstructions performed during the establishment of single-service head and neck surgical free flap reconstruction model at the Royal Adelaide Hospital (RAH).

Methods: Retrospective cohort study of patients undergoing free flap reconstruction between September 2015 and August 2021 by the Otolaryngology, Head and Neck Surgery (OHNS) Unit. Patients were included if they had microvascular free tissue transfer, performed by the OHNS department at the RAH. Patients who underwent reconstruction with regional flaps or had surgery performed by plastic surgery department were excluded. The primary outcome of interest was free flap survival. Secondary outcome included surgical, medical complications and hospital/intensive care unit (ICU) length of stay. Univariate binary logistic regression models were used to investigate the association between primary, secondary outcomes and various predictors.

Results: Two hundred patients were identified with a microsurgical free flap success rate of 98.5%. The timing of free flap failure was at two, five and eight days post-operatively. Operation time was shown to be associated with flap failure (P=0.0213). Nineteen (9.5%) cases required return to theatre. Eight (4.0%) for anastomosis revision, six (3.0%) for post-operative bleed/hematoma, three (1.5%) for debridement of recipient site infection and two (1.0%) for further resection and neck dissection, unrelated to post-operative complications. The rate of surgical and medical complications was 25.5% and 40.5% respectively. There was a statistically significant association between American Society of Anesthesiologists (ASA) status and rate of surgical (P=0.0026)/medical complications (P<0.001). Hypertension (P=0.0167) and operation time (P<0.0001) showed a statistically significant association with hospital length of stay.

Conclusions: Our data confirms transitioning to a single-service head and neck surgical free flap reconstruction model solely within the OHNS Unit is obtainable whilst maintaining internationally recognized standards and providing patients multiple benefits in the process.

Keywords: Head and neck cancer; case series; free flap reconstruction; otolaryngology, head and neck surgery (OHNS); American Society of Anesthesiologists (ASA)

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Introduction

Primary oncologic surgery, where feasible, is the current modality of choice in managing many head and neck cancers (1). In Australia, the estimated number of new head and neck cases are 5,189, accounting for 3.2% of all new cancer diagnosis (2). Nationally, there was a 12.7% increase in the number of surgical admissions for head and neck cancer from 2002–2003 to 2011–2012, which comparatively is significantly higher than the increase in overall disease incidence (2).

Ablative surgery of head and neck cancers can result in significant functional and cosmetic impairments that undoubtedly require reconstruction. Reconstructive surgery in the head and neck is indispensable in providing tissue support for vital structures such as orbital contents, skull base, dura, and also in restoration of mastication, speech, swallowing and respiration (3,4). Options for reconstruction include healing by primary or secondary intention, allografts, skin grafts, local flaps, regional flaps, and free tissue transfer (4,5). Amongst a surgeon's armamentarium, free tissue transfer is the modality of choice for larger ablative defects. These have become increasingly necessary as the proportion of locally advanced disease on presentation has increased (2,6). This accounts for the majority of reconstructive work in head and neck surgery departments.

Contemporary free flap survival rates in head and neck surgery average 95–99% (7-11). Despite increasingly favourable reconstructive outcomes, published perioperative complications rates range from 30–71% (7,9). Complications can range from minor, such as infection and pain requiring medications to major, including bleed from flap site, flap failure, and flap loss, requiring further operations (10,12). Surgical and flap-related complications are underrepresented compared with medical complications (7). Irrespective, complications have a disproportionately high impact on patient morbidity, adjuvant therapy and overall healthcare costs (7).

As such, there is significant interest in analysis of institutional outcomes to ensure appropriate standards of care are being met. Traditionally, ablative head and neck surgery with free flap reconstruction has been performed as a two-team approach, most commonly in collaboration with plastic surgeons. However, as microvascular skills have become commonplace in a wide range of surgical specialties, there has been an international trend towards a single service reconstruction model, recognizing numerous patient benefits that result from this approach. Little data is available on outcomes of free flap reconstruction in head and neck surgery units in Australia. This study aims to retrospectively analyse the outcomes of head and neck surgery patients undergoing free flap reconstruction within a new, centralized single centre otolaryngology, head and neck surgery (OHNS) service within South Australia and compare these with current national and international standards. This research study may inform changes to current practice. We present this article in accordance with the STROBE reporting checklist (available at https://www.theajo.com/article/view/10.21037/ajo-23-16/rc).

Methods

Ethics approval

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Central Adelaide Local Health Network Human Research Ethics Committee (EC00192) (Reference Number 14185). Due to the low-risk nature of the study, the ethics committee approved the waiver of individual consent in this project.

Study design

A retrospective cohort study of patients undergoing primary reconstructive head and neck surgery with microvascular free tissue transfer between September 2015 and August 2021 by the OHNS Unit at the Royal Adelaide Hospital (RAH) across two sites: RAH and the Memorial Hospital. Patients were identified through departmental databases and operating lists. Data was limited to the primary inpatient admission. Outpatients follow up data was not included.

Inclusion criteria

(I) Patients with head and neck cancer over 18 years old.
(II) Patients underwent microvascular free flap reconstruction by the OHNS Unit at the RAH.
(III) Patients were operated between September 2015 and August 2021.

Exclusion criteria

(I) Patients who underwent reconstruction with regional flaps.
(II) Patients who underwent reconstruction by alternate hospital department.
(III) Patients with missing records.

Study variables

Baseline patient characteristics included age, gender, body mass index (BMI), American Society of Anesthesiologists (ASA) physical status classification, smoking status, comorbidities, primary tumour site and pathological T staging. Operative details including flap type, flap area, number of venous anastomoses, donor site, total operating time, intraoperative ischemic time were recorded. Reported perioperative outcomes included pre- and post-operative haemoglobin drop, donor, and recipient site complications, return to theatre, flap failure, medical complications, in-hospital mortality, days in intensive care unit (ICU) and hospital length of stay. Information was obtained from clinic notes, preadmission records, operative and anaesthetic reports, progress notes, medication charts, discharge summaries, multidisciplinary team meeting reports, and pathology results.

Surgical method

During the study period, the OHNS Unit at the RAH consisted of six fellowship-trained head and neck surgeons. Three of these surgeons were trained in microvascular reconstruction. To reduce operating time, the preference of the unit is to perform two-team surgery. In this way, one surgeon is responsible for the tumour ablation and the second surgeon will perform the reconstruction. Where possible the tumour excision was performed early to enable defect sizing and flap planning. Thus, flap harvest could be undertaken simultaneously with the remainder of the ablative procedure. Following tumour resection and appropriate neck dissection, the flap was harvested and inset to the defect before vessel preparation and microvascular anastomosis in the neck was performed. Arterial anastomosis was performed with an interrupted suture technique and the Flow Coupler Device (Synovis Micro Companies Alliance, Birmingham, AL, USA) was used for venous anastomosis. Either one or two venous anastomoses were performed, dependent on flap anatomy as well as the number and geometry of recipient vessels in the neck. The use of the Flow Coupler Device facilitated post-operative flap monitoring by medical and nursing staff.

Outcome measures

The primary outcome was free flap survival. Free flap failure was defined by total loss of the transferred tissue requiring removal from the recipient site.

Secondary outcomes included surgical complications (donor site, recipient site), medical complications, return to theatre and hospital/ICU length of stay. These included only those complications limited to the initial admission.

Statistical analysis

The statistical software used was SAS On Demand for Academics (SAS Institute Inc., Cary, NC, USA, 2021). Sample size used (N=200) was based on practical considerations—all RAH patients undergoing free flap reconstruction between September 2015 and August 2021 by the OHNS Unit.

Univariate binary logistic regression models were used to investigate association between primary, secondary outcomes and various predictors including gender, smoking status, comorbidities, BMI, age, ASA status, flap area, operating time, intraoperative ischemic time, and number of venous anastomoses. Odds radios, 95% confidence interval (CI) and global P values were calculated. A significant P value was considered to be P value ≤ 0.05 throughout. All P values were for a two-sided test. Categorical variables were described using frequency and percentage, normally distributed continuous variables were described using mean and standard deviation and skewed continuous variables were described using median and interquartile range (IQR). Only complete data were included for statistical analysis.

Univariate and multivariable linear regression model was performed to investigate the associations between length of stay and various predictors. All covariates with P value <0.2 on univariate regression with length of stay were included in initial multivariable linear regression model. Backwards elimination was then performed, removing one covariate at a time until all covariates had a P value <0.2. P value of 0.2 was used as per Heinz & Dunkler (13).

Results

Patient characteristics

A total of 203 patients underwent free flap reconstruction between the 30th September 2015 and the 3rd August 2021. Of these, data was available on 200 patients. The key demographic data is outlined in *Table 1*.

Operative details

All cases were reconstructed by a microvascular surgeon within the OHNS Unit. Flaps were established by single arterial anastomosis, and single (35%) or double

Table 1 Patient characteristics (n=200)

Parameter	Statistic results
Age (year), mean ± SD	65.52±12.04
Gender, n (%)	
Male	138 (69.0)
Female	62 (31.0)
BMI (kg/m^2), median [IQR]	26.4 [23.2–30.0]
ASA, n (%)	
I	8 (4.0)
II	64 (32.0)
III	115 (57.5)
IV	13 (6.5)
Comorbidities, n (%)	
Previous radiotherapy	27 (13.5)
COPD	29 (14.5)
Diabetes	33 (16.5)
Ischemic heart disease	33 (16.5)
Hypertension	97 (48.5)
Dyslipidaemia	68 (34.0)
Operation time in minutes, median [IQR]	400 [315–499]
Return to theatre, n (%)	19 (9.5%)
ICU stay in days, median [IQR]	4 [2–6]
Length of stay in days, median [IQR]	13 [10–18]
Decannulation days, median [IQR]	5 [4–10]
Post-operative IV Abx in days, median [IQR]	4.2 [3–5]
Post-operative Hb drop in g/L, median [IQR]	27 [18–37]

SD, standard deviation; BMI, body mass index; IQR, interquartile range; ASA, American Society of Anesthesiologists; COPD, chronic obstructive pulmonary disease; ICU, intensive care unit; IV Abx, intravenous antibiotics.

(65%) venous anastomosis. Median operation time was 400 minutes [IQR 315, 499]. Ischemia time was available for 83 free flaps with median of 86.5 minutes [IQR 75, 110]. Post-operatively, patients were transferred to ICU for regular clinical flap assessment augmented by implantable venous Doppler monitoring.

Free flap outcomes

Recipient site comprised 54.0% oral cavity, 9.0% cutaneous, 8.5% sinonasal, 8.0% oropharynx, 7.5% hypopharynx, 6.5% larynx, and 6.5% others. See *Table 2* for primary tumour site details. The majority (66.0%) of the patients had radial forearm free flap, followed by 21.5% anterior lateral thigh (ALT) free flap, 9.0% fibular free flap, and 3.5% others. Number of cases for each type of flap are outlined in *Table 3*.

Table 2 Recipient site

Recipient site	N (%)
Oral cavity	108 (54.0)
Tongue	50
Floor of mouth	20
Mandible	15
Buccal mucosa	10
Hard palate	7
Retromolar trigone	6
Cutaneous	18 (9.0)
Cheek	15
Scalp	1
Maxillary	1
Nasal	1
Sinonasal	17 (8.5)
Oropharynx	16 (8.0)
Tonsil	8
Oropharynx	4
Soft palate	2
Tongue base	2
Hypopharynx	15 (7.5)
Larynx	13 (6.5)
Parotid	6 (3.0)
Ear	5 (2.5)
Orbit	2 (1.0)

Of the 200 free flap reconstructions, 197 (98.5%) survived resulting in an overall free flap failure rate of 1.5%. Of the three free flaps, the timing of failure was at two, five and eight days post-operatively. Two were laryngopharyngeal reconstruction cases which failed due to thrombus within recipient vein and infection. One was a lip split oropharyngectomy case pedicled to the external jugular vein, which became compressed in the superficial course. Attempts with revision of venous anastomosis were unsuccessful, and the patient was taken back to theatre for salvage flap on day five post-op. One flap loss was salvaged with an ALT free flap and two were salvaged with

Table 3 Donor site complications

Complication	RFFF (n=132)	ALTFF (n=43)	FFF (n=18)	TFFF (n=4)	UFFF (n=1)	VLFF (n=1)	MTPFF (n=1)
Bleeding/haematoma	2 (1.5%)	1 (2.3%)	0	0	0	0	0
Infection	4 (3.0%)	1 (2.3%)	1 (5.6%)	0	0	0	0
Dehiscence	1 (0.8%)	1 (2.3%)	0	0	0	0	0
Seroma	2 (1.5%)	4 (9.3%)	0	0	0	0	0

RFFF, radial artery forearm free flap; ALTFF, anterolateral thigh free flap; FFF, fibula free flap; TFFF, temporoparietal fascia free flap; UFFF, ulnar artery forearm free flap; VLFF, vastus lateralis free flap; MTPFF, medial thigh perforator free flap.

Table 4 Flap compromise/failure characteristics

Patients	Age, years	Primary tumour	Free flap type	Failure/compromise	Timing (days)	Reason for failure/compromise	Salvage procedure
1	50	Hypopharynx	ALT	Failure	8	Infection, necrotic flap	PM flap
2	57	Larynx	ALT	Failure	2	Venous thrombosis	PM flap
3	53	Oropharynx	RFFF	Compromise	2	Anatomical compression	Revision of anastomosis
				Failure	5	Venous thrombosis	ALT flap
4	64	Larynx	ALT	Compromise	3	Compression by hematoma	Evacuation of hematoma
5	41	Sinonasal	ALT	Compromise	<1	Arterial thrombosis	Revision of anastomosis
6	41	Tongue	RFFF	Compromise	4	Venous thrombosis	Revision of anastomosis
7	71	Buccal	RFFF	Compromise	<1	Venous thrombosis	Revision of anastomosis
8	59	Retromolar trigone	RFFF	Compromise	<1	Venous thrombosis	Revision of anastomosis
9	72	Cheek	ALT	Compromise	<1	Twisted pedicle	Revision of anastomosis

ALT, anterolateral thigh; PM flap, pectoralis major flap; RFFF, radial artery forearm free flap.

regional pectoralis major flaps. See *Table 4* for flap failure/compromise characteristics.

Nineteen (9.5%) cases required a return to theatre. Eight (4.0%) of these were for anastomosis revision with a mean return to theatre at 37 hours post-operatively (range, 8.5–96 hours), six (3.0%) were for post-operative bleed or hematoma evacuation (five recipient site and one donor site), three (1.5%) were for debridement of recipient site infection. Two (1.0%) return to theatre cases were unrelated to post-operative complications, that being they returned for further surgery in the form of a contralateral neck dissection and further margin resection based on primary tumour characteristics.

There was a statistically significant association between flap failure and operation time (P=0.0213) albeit the overall effect was small [odds ratio (OR) 1.0065, 95% CI: 1.0010–1.0121]. Age (P=0.09), gender (P=0.99), BMI (P=0.31), ASA status (P=0.37), smoker status (P=0.85), co-morbidities (P=0.61–1.00), intra-operative ischemia time (P=0.44), post-operative haemoglobin drop (P=0.76), and number of venous anastomoses (P=0.29) were not associated with flap failure (Table S1).

Free flap recipient site complications

Free flap recipient site complications included infection (5.5%), hematoma/bleed (5.5%), dehiscence (2.5%), salivary fistula (2.0%), and seroma (1.5%). Infections were managed with washout in theatre in three cases, and antibiotics in eight patients. Hematoma/bleed cases were managed with ultrasound guided aspiration in one patient, conservative management in five, and the evacuation of hematoma in theatre in five patients. Wound dehiscence was managed operatively in one patient who developed a pharyngeal defect with pharyngocutaneous fistula. One patient with a salivary leak received Botox injections. Others were managed with surgery (two patients) and medical management (one patient). One patient with seroma had

Table 5 Recipient site complications

Complication	Patients (n=200)
Infection	11 (5.5%)
Hematoma/bleed	11 (5.5%)
Dehiscence	5 (2.5%)
Salivary fistula	4 (2.0%)
Seroma	3 (1.5%)

aspiration and two resolved with observation. Number of recipient site complications are shown in *Table 5*.

Free flap donor site complications

Free flap donor site complications are outlined in *Table 3*. Five patients had chyle leaks. Univariate binary logistic regression analysis showed a statistically significant association between donor site complication and ASA status. With every unit increase in ASA status, the odds of having a donor site complication increase by 3.8 times (P=0.0026). Patients with chronic obstructive pulmonary disease (COPD) were 3.4 times more likely to have a donor site complication compared to those without COPD (OR 3.409; 95% CI: 1.16–10.01; P=0.0257) (Table S2).

Medical complications in patients undergoing free flap reconstruction

Eighty-one (40.5%) patients experienced one or more inpatient medical complications. Twenty-three (11.5%) had pneumonia, 12 (6.0%) developed delirium, 12 (6.0%) had electrolyte disturbances, 9 (4.5%) had fluid overload, 8 (4.0%) had post-operative anaemia requiring transfusion, 6 (3.0%) had liver enzyme derangements, 4 had venous thromboembolism, arrhythmias, alcohol withdrawal and deconditioning requiring transfer to rehabilitation, 3 (1.5%) had myocardial infarctions and acute urinary retention, 2 (1.0%) had *Clostridium difficile* colitis, 1 (0.5%) had a cerebrovascular accident and 1 (0.5%) had surgery aborted for pneumomediastinum and bilateral pneumothoraces. There was a statistically significant relationship between ASA status and medical complications (OR 2.7; 95% CI: 1.6–4.5; P=0.0002). With every unit increase in ASA status, patients were 2.7 times more likely to develop a medical complication. Patient comorbidities showed no statistically significant association with medical complications (P=0.09–0.92). See Table S3 for univariate regression results.

Length of stay

Median length of ICU admission and hospital admission were 4 days [IQR 2, 6] and 13 days [IQR 10, 18] respectively. There was a variation in length of ICU stay between patients operated in private hospital and public hospital. Median ICU length of stay for private hospital patients was 5 days [IQR 4, 6] and 1 day [IQR 1, 2] for public hospital patients.

Univariate analysis indicated smoking status (P<0.001), flap area (P=0.01), and operation time (P<0.001) were associated with increased hospital length of stay. Non-smokers and ex-smokers had average length of stay of 5 days less (mean difference =−5; 95% CI: −7.5 to −2.5, P=0.0001) and 2.6 days less (mean difference =−2.6; 95% CI: −5.1 to −0.03; P=0.0473) respectively than active smokers. With every 10 cm^2 increase in flap area, the mean length of stay increased by 0.44 days (mean difference =0.044; 95% CI: 0.008–0.081, P=0.01).

Multivariate analysis of length of stay against various predictors showed statistically significant association between length of stay and hypertension, operation time, ICU length of stay adjusting all other predictors in the model (*Table 6*).

Discussion

This manuscript describes our experience in transitioning to a single-service ablative and reconstructive head and neck surgery service at the RAH. Intuitively we know there are benefits of a single surgical team performing a patient's surgery. Our results confirm that this transition can occur without compromising patient outcomes by demonstrating that the primary outcome measure of flap survival (98.5%) is well within internationally accepted standards (10,11,14).

Microvascular reconstruction of complex surgical defects, including those in the head and neck, have traditionally been performed by the plastic and reconstructive specialty, primarily because the surgical techniques were pioneered within that specialty. Since the first free flaps were performed in the 1970s there has been an explosion of knowledge around flap physiology, microvascular techniques and donor site capabilities in addition to technical advances that have dramatically improved expected flap survival outcomes (15,16). In recent years, internationally, there has been a shift away from this paradigm with now multiple surgical specialties, including general surgery, orthopedics and otolaryngology, all performing free tissue transfer (14,17).

Table 6 Multivariable linear regression models of length of stay versus various predictors

Predictor	Comparison	Mean difference	95% CI		Global P value
			Lower limit	Upper limit	
Hypothyroidism	No *vs.* yes	2.2176	−0.9550	5.3903	0.1707
Hypertension	No *vs.* yes	−2.0612	−3.7493	−0.3732	0.0167
BMI	Per 1 unit increase	−0.1402	−0.2910	0.0107	0.0686
Operation time	Per 10 minutes increase	0.2206	0.1573	0.2840	<0.0001
Duration perioperative antibiotics	Per 1 day increase	0.2975	−0.0826	0.6776	0.1250
Days in ICU	Per 1 day increase	0.6049	0.2683	0.9416	0.0004

CI, confidence interval; BMI, body mass index; ICU, intensive care unit.

The RAH OHNS Unit is the largest tertiary referral centre covering South Australia and the Northern Territory. Traditionally, ablative surgery has been performed by the otolaryngology service and reconstruction by the plastic surgical service. In 2015, this changed to a single unit model where otolaryngology head and neck surgeons commenced performing their own reconstructions.

There are several benefits for a patient having their entire care managed by a single surgical team. Firstly, the patient can meet their ablative surgeon and reconstructive surgeon in a single clinic appointment and be informed regarding the entirety of their surgical procedure in the one visit. This promotes consistency of information and understanding for the patient, as well as ensuring all members of the surgical team contribute to and agree upon the surgical plan. Through this process, booking of surgical time can be stream-lined and post-operative care simplified through a more direct hierarchy of decision-making within the one team. This can have beneficial effect on both time-to-treat metrics and post-operative patient care.

The development of a single service head and neck team was not without its barriers. It challenges dogma about who should perform certain surgical procedures, especially those that cross traditional specialty divisions. This is reflected in the slow increase in flap numbers in the initial years of this process. The issues around quality assurance, decision-making and outcomes were ever-present during this transition. The success of the service was ensured primarily through the appointment of three fellowship-trained microvascular reconstructive surgeons (A.F., S.B., R.V.) into a supportive otolaryngology team environment. Bringing together a range of skills from high volume fellowship programs ensured at least equivalent outcomes were maintained and support in the pre-operative, intra-operative and post-operative decisions was available throughout the learning curve for each surgeon.

Whilst this study confirms single service head and neck reconstruction is a feasible and efficacious practice model, the data is not without limitations. The retrospective nature of the analysis prevents the evaluation of a matched comparison group. Furthermore, operative time, ischemic time and other variables were not always accurately recorded and long-term follow-up was not included. Nevertheless, the equivalence of this model in terms of outcomes is clear when compared to international standards. When coupled with the multiple patient benefits already discussed, our data demonstrates useful information for any department planning to make this same transition.

Surgical complications

Free flap failure is a challenging complication with limited data on predictors. Operation time was the only predictor identified in our study. Most results did not converge due to small number of failures. In our study, we found that laryngopharyngectomy comprised of two-thirds of failures, despite hypopharynx/larynx cases forming small percentage of our cohort. One possible explanation may be the intrinsically complex and lengthy reconstruction required for laryngopharyngectomies compared to other cases.

On a multi-institutional review (18) of 188 free flap failures, the most common cause of flap failure was arterial thrombus, followed by venous and combined arterial/venous thrombus. Another study by Corbitt *et al.* (10) presented infection, problem with flap design, pedicle compression, kinked pedicle, hemorrhage and hypercoagulable disorder as causes of flap loss. In our experience, the most common reason for flap failure/compromise was venous thrombosis (55.5%). Cases of failure due to vein thrombosis were in flaps inset with single vein anastomosis.

Of the recipient site complications, there were two cases which compromised flaps. One case of hematoma which compressed the anastomosis and another case of infection causing necrosis of flap. No other surgical complications affected flap viability.

The overall success rate of free flap reconstruction in our cohort was 98.5% for primary flaps and 100% for second flaps. Our results for single salvage free flap are well within the accepted international standard for primary flaps (7-11) and are similar to the salvage rate of 92–100% for second free flap described in the literature (10,11,18). These findings support the safety of free flap reconstruction in head and neck cancer patients, and assure that salvage flap is an feasible option even in cases of flap compromise or failure.

Medical complications

Our cohort represents a group of patients of high surgical risk with multiple comorbidities (*Table 1*). Majority (64.0%) of the patients had ASA of III–IV. This is reflected on our medical complication rate of 40.5% following surgery. Our results showed strong association between ASA status and medical complications with 2.7 times increase in risk of complications with each unit increase in ASA status.

Mean ICU length of stay was 4 days, which is longer than the cases described in the literature (14). This was due to varying length of stay between the Memorial Hospital and the RAH with differing local practice; where patients treated in private hospitals are required to remain in ICU whilst tracheostomy tube is *in situ*.

Radiotherapy (19) and age (20) has been described as factors contributing to flap failure in the literature. In our cohort, we were unable to determine if radiotherapy affected failure rates due to the small number of flap failures. American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) can assist with discussion around decision making for patients (21). This forms a useful tool for discussion and informed consent.

Conclusions

Head and neck surgical oncology is a complex area of surgery where ablative defects significantly impact important bodily functions and often detrimentally alter cosmesis as well. The complexity is present for both the patient and the surgical team. We have presented data that confirms transitioning to a single-service head and neck surgical solely within the OHNS Unit is obtainable whilst maintaining internationally recognized standards and potentially affording patients' multiple benefits in the process.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://www.theajo.com/article/view/10.21037/ajo-23-16/rc

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Central Adelaide Local Health Network Human Research Ethics Committee (EC00192) (Reference Number 14185). Due to the low-risk nature of the study, the ethics committee approved the waiver of individual consent in this project.

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Supplementary

Table S1 Univariate binary logistic regression models of primary outcome: flap failure versus various predictors

Predictor	Comparison	Odds ratio[†]	95% CI		Comparison P value	Global P value
			Lower limit	Upper limit		
Gender	Female *vs.* male	2.18E−11	Did not converge			0.9999
AJCC staging	1 *vs.* 2	8.3E−12	Did not converge		>0.9999	<0.0001
	1 *vs.* 3	3.27E−12	Did not converge		>0.9999	
	1 *vs.* 4	1.0002	Did not converge		>0.9999	
	2 *vs.* 3	0.3936	0.03435	4.5106	0.4537	
	2 *vs.* 4	1.206E−11	1.052E−10	1.381E−12	<.0001	
	2 *vs.* 5	3.063E−11	3.063E−11	3.063E−11		
Smoker	Non *vs.* ex	0.9494	0.05833	15.4530	0.9709	0.8494
	Non *vs.* current	0.4810	0.02929	7.8997	0.6083	
	Ex *vs.* current	0.5067	0.03084	8.3249	0.6340	
Preoperative radiotherapy[§]						Did not converge
COPD asthma	Asthma *vs.* COPD	Did not converge			>0.9999	>0.9999
	Asthma *vs.* no asthma				>0.9999	
	COPD *vs.* no COPD				0.9999	
Diabetes	No *vs.* yes					Did not converge
Ischaemic heart disease	No *vs.* yes					Did not converge
Hypertension	No *vs.* yes	1.8447	0.1646	20.6742		0.6195
Dyslipidaemia	No *vs.* yes					Did not converge
Liver disease	No *vs.* yes					Did not converge
Age		0.9309	0.8570	1.0111		0.0895
BMI		0.8825	0.6947	1.1209		0.3056
ASA status		2.3888	0.3587	15.9083	.	0.3680
HbA1c						>0.9999
Operation time		1.0065	1.0010	1.0121		0.0213
Intraoperative ischaemic time		1.0207	0.9686	1.0755		0.4437
Number venous anastomoses		0.2674	0.02382	3.0022		0.2851
Post-op Hb drop		1.0106	0.9437	1.0822		0.7636
Duration perioperative antibiotics		1.2624	0.9451	1.6862		0.1146

[†], modelling the probability of flap failure or compromise = yes. [§], radiotherapy to operative site.

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Table S2 Univariate binary logistic regression models of secondary outcome: donor site complication versus various predictors

Predictor	Comparison	Odds ratio[†]	95% CI		Comparison P value	Global P value
			Lower limit	Upper limit		
Gender	Female *vs.* male	0.5701	0.1812	1.7936		0.3366
AJCC staging[‡]	1 *vs.* 4	0.229	0.011	4.688	0.2500	0.6432
	2 *vs.* 4	1.419	0.378	5.327	0.3066	
	3 *vs.* 4	1.423	0.354	5.714	0.3240	
Smoker	Non *vs.* ex	0.9452	0.3152	2.8342	0.9199	0.7678
	Non *vs.* current	0.6521	0.1930	2.2035	0.4913	
	Ex *vs.* current	0.6899	0.2039	2.3341	0.5505	
Preoperative radiotherapy[§]		0.5459	0.1667	1.7881		0.3173
COPD/asthma	Asthma *vs.* COPD	0.3667	0.03884	3.4618	0.3811	0.0822
	Asthma *vs.* no asthma	1.2500	0.1474	10.6038	0.8379	
	COPD *vs.* no COPD	3.4091	1.1608	10.0117	0.0257	
Diabetes	No *vs.* yes	0.5091	0.1699	1.5258		0.2280
Ischaemic heart disease	No *vs.* yes	0.6532	0.2015	2.1178		0.4780
Hypertension	No *vs.* yes	1.0175	0.3950	2.6215		0.9713
Dyslipidemia	No *vs.* yes	2.9630	0.8322	10.5490		0.0936
Liver disease[‡]	No *vs.* yes	0.321	0.003	30.196		0.6238
Age		1.0049	0.9657	1.0458		0.8085
BMI		0.9777	0.8955	1.0674		0.6144
ASA status		3.8191	1.5972	9.1317		0.0026
HbA1c		0.7839	0.2043	3.0076		0.7227
Flap area		1.0063	0.9903	1.0226		0.4405
Operation time		1.0010	0.9978	1.0042		0.5544
Intraoperative ischaemic time		1.0019	0.9770	1.0273		0.8839
Number venous anastomoses		0.2159	0.07813	0.5965		0.0031
Duration perioperative antibiotics		0.9059	0.7146	1.1484		0.4141

[†], modelling the probability of donor site complication = yes. [‡], firth correction used. [§], radiotherapy to operative site.

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Table S3 Univariate binary logistic regression models of primary outcome: medical complication versus various predictors

Predictor	Comparison	Odds ratio†	95% CI		Comparison P value	Global P value
			Lower limit	Upper limit		
Gender	Female *vs.* male	0.6955	0.3672	1.3172		0.2651
AJCC staging final	1 *vs.* 2	0.6667	0.2215	2.0062	0.4707	0.3908
	1 *vs.* 3	0.5952	0.1919	1.8466	0.3691	
	1 *vs.* 4	0.4167	0.1431	1.2130	0.1083	
	2 *vs.* 3	0.8929	0.3675	2.1694	0.8024	
	2 *vs.* 4	0.6250	0.2794	1.3981	0.2526	
	3 *vs.* 4	0.7000	0.3003	1.6316	0.4088	
Smoker	Non *vs.* ex	0.4894	0.2492	0.9610	0.0380	0.0665
	Non *vs.* current	0.4606	0.2059	1.0306	0.0592	
	Ex *vs.* current	0.9412	0.4316	2.0525	0.8789	
Preoperative radiotherapy§		0.5718	0.2525	1.2948		0.1801
COPD/asthma	Asthma *vs.* COPD	1.2000	0.2962	4.8616	0.7984	0.0992
	Asthma *vs.* no asthma	2.4679	0.7204	8.4549	0.1505	
	COPD *vs.* no COPD	2.0566	0.9147	4.6242	0.0811	
Diabetes	No *vs.* yes	0.5456	0.2568	1.1593		0.1151
Ischaemic heart disease	No *vs.* yes	0.7552	0.3463	1.6470		0.4804
Hypertension	No *vs.* yes	0.6999	0.3930	1.2463		0.2255
Dyslipidemia	No *vs.* yes	0.9713	0.5294	1.7819		0.9250
Liver disease‡	No *vs.* yes	0.186	0.002	17.585		0.4867
Age		1.0182	0.9934	1.0437		0.1522
BMI		0.9567	0.9068	1.0093		0.1052
ASA status		2.6908	1.6099	4.4977		0.0002
HbA1c		0.4499	0.1420	1.4254		0.1746
Flap area		1.0019	0.9906	1.0133		0.7457
Operation time		1.0012	0.9992	1.0033		0.2305
Intraoperative ischaemic time		1.0138	0.9984	1.0294		0.0798
Number venous anastomoses		0.6158	0.3394	1.1175		0.1108
Post-op Hb drop		0.9898	0.9725	1.0075		0.2571
Duration perioperative antibiotics		0.9254	0.8076	1.0604		0.2645
Days in ICU		1.1047	0.9894	1.2335		0.0767

†, modelling the probability of medical complication = yes. ‡, firth correction used. §, radiotherapy to operative site.

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