Microvascular reconstruction outcomes from a New Zealand Oral and Maxillofacial Surgery Unit

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ABSTRACT

AIM: The Oral and Maxillofacial Surgery (OMS) Department at Waikato District Health Board (WDHB) is the only current OMS unit within New Zealand to reconstruct oral cavity defects with microvascular free flaps. The primary objective of the study was to retrospectively analyse the demographics, outcomes and complications of free flap surgery patients at WDHB.

METHOD: An OMS reconstruction database was developed and data collected retrospectively. Seventy-five free flaps were performed on 74 patients between 2012 and 2020.

RESULTS: There were 34 females and 40 males, with a mean and median age of 62 and 64 respectively. The tongue was the most common site of resection, and squamous cell carcinoma was the most frequent diagnosis. The radial forearm free flap was used most often followed by the fibula and anterolateral thigh flaps. The Clavien–Dindo classification was used to classify complications, with 10 patients having "major" complications and 34 patients having "minor" complications.

CONCLUSION: Flap success rate was 98.7%, which meets internationally accepted standards of care.

The Oral and Maxillofacial Surgery (OMS) department at Waikato District Health Board (WDHB) is unique, as it is the only OMS unit in New Zealand to independently reconstruct oral cavity defects with microvascular free flaps. This unit has been reconstructing major oral cavity defects since 2012 with fasciocutaneous radial forearm, composite fibula, and anterolateral thigh free flaps (ALT). There is no study to date that analyses the demographics, complications or outcomes of patients who have undergone free flap reconstruction surgery within the OMS speciality in New Zealand.

Reconstruction of oral cavity defects poses many challenges. The overall aims are to restore orofacial function and aesthetics, while improving, or maintaining, a patient's quality of life. It has been shown that free tissue transfers can assist with achieving these goals. As such, microvascular free flaps have become the "gold standard" for reconstructing large head and neck defects. Complications can occur and are often associated with a high level of morbidity or even mortality.[1–3] In general, free flap reconstruction in the overall head and neck region have good outcomes with reports of success rates ranging between 90–98.8%[4] while the reported complication rate can range from 34–85%.[5] Specific data on oral cavity free flap reconstruction outcomes in New Zealand are limited.

The primary objective of this study is to retrospectively provide an overview of complications and outcomes of patients who underwent free flap reconstruction by the OMS Department at WDHB (Hamilton, New Zealand). This information can then be compared with national and international results to ensure an adequate level of patient care is being provided, while contributing to scarce data for head and neck reconstruction in New Zealand. It will also serve as a valid baseline for further local research endeavours.

Method

The study was accepted and registered with the WDHB Research Committee, and local Māori consultation was completed. Health and Disability Ethics Committee approval was also obtained.

Patients were identified through past head and neck multidisciplinary team meetings and then confirmed with the yearly logbooks from 2012–2020. Patients were included if they had a free flap transfer for reconstruction of an oral cavity defect by the OMS team only. A total of 74 patients were identified and included.

A database was created that incorporated entry points similar to other major head and neck units. Standardised de-identified data collection was

then retrospectively collected for each patient by analysing their electronic and hard-copy notes. This included demographics, diagnosis, past medical history, laboratory results, surgery details and post-operative outcomes and complications. Demographics included gender, address, ethnicity, date of surgery, age at surgery, smoking and alcohol history as well as medical history. Blood results such as albumin, inflammatory markers and C-reactive protein were collected pre- and post-operatively. Other data points collected included the requirement for a tracheostomy, gastrostomy, transfusion, vasopressor and length of hospital stay. Hospital stay was then subcategorised into length of stay in the intensive care unit (ICU), high dependency unit (HDU) and the inpatient ward. Information about the patient's discharge location was also recorded.

The Clavien–Dindo[6] classification was used to classify complications during the post-operative inpatient stay. Complications scoring IIIb or higher were considered major complications with all others considered minor. All data points were verified independently by two clinical staff members of the OMS department.

Statistical analysis was performed with Microsoft Excel 2016 (Microsoft, Redmond, WA, USA), and multivariate statistical analysis was carried out using a licensed version of SPSS Statistics for Windows (version 25.0, Armonk, NY: IBM Corp). Any variable with a p-value of less than 0.05 was considered statistically significant. For categorical variables, Pearson's Chi-squared test was used as appropriate.

Results

A total of 75 free flap reconstructions were completed on a total of 74 patients between 2012 and August 2020 (Figure 1). There were 51 (68%) radial, 22 (29.3%) fibula and 2 (2.7%) ALT microvascular free flaps performed (Figure 2). One patient received two free flaps during one surgery, a fibula and a radial forearm flap, to treat an extensive squamous cell carcinoma involving both the lower lip and mandible.

The study population comprised 34 (46%) females and 40 (54%) males with a mean age of 61.9 years. Fifty-eight (78.4%) of the patients were NZ European, 11 (14.9%) were NZ Māori. Of the remaining ethnicities, 3 (4.1%) were Asian, 1 (1.4%) was Cook Island, and 1 (1.4%) was Latin American/Hispanic. The mean body mass index (BMI) for the group was 27.4.

The primary diagnosis requiring resection was squamous cell carcinoma (SCC) consisting of 56 (75.7%) patients followed by 11 (14.9%) with other malignancies, 5 (6.8%) ameloblastomas and 2 (2.7%) cases of osteomyelitis/osteoradionecrosis of the jaw. Anatomical sites resected and then reconstructed are demonstrated in Figure 3. 20 of the 74 (27%) patients had had previous surgery to the head and neck region and 12 had previous radiotherapy.

A temporary surgical tracheostomy was conducted in 44 (59.5%) patients; the remainder (30 patients) had nasal endotracheal tubes. 23 of these patients (77%) were extubated at the end of the case, and 7 patients (23%) spent at least one night intubated in ICU. Tracheostomy patients had a longer total inpatient stay than patients that did not (16 days compared with 11 days, $p<0.001$). Although tracheostomy patients had more complications ($p=0.008$), there was no statistical significance ($p=0.566$) when comparing tracheostomy versus no tracheostomy free flap outcomes overall.

Nutrition was managed with a pre- or post-operative gastrostomy in 23 patients. The other 51 patients had a fine bore feeding nasogastric tube placed at time of surgery for temporary nutritional support, and transitioned to an oral diet when able.

Sixty-six patients were discharged from hospital directly to their residence while two required rehabilitation prior to hospital discharge. Six patients were discharged to convalescence care in their local hospitals due to the relatively isolated geographical location of their residence.

Twenty-seven (36.5%) patients received a transfusion during their inpatient stay, and 15 (16.2%) patients required a vasopressor agent post-operatively to meet haemodynamic targets. The most commonly used vasopressor agent was phenylephrine (n=12).

Using the Clavien–Dindo Classification, 10 (13.5%) patients had a score of IIIb or more as seen in Table 1. These patients required an unexpected return to theatre during their inpatient stay, and thus were classified as having had a "major" complication. Two patients were taken back to theatre more than once. The reasons for returning to theatre included: reanastomosis or clot removal (n=4), post-operative infection (n=2), haemorrhage (n=2), failed extubation requiring surgical tracheostomy (n=1), debridement of skin paddle (n=1), and total flap failure (n=1).

A total of 34 patients (45.9%) had minor complications and 30 (40.5%) had no complications

Figure 1: Number of free flaps performed per year.

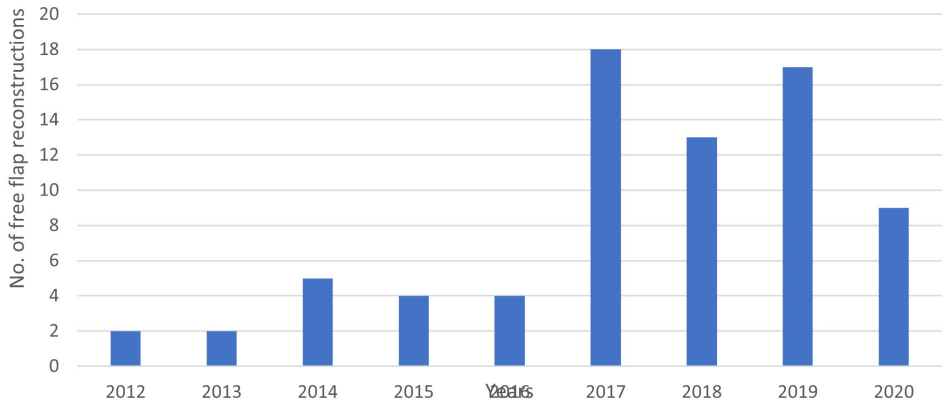

Figure 2: Types of free flap reconstructions.

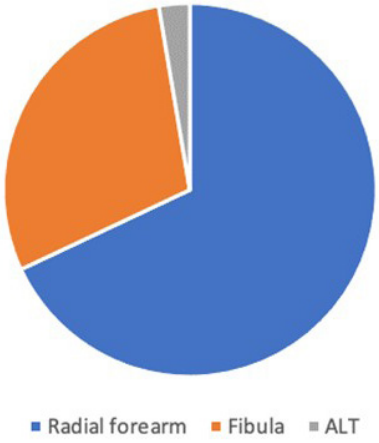

Figure 3: Site of resections.

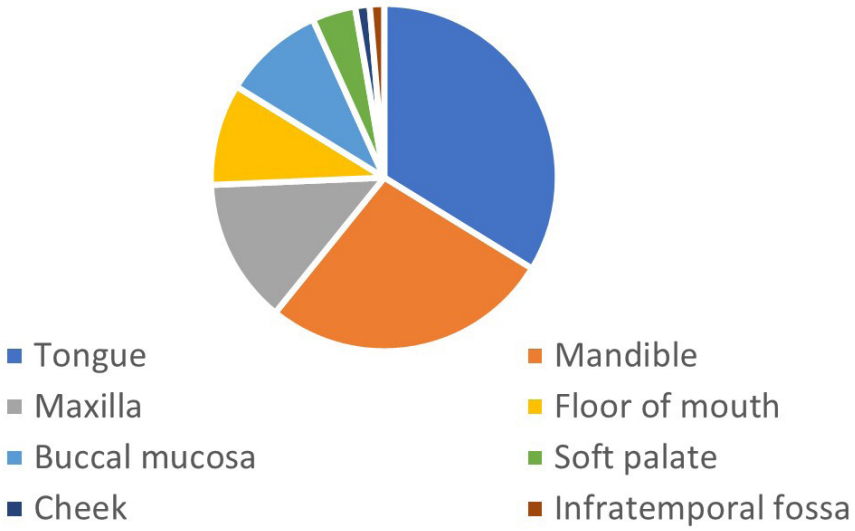

Table 1: Summary table of outcomes of free flap reconstruction.

Complications	Cases	Percentage (%)
None	30	40.1
Clavien–Dindo I	1	1.4
Clavien–Dindo II	25	33.8
Clavien–Dindo IIa	8	10.8
Clavien–Dindo IIb	10	13.5
Flap success	73	98.6
Flap failure	1	1.4

(Table 1). Minor infection was the most common minor complication (n=6). Treatment for minor infection was debridement, drainage and/or aspiration under local anaesthetic. Debridement of a non-viable portion of the flap under local anaesthetic was the next most common minor complication (n=2).

The most common minor complications requiring medical management were low post-operative blood pressure requiring vasopressor support, post-operative anaemia requiring red blood cell transfusion, pneumonia, delirium and fluid overload.

Radial forearm free flaps were complicated occasionally by venous congestion requiring thrombus evacuation and reanastomosis (n=4). This was followed by infection (n=2), tracheostomy site bleed (n=2) and neck haematoma (n=1). One patient had a bleed from the tracheostomy site as well as venous congestion, requiring two separate returns to theatre.

There were only two major postoperative complications in patients receiving a fibula free flap. These were infection requiring incision and drainage of a collection in the neck and one case of venous congestion requiring reanastomosis.

To date, five free flaps have had partial flap loss and one complete flap failure. Partial flap loss in four cases was due to partial or complete loss of the skin paddle and the other was due to an internal jugular vein thrombosis. This occurred in 9% (n=2) of fibula, 2% (n=1) of radial forearm free flaps, and in one ALT free flap. The only complete flap loss was in a fibula in a smoker with an infected, pathological mandibular fracture secondary to osteoradionecrosis, and who had previously undergone a radial forearm free flap for reconstruction of a tongue SCC. This was also the only free flap used for a salvage.

When comparing the three different free flaps, ALT flaps had to be excluded due to numbers, which meant a meaningful comparison for that group could not be produced. Radial and fibula free flaps complications were compared and there was no statistical significance between groups.

Discussion

The Waikato OMS Unit in New Zealand provides an independent microvascular free flap reconstructive service for the reconstruction of complex maxillofacial defects. The unit services a population of over 930,000 covering the large geographical midland region. The 14.9% of patients who identified as NZ Māori is representative of New Zealand's population and the population included in recently published New Zealand head and neck literature.[3,7]

An adequate number of procedures is required to ensure surgeons, theatre and ward staff are familiar with the peri-operative, intra-operative and post-operative cares required. Previous research has suggested that an increased number of cases correlates with a decrease in the number of post-operative complications and more successful outcomes for patients.[8] Since 2012 the number of free flaps per year has increased, particularly since 2017, when a second OMS surgeon started (Figure 1), and although numbers are small currently there appears to be a proportionately lower number of complications thus far.

International literature shows that the success rate of free flap transfers varies from 90% to 98.8%.[4,8–10] WDHB OMS results are at the upper limit of that range with a success rate of 98.7%.

Published data regarding head and neck free flaps from New Zealand is scarce. Results from Hutt Hospital (Wellington, New Zealand) in 2010 suggest that outcomes from Waikato OMS unit are comparable. Their overall success rate was 93.7%, however, the study was not limited to head and neck reconstructions. Six out of 13 flap losses were in head and neck cases. [11] A more recent New Zealand study focusing on head and neck reconstructions had an unexpected return to theatre rate of 13% and an overall success rate of 96.6%, which are both similar to the outcomes found in this study.[3]

The Clavien–Dindo classification of surgical complications can be readily applied to study populations, and aids future research by providing a useful objective outcome measure.The major complication rate (Clavien–Dindo IIIb) was lower (13%) when compared with a similar study that used the same classification system and found that 32% of patients had a major complication.[8] Reasons for this could include patient selection, a multidisciplinary approach during treatment planning and the use of a small, regular and specialised surgical, nursing and post-operative care team.

Research suggests that age, BMI, ASA, Kaplan–Feinstein Index, pre-existing hypertension, pre-operative low haemoglobin and tracheostomy were independent predictors of major complications.[13] Our results suggest that having a tracheostomy was the only statistically significant predictor of complications including an unexpected return to theatre, post-operative pneumonia and a longer inpatient stay. This is consistent with other studies comparing patients that underwent free flap reconstruction with a tracheostomy versus endotracheal tube.[14]

Multiple variables including surgical defect size and composition, function and surgeon familiarity are considered when deciding on a donor site.[15,16] The radial forearm free flap was the most popular flap used in the study for reconstructing oral cavity defects, likely due to its predictability, long pedicle and the diameter of the vessels.[1,9] The literature shows that the radial forearm is the most commonly used flap for oral cavity reconstruction as it is also extremely reliable and consistent, and has the ability to be concurrently harvested using a two-team approach.[17–19] The most frequent complication requiring a return to theatre associated with this flap in this study was venous congestion. The most common major complication of the WDHB fibula free flaps was a partial loss of the skin paddle, although this did not affect the patient's long-term outcome. This again is consistent with the literature, with other studies reporting a significant rate of skin paddle loss from fibula free flaps of approximately 10%.[9,20] ALT free flaps could not be properly compared as there were only two, partially due to patient body habitus and slightly reduced predictability compared with the radial forearm free flap.[9]

Research suggests that administering heparin intra-operatively and post-operatively is associated with decreased venous thrombosis without the increased risk of haematoma.[21–23] Since the OMS department started routinely using 5000u of subcutaneous heparin intra-operatively there have been no cases of venous congestion or skin flap failures. Due to the small numbers, no statistical significance could be found; however, the department will continue to monitor this area in the future. Studies also found longer ischaemic times were associated with flap failures. Unfortunately, this data wasn't accurately recordable retrospectively, but is a data point that will be added for future patients.[24]

The major limitation of this study was its retrospective nature, but a live database has been developed for future prospective research to improve the quality of data collection and patient outcomes.

Conclusion

The OMS unit at WDHB provides a comprehensive maxillofacial free flap reconstruction service for patients who require significant head and neck resections. The demographics of patients within this study is similar to that of other free flap reconstruction studies, and in general appears to reflect the make-up of the New Zealand population.

The overall success rate of free flap transfers within the department is 98.7%, confirming that free flaps by the OMS department are extremely reliable in achieving successful reconstruction of oral cavity defects.

The study confidently concludes that both minor and major complications rates are low, and the overall success rate is high.

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