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# Microvascular free flaps in head and neck surgery

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**Abstract**

This study is a retrospective review of 60 patients who had microvascular free flap reconstructions in the head and neck region. They were all performed over a 10-year period by a single surgeon. The series includes a wide range of flap types and analyses pre-operative risk factors for flap failure as well as complications and outcome. Smoking and advanced age did not appear to prejudice flap survival but peripheral vascular disease, cardiac disease and alcohol withdrawal were found to increase the likelihood of flap failure. The most frequent complications encountered were thrombosis of one of the anastomosis and haematoma. The most successful flap in terms of survival and function was the fasciocutaneous radial forearm flap. The literature is reviewed in relation to the general principles of microvascular free flap surgery and the results of this series are placed in context.

**Key words: Surgical flaps, microvascular; Head and neck, surgery, complications**

## Introduction

Reconstruction following radical head and neck surgery for cancer was limited in scope for many decades when large volumes of tissue could only be introduced with tube pedicles. Research into the concept of vascular territories being served by a single arteriovenous system led to the identification of axial pattern flaps (McGregor, 1973). The first axial pattern flap described was the groin flap (Smith *et al.*, 1972), but other flaps previously described including the deltopectoral (Bakamjian, 1965) and the forehead (Hoopes and Edgerton, 1966) were then recognized as having an axial pattern basis. These pedicled flaps together with the pectoralis major flap, (Ariyan, 1979) provided a great advance for head and neck reconstruction.

The concept of free tissue transfer was first described by Carrel (1908). The earliest successful clinical application was for primary oesophageal reconstruction using free vascularized jejunum by Seidenberg *et al.* (1959). The first successful anastamoses of small blood vessels using an operating microscope were performed by Jacobsen and Snarez (1960).

Axial pattern flaps were well suited to free tissue transfer and as more flaps were identified and transfer became more reliable partly due to better instruments and improved training (Baker, 1986) their use in head and neck reconstruction increased. A large series using the radical forearm flap, probably still the most commonly used free flap, was published by Soutar and McGregor (1986) although it was originally described in China (Yang *et al.*, 1981). Free osseocutaneous and myocutaneous flaps and combinations of these, some previously described by Harii *et al.* (1976) and Serafin *et al.* (1977) subsequently became more popular.

Table I summarizes the advantages (Zuker *et al.*, 1980; Panje, 1982; Frampton *et al.*, 1986) and disadvantages (Frampton *et al.*, 1986; Soutar, 1989) of microvascular free flaps surgery over other methods of reconstruction for larger defects.

## Patients and methods

Sixty patients who had head and neck microvascular free flaps performed by one surgeon, (M.D.B.) were

TABLE I
ADVANTAGES AND DISADVANTAGES OF MICROVASCULAR FREE FLAPS

| |
|---|
| Advantages |
| Single stage reconstruction |
| Shorter convalescence |
| Effective in poorly vascularized sites e.g. post-radiotherapy |
| Tolerates superficial infection |
| Success rate better than axial flaps |
| Circumferential closure when used intraorally |
| Flexibility of orientation |
| Donor site selected to minimize morbidity |
| Wide range of donor sites |
| More appropriate flap for defect |
| Disadvantages |
| Microvascular equipment and expertise required |
| Long operations |
| Failure is usually total |
| Technique relies on suitable vessels at recipient site |

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reviewed. Details of their pre-operative assessment, operations, post-operative care, including secondary treatment, and post-operative assessment were analysed.

*Pre-operative assessment*

Patients with tumours had the annotion of the primary site, histology, lymph node staging and the exclusion of distant metastases or synchronous tumours assessed. Details of previous radiotherapy and surgery were recorded because of their effect on recipient site vascularity and anatomy respectively. Also noted were the presence of medical conditions which might affect flap survival such as diabetes, smoking status, post-operative alcohol withdrawal symptoms, peripheral vascular disease and cardiac disease. Additional factors of anaesthetic relevance (Inglis *et al.*, 1988) noted were a history of previous chemotherapy, asthma and chronic obstructive airways disease as well as an assessment of the severity of medical conditions and anticipation of difficult intubations.

Investigations included a FBC, clotting screen, U + E's, LFT's and ECG. Diagnostic imaging was tailored to the clinical findings but routinely included a chest X-ray and a barium swallow and upper abdominal ultrasound is appropriate. An OPG was performed if the planned procedure or the pathology involved the mandible. CT and MRI of the head and neck were frequently used. CT of the chest or brain were only carried out if metastases or invasion was suspected at these sites.

After assessment, the most appropriate free flap for reconstruction was chosen, identified and planned in advance of surgery. A laser doppler was often used to identify vessels but arteriography was rarely required for donor or recipient vessels.

*The operation (Baker, 1986)*

A two-team approach was always used one to do the resection and a second to do the reconstruction. The maxillofacial team was frequently involved in cases requiring mandibular reconstruction.

A tracheostomy was performed prior to resection if the airway was likely to be compromised post-operatively.

(1) Resection: when there was doubt about the size of the defect arising from the resection, a final decision as to the most suitable method of reconstruction was left until the latter was complete, despite this prolonging the procedure. When the recipient vessels for the microvascular anastamoses were identified during the resection magnification was used to avoid damage to these vessels. In general the largest available vessels were used. When possible the flap artery or arterial graft was anastamosed end-to-side to the external carotid and the flap vein or venous graft end-to-side into the internal jugular vein or its stump.

The recipient vessels were usually isolated and prepared after the resection had been completed.

(2) Raising the flap (Acland and Flynn, 1978): the flap was marked and measured to fit the defect. After raising the flap the vessels in the pedicle were identified and isolated. The vascular pedicle was made as long as possible and the flap was then left *in situ* attached to its pedicle for at least 10 minutes to confirm its viability.

(3) Microvascular anastomosis (Harii *et al.*, 1974; Panje *et al.*, 1977; Acland and Flynn, 1978; Soutar and McGregor, 1986; Urken *et al.*, 1991): an operating microscope or magnifying loops were always used. Vessels of similar diameter were matched for end-to-end anastamoses. The flaps were not perfused during transfer. Anastamoses were performed with 8/0 or 10/0 nylon, the deeper anastamosis being performed before the more superficial one. Most flaps required only one arterial anastamosis but often more than one venous anastamosis was performed. Vein grafts were used frequently to link the flap artery or vein to a suitable recipient vessel sometimes on the contralateral side of the neck. Care was taken to complete the anastamosis without vessel tension, kinking or twisting. The vascular pedicle was placed in the longitudinal axis of the neck whenever possible.

(4) Closure (Baker, 1986): the flap was normally secured to the defect with a few sutures to establish correct alignment of the vessels for the microvascular anastamosis. When this had been completed the flap was sutured into the defect using a two-layer closure or interrupted mattress sutures for intraoral flaps.

Continuous suction drainage of the defect was used in the neck but the drain had to be kept distant from the vessels and anastamoses. Simple Yates drains were used in the proximity of the anastamosis. As the caudal drainage is on the contralateral side peroperative neck CVP lines should be avoided or if necessary placed ipsilaterally post-operatively, (Meagher *et al.*, 1991).

In most cases the donor defect was closed primarily but occasionally a split skin graft was required. Minimal dressings only were used with micropore or chloramphenicol ointment applied to the flap margins.

*Post-operative care*

Most of the patients were electively ventilated for one night post-operatively in an intensive care unit. Patients were nursed in a neutral position to avoid tension or kinking of the anastamosis i.e. usually lying straight in the bed with slight neck flexion when the anastamosis was in the neck.

Flaps were monitored clinically i.e. by the colour, temperature, turgor and response to pin prick, the most critical period being the first few hours post-operatively. Implantable monitoring devices such as the ultrasonic or laser doppler, temperature, $Po_2$ and, pH probes were not used (Furnas and Rosen, 1991).

Patients were given prophylactic cimetidine routinely to prevent stress ulceration, (Jawad *et al.*, 1990). Antibiotics were only used when surgery involved the oral cavity.

*Post-operative assessment*

The outcome of surgery was assessed subjectively on the basis of function for both the donor and recipient sites. Function was graded as either normal, satisfactory or poor and aesthetic appearance as either excellent, good, satisfactory or poor.

The percentage of patients with medical problems in the free flap survival and free flap failure groups was compared by calculating the standard error of difference between the percentages. The actual difference in percent-

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ages was then divided by this figure to give an estimate of the number of standard deviations from which *p*-values are obtained from tables.

## Results

The average age of patients in this study was 52.5 years with a mean age for tumour patients being 54.1 years and nontumour patients being 34.2 years (range 11–82 years). Forty-one patients were male and 29 female.

Of the 60 patients who had microvascular free flaps performed 54 had a tumour diagnosis and six did not. Thirty-nine of the tumours were squamous cell carcinoma, six sarcomas and five salivary gland tumours. In the non-tumour category the largest group were three facial palsies.

Table II shows the different free flaps employed in this series and for which sites they were used. Table III shows the incidence of relevant medical conditions in patients related to the groups with successful and failed flaps. In this small series smoking appears to have no effect on flap survival but peripheral vascular disease, cardiac disease and significant alcohol consumption appears relevant in this group, although these figures are not statistically significant. Table IV looks at the pre-operative treatments in the flap survival and the flap failure groups.

TABLE II
FLAP TYPES

| Flap | Total no. | sites | |
|---|---|---|---|
| Radial fasciocutaneous | 19 | Oral cavity | 12 |
| | | Lip | 1 |
| | | Pharynx | 1 |
| | | Orbit | 2 |
| | | Facial skin | 3 |
| Radial osseocutaneous | 9 | Mandible plus: | |
| | | Oral cavity | 8 |
| | | Tonsil | 1 |
| Vascularized radius | 1 | Mandible | 1 |
| Latissimus dorsi | 10 | Scalp | 2 |
| | | Pinna | 2 |
| | | Parotid | 1 |
| | | Orbit | 1 |
| | | Neck | 1 |
| | | VIIth palsy | 1 |
| | | Intraoral lining | 1 |
| Fibula | 13 | Mandible | 5 |
| | | Mandible plus: | |
| | | Oral cavity | 7 |
| | | Lip | 1 |
| Jejunal | 5 | Pyriform fossa | 3 |
| | | Hypopharynx: | 1 |
| | | Pharyngeal stricture | 1 |
| Deep circumflex iliac | 2 | Mandible plus tongue | 1 |
| | | Maxilla plus ethmoid | 1 |
| Pectoralis minor | 2 | VIIth palsy | 2 |
| Dorsalis pedis | 1 | Mandible plus floor of mouth | 1 |
| Rectus abdominis | 1 | Oral cavity | 1 |
| Scapula | 1 | Hemifacial microsomia | 1 |

The most common indication for using microvascular free flaps (42 per cent) in tumour patients was following resection of recurrent disease after previous surgery (59.6 per cent) or radiotherapy (52.6 per cent). Previous treatment did not appear to affect flap survival. Microvascular reconstruction as part of primary disease treatment was performed in only 27 per cent of patients.

The distribution of flap types in the flap failure group is shown on Table V. In addition three patients did not have their planned flaps transferred for various reasons and one patient died in hospital from a myocardial infarct before discharge.

The mean operating time was 9.8 hours with a range of four to 16.5 hours and there was no significant difference between the flap failure and flap survival group. The mean ischaemic time of the flap during transfer for the flaps surviving was 1.65 hours with a range of 0.6 to 3.2 hours whilst that for the failed flaps was 1.3 hours with a range 1.1 to 3.25 hours.

Most of the arterial anastamoses (21) were end-to-side to the external carotid artery and 33 were end-to-end to one of its tributaries mainly the facial or lingual arteries. A single arterial anastamosis was sufficient in all cases. End-to-end arterial anastamoses were relatively more common in the flap failure group but interposed grafts were not. The internal jugular vein (34), external jugular vein (29) and facial veins (11) were the most common sites of venous anastamosis, 48 being end-to-end, and 39 end-to-side, with 75 per cent of these being multiple and 76 per cent having interposed venous grafts. External jugular, facial vein and end-to-end anastamoses were more common in the flap failure group with interposed venous grafts being used less commonly.

The mean number of units of blood transfused was 5.33 units with a range of 0 to 15.

Peroperative problems included four flaps in which the anastamosis needed revision, one haematoma under a radial forearm flap which required evacuation and suturing of a small venous leak, one significant peroperative haemorrhage because of prolonged clotting times, one pectoralis minor flap which had to be abandoned as the vessels were too small and one nonviable skin paddle from a fibula flap which was replaced by a local tongue flap.

Sixty-two per cent of patients were sent to the intensive

TABLE III
COMPARISON OF MEDICAL PROBLEMS IN FLAP SURVIVORS AND FLAP FAILURES

| | Flaps survival (= 54) (Mean age = 50.68 years) | Flap failure (= 6) (Mean age = 47.11 years) | *P* values |
|---|---|---|---|
| Smoking | 18 = 32% | 2 = 33% | >0.5 |
| Diabetes | 1 = 1.8% | 0 | |
| PVD | 3 = 5.5% | 1 = 16% | <0.5 |
| Cardiac | 6 = 11% | 1 = 16% | >0.5 |
| Alcohol | 3 = 5.5% | 1 = 16% | <0.5 |

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TABLE IV
COMPARISON OF PRE-OPERATIVE TREATMENT IN THE FLAP FAILURE AND FLAP SURVIVAL GROUPS (TUMOUR PATIENTS ONLY)

| | Flap survival (= 48) | Flap failure (= 6) |
|---|---|---|
| Radiotherapy | 62.5% | – |
| Chemotherapy | 37.5% | 17% |
| Combined R/T + C/T | 33% | 17% |
| Surgery | 71% | 50% |

care unit (ITU) post-operatively and 79 per cent of those were electively ventilated overnight. The mean duration of stay on the ITU was 3.8 days (range one to 11 days).

Table VI lists post-operative complications by resection and donor site as well as the general complications. Twenty-two free flaps were reexplored post-operatively: 15 of these flaps survived, six failed and one patient died from a cardiac arrest during the procedure. Of the six flap failures the two fibulas survived effectively as free grafts. The findings at reexploration included venous congestion (in nine patients), arterial anastamosis failure (five), haemorrhage (four) haematoma (three), flap necrosis (one).

Table VII shows the post-operative assessment.

## Discussion

Many series of free tissue transfer have been reported but as far as we are aware the incidence of pre-operative risk factors and coincidental specific medical diagnoses has not been reported. The small numbers of patients in the flap failure group make the differences between it and the flap survival group statistically insignificant but the findings are worthy of comment. Surprisingly advanced age and smoking did not seem to predisposes to flap failure. Peripheral vascular disease, cardiac disease and post-operative alcohol withdrawal symptoms appeared to prejudice flap survival in this series. Pre-operative treatments with radiotherapy, chemotherapy or surgery again were not evident risk factors for flap failure.

In common with other UK series reported, the radial forearm flap was the most commonly used free flap although in one recent American series, (Carlson and Coleman, 1989) of 44 free flaps and one Japanese series, (Harishina, 1988) of 200 flaps the radial forearm flap was the least commonly used. The radial forearm flap is a reliable and versatile flap for head and neck reconstruction, (Soutar and McGregor, 1986; Evans and Lampe, 1987). It is relatively easy to raise. It is particularly useful for closing intraoral defects as the flap is thin and folds easily, allowing contouring in the oral cavity. It may provide cover of exposed mandible allowing later fitting of dentures and the osseocutaenous flap can be used to reconstruct mandibular defects of less than 10 cm. Its main disadvantages are delayed donor site healing (10–20 per cent) due to exposed tendon and radial fracture in osseocutaneous flaps (40 per cent).

TABLE V
FLAP FAILURE

| | |
|---|---|
| Six flaps failed after transfer: | |
| Latissimus dorsi | 2 |
| Jejunum | 2 |
| Fibula | 1 |
| Scapula | 1 |

TABLE VI
POST-OPERATIVE COMPLICATIONS

| | | | |
|---|---|---|---|
| At operation site (Total no. = 42) | | | |
| Venous congestion | 9 | Fibula | 4 |
| | | Radialosseocutaneous | 3 |
| | | Deep circumflex iliac | 1 |
| | | Scapula | 1 |
| Haematoma | 7 | Jejunum | 1 |
| | | Fibula and deltopectoral | 1 |
| | | Latissimus dorsi | 1 |
| | | Pectoralis minor | 1 (infected) |
| | | Radial fasciocutaneous | 1 |
| | | Radial osseocutaneous | 1 |
| Flap failure | 6 | See Table V | |
| Arterial anastamosis failure | 5 | Radial forearm | 1 |
| | | Deep circumflex iliac | 1 |
| | | Fibula and deltopectoral | 1 |
| | | Latissimus dorsi | 1 |
| | | Latissimus dorsi and pectoralis minor | 1 |
| VIIth nerve weakness | 2 | Fibula | 1 |
| | | Radial osseocutaneous | 1 |
| Salivary fistula | 2 | Fibula | 1 |
| | | Jejunum | 1 |
| Haemorrhage (requiring return to theatre) | 1 | Fibula and deltopectoral | 1 |
| Dehiscence of jejunal anastamosis | 1 | Jejunum | |
| Ischaemia of jejunal flap | 1 | Jejunum | 1 |
| Abcess adjacent to flap | 1 | Radial fasciocutaneous | 1 |
| Infected bone graft | 1 | Fibula | 1 |
| Stricture | 1 | Pharyngojejunal junction | 1 |
| Dysphagia for solids | 1 | Radial fasciocutaneous for pharyngeal reconstruction DP flap for skin cover | |
| Lip necrosis | 1 | Radial osseocutaneous with post operative radiotherapy | |
| Intraoral dehiscence | 1 | Radial fasciocutaneous | |
| Prosthesis removal | 1 | Radial fasciocutaneous | |
| Skin necrosis | 1 | Fibula | |
| At the donor site (total no. = 9) | | | |
| Breakdown of fibula donor site | 1 | | |
| Delayed healing of donor site | 1 | Radial fasciocutaneous | 1 |
| Haematoma at donor site | 2 | Fibula | 1 |
| Radial fracture | 2 | | |
| Seroma at donor site | 2 | Latissimus dorsi | 2 |
| Osteomyelitis at donor site | 1 | Dorsalis pedis | |
| General complications (Total no. = 23) | | | |
| Wound dehiscence | 6 | | |
| Myocardial infarct | 1 | | |
| Cardiac arrest | 1 | | |
| Cerebrovascular accident | 1 | | |
| Respiratory arrest | 1 | | |
| Pneumonia | 1 | | |
| Deep vein thrombosis | 1 | | |
| Tracheostomy fistula | 1 | | |
| Dehiscence of tracheal attachment | 1 | | |
| Otitis media | 1 | | |
| MRSA infection | 1 | | |
| Hypoparathyroidism | 1 | | |
| Alcohol withdrawal | 1 | | |
| Perforated duodenal ulcer | 1 | | |
| Haematemesis | 1 | | |
| Bleeding peptic ulcer | 1 | | |
| Urinary retention | 1 | | |
| Death post MI | 1 | | |

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TABLE VII
OUTCOME OF FIVE MICROVASCULAR FREE FLAP TYPES

| Flap type | Recipient site | | | Donor site | | |
|---|---|---|---|---|---|---|
| | Function (% N/S)* | Aesthetics (% S + % G/E)† | | Function (% N/S)* | Aesthetics (% S + % G/E)† | |
| Radial FC | 85 | 25 | 55 | 85 | 20 | 65 |
| Radial OC | 77 | – | 66 | 88 | 22 | 66 |
| Fibula | 83 | 25 | 33 | 75 | 25 | 25 |
| Latissimus dorsi | 66 | 16 | 33 | 66 | – | 66 |
| Jejunal | 33 | | | 40 | | |

*% N/S = percentage normal or satisfactory.
†% S + % G/E = percentage satisfactory and percentage good or excellent.

The latissimus dorsi flap is well described in many series, (Barton *et al.*, 1983; Frampton *et al.*, 1986; Harishina, 1988; Carlson and Coleman, 1989; Aviv *et al.*, 1991; Watkinson and Breach, 1991). It is a flap with a long reliable vascular pedicle. It is particularly useful for filling large contour defects in the head and neck and in combination with the other flaps based on the subcapsular arterial system which can be used to reconstruct complex three-dimensional composite defects. When used in the oral cavity it has the advantage of being nonhair bearing and is particularly useful for reconstructing the tongue following total glossectomy as it produces an anatomically correct convex platform in the floor of the mouth. In the neck it can be used to repair pharyngeal fistulae, to provide reconstruction after excision of skin invaded with tumour and for partial pharyngeal reconstructions. In the latter case it may be used as a pedicled flap rather than a free flap. Its disadvantages are that it has to be taken in the semi-lateral position requiring turning of the patient during surgery and it requires dissection into the axilla. Donor site seromas are common and poor colour match of back skin with head and neck skin can be a problem.

The osseocutaneous free fibular flap for mandibular reconstruction in head and neck surgery, (Fleming *et al.*, 1990) has several advantages. It can replace a long segment of mandible up to 22 cm i.e. where the resection has crossed the midline. It can be moulded to reconstruct accurately the mandibular contour by multiple osteotomies fixed with Champy plates. It is thick and strong, it has large donor vessels based on the common peroneal artery and the associated skin paddle can be used to provide lining for the floor of mouth or alveolar defect. Problems related to the donor site are few (Goodacre *et al.*, 1990); the vascular pedicle is short, usually necessitating the use of a vein graft and although mobility is initially limited it is subsequently almost totally regained.

Free jejunal flaps for pharyngooesophageal reconstruction are well described in a number of small series (Hester *et al.*, 1980; Tabah *et al.*, 1984; Buckspan *et al.*, 1985; Harishina, 1988; Carlson and Coleman, 1989; Watkinson and Breach, 1991) with a range of five to 14 patients and one larger series from the United States by Coleman *et al.* (1987) with 88 patients. In all series there is a significant complication and flap failure rate which may be related to the poor condition of these patients pre-operatively. There is also a significant learning curve for this operation. Schechter *et al.* (1987) suggests that the functional outcome in terms of voice and long-term swallowing is worse after free jejunal transfer than after gastric pull-up surgery possibly related to nonpurposeful peristalsis or anastomotic strictures (Coleman *et al.*, 1987). Despite these problems Coleman *et al.* (1987) quotes that 75 per cent have good swallowing function.

The overall success rate in this series was 83 per cent i.e. 50/60 patients left hospital with surviving free flaps. Six flaps actually failed following surgery giving a failure rate of 10 per cent. Figures quoted in the literature range from zero per cent by Evans and Lampe (1987) to 13.3 per cent by Carlson and Coleman (1989) with six out of nine publications quoting figures in the five to 10 per cent range, (Zucker *et al.*, 1980; Tabah *et al.*, 1984; Frampton *et al.*, 1986; Soutar and McGregor, 1986; Harishina, 1988; Watkinson and Breach, 1991).

Operating times have not been previously quoted but the long mean operating time of 9.8 hours emphasizes the value of a two-team approach.

Ischaemic times for free flaps in head and neck reconstruction have only previously been reported by Frampton *et al.* (1986). Both were similar theirs ranging from 1.5 to 3.5 hours. It is interesting that in this series their failed flaps did not have a longer mean ischaemic time than those that succeeded.

The complication rates of this type of surgery may be considerable and are shown on Table VI. Complication rates from different series in the literature are difficult to compare. For example Watkinson and Breach (1991) give a major complication rate of 20 per cent and using their criteria for a major complication the rate in this series was 14 per cent. Shestak *et al.* (1992) in their recent study on the outcome of microvascular free flaps in the elderly with coincidental medical disease, reported similarly detailed results for complications and related these to pre-operatively ASA class. They found that medical complications were higher in patients with ASA ratings equal to, or greater than, 3 in those aged over 60 whilst the incidence of surgical complications was not affected by whether the patient was ASA 2 or 3 pre-operatively.

Early reexploration of vascularly compromised flaps increased the success rate of microvascular surgery in this series from 65 per cent (39/60) to 83 per cent (50/60). Similar findings have been reported by Hidalgo and Jones (1990). The need for reexploration decreases as experience of the operators increased. Reported flap salvage rates vary from 33 to 100 per cent depending on the duration of flap ischaemia. The cause of inflow or outflow obstruction was not recorded in this series although Hidalgo and Jones (1990) state that it is primarily due to recipient vessel problems rather than primary anastomotic failure.

Most of the failed flaps (four out of six) were replaced

by axial pattern pedicled flaps with an adequate functional and aesthetic result. Only one flap, the failed jejunal flap was revised but the revision failed following a post-operative CVA. The chances of success of a second attempt at microvascular free tissue transfer after initial failure are less good than for first time surgery, (Fearon *et al.*, 1990) but may be acceptable provided that the cause for initial failure is analysed carefully, a more difficult operation is anticipated and the threshold for reexploration is lower. It can be performed relatively soon after the first procedure provided that adequate debridement and bacterial control of the wound have been obtained. In addition the patients must be fit enough to tolerate further surgery.

In this study the best outcome was achieved for the radial forearm flap both functionally and aesthetically the fasciocutaneous being better than the osseocutaneous flap at the recipient site but there was no significant difference at the donor site. The choice of this rather simplistic subjective scoring system was intended to allow comparison between flaps at very diverse sites in the head and neck region. It must be emphasized that this comparison makes no allowance for the varying complexity of these operations. The radial forearm flap is used to reconstruct smaller defects than when other flaps are used and the potential deformity is much less in these cases making direct comparisons inappropriate. However more detailed objective evaluations of oral cavity and pharyngeal function have been done (Stern *et al.*, 1989; Urken *et al.*, 1991; Vaughan *et al.*, 1992). Vaughan *et al.* (1992) concluded that using the radial forearm flap many of the disabling factors with older methods of reconstruction such as salivary drooling, ability to tolerate liquid diet only, weight loss, loss of dentition, difficulty in masticating, dysphagia, speech problems and TMJ dysfunction may be significantly reduced or overcome. This results in improvements in quality of life for the patient as evidenced by less depression and a much higher percentage of patients returning to work. Stern *et al.* (1989) when comparing microvascular radial forearm and rectus abdominis flaps with pedicled pectoralis major flaps showed that the former were able to tolerate oral feeds and be discharged from hospital sooner. They were also less likely to have local complications and the quality of life with respect to swallowing and intelligibility of speech was also superior. These findings are confirmed by the detailed objective analyses of Urken *et al.* (1991). They also comment on the potential benefits of sensate free flaps and primary osseointegrated dentition in microvascular flaps to improve oral function.

## Conclusions

A series of cases incorporating free tissue transfer for head and neck reconstruction have been reviewed. The results continued to improve as the series progressed. This was due to a number of factors including greater experience of the surgical teams; more use of vein grafts – allowing use of larger vessels; shorter operating times and finally better selection of both patients and flap types.

The long duration of surgery, particularly with the more sophisticated reconstructions the presence of two or more surgical teams during the procedure as well as the facility for an early urgent return to theatre make this surgery extremely labour intensive but this is offset by the short hospital stay, and reduced long-term morbidity. Problems were encountered in patients with peripheral vascular disease and consideration of alternative treatments or reconstructions should be given to patients with these conditions. It is considered that the key benefit for patients is the multidisciplinary approach with one surgical team performing the excision and a second performing the reconstruction.

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