The Ulster Medical Journal, Volume 69, No. 1, pp. 14-18, May 2000.

A review of 100 consecutive free tissue transfers

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Accepted 4 April 2000

SUMMARY

Following the introduction of microsurgical techniques the availability of free tissue transfer has radically transformed reconstructive possibilities for both oncological and surgical defects. This study is a review of 100 consecutive free tissue transfers (free flaps), carried out in 96 patients over a period of 25 months in our unit. The indications for surgery in this series mainly resulted from malignancy, trauma, chronic osteomyelitis, burns and congenital abnormalities. The tissues transferred included various combinations of skin, fat, fascia, muscle, bone and several free digits. Fourteen cases required re-exploration, of which 12 were salvaged, and the overall success rate was 96%.

INTRODUCTION

The principle of reconstructive surgery is the replacement of lost or deficient tissue with similar tissues.[3] A variety of tissues including skin, mucous membrane, cornea, fat, tendon, bone and nerve may be used as grafts. The essential difference between a graft and a flap is that a graft is a non-vascularised structure which depends on the recipient site for nutrition until a suitable circulation has been established, whereas a flap has an independent circulation from the outset. A free flap consists of tissue perfused through a single vascular pedicle, which is detached from the circulation entirely and subsequently revascularised, by means of a microvascular anastamosis, at the recipient site. This technique facilitates restoration of form, contour and function by transferring tissue with more than one specialised component.

The concept of free tissue transfer has progressed through the initial experimental phase in animals in the 1960's.[4,7,3] In the early 1971 Kaplan transferred a free groin flap, which survived for three weeks.[15] Several authors have subsequently reported cases of free tissue transfer in humans.[5,6,12,13,19,23,24]

One advantage of free tissue transfer is the ability to transport vascularised tissue in a single operation thus avoiding multistage procedures. The independent blood supply also avoids the necessity to rely on the recipient bed thereby facilitating the use of flaps in contaminated wounds, in irradiated areas and over large avascular areas such as bone or foreign bodies. Tissue with specialised function may be transferred to restore sensibility, muscle power, bone or even part of the gastrointestinal tract. The ability to select tissue from a distance spares the limited local resources, which may have been compromised by trauma or irradiation rendering them unsuitable for use.

Disadvantages of free tissue transfer include prolonged operating times with most procedures taking four to six hours and longer in complicated cases. This is kept to a minimum with two teams working simultaneously on the donor and recipient sites. As larger and greater varieties of tissues are used for reconstruction, certain problems such as contour defect, decreased muscle power, sensation and some specialised function is compromised in specific donor sites. These need to be carefully considered against the severity of the reconstructive requirement and the risk of failure.

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Microvascular surgery requires microvascular instruments, magnifying loupes and an operating microscope. These are not too expensive by modern standards especially if there is a large volume of microvascular work carried out in the specialist unit. Apart from the instrumentation microvascular surgery requires considerable training of both medical and nursing staff.

This review of 100 consecutive cases was carried out in order to determine the current incidence of free flap failure and associated morbidity in our unit as compared to results published in the current world literature.

METHODOLOGY

100 consecutive free tissue transfers in 96 patients were reviewed. These had been performed over a period of 25 months by five consultants. Patient demographics, hospital stay, indications, complications and flap survival were analysed. The flaps requiring re-exploration were assessed regarding fate of the flap, subsequent management and the outcome.

RESULTS

There were 65 male and 31 female patients. Two patients had two free flaps simultaneously for bilateral breast reconstruction and two patients required a second free flap following failure of the initial procedure, bringing the total up to 100. Mean hospital stay was 31 days (range 8 to 133).

The majority of the procedures were undertaken for reconstruction of the breast and head and neck following malignancy and for limb defects (Fig 1). There were 9 types of free flap used, the most common of which was the radial forearm flap (Fig 2). Microvascular anastamoses were carried out in either end-to-side or end-to-end orientation, using an interrupted suturing technique with 8/0 or 9/0 nylon. All patients received both intraoperative and post-operative dextran 70 for a period of 5 days.

There were two deaths. Both of these high-risk patients had undergone resection of intraoral malignancies with an associated neck dissection, and the cause of death was sepsis followed by multi-organ failure. Four flaps failed. These included two muscle flaps used following debridement of chronic osteomyelitis of the tibia, one TRAM flap for breast reconstruction and one radial forearm flap used for reconstruction following resection of an intraoral carcinoma.

Figure 1
Indications for surgery

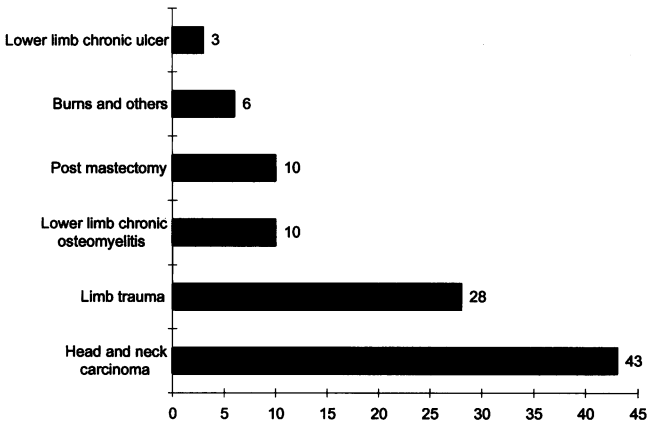
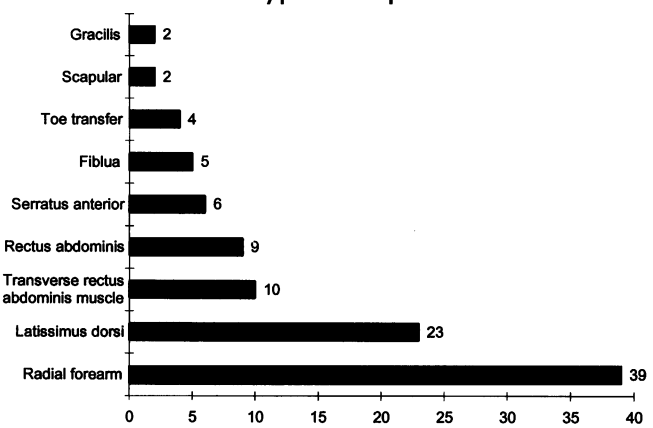


Figure 2
Type of flap



Of the two flap failures in the lower limb, one latissimus dorsi muscle flap failed due to an underlying haematoma and a rectus abdominis flap was lost due to vasospasm of fibrotic vessels. Both patients subsequently were successfully treated with further free latissimus dorsi flaps. A TRAM flap for breast reconstruction following mastectomy failed due to venous thrombosis, and a patient with intraoral carcinoma avulsed his radial forearm flap in the postoperative period whilst profoundly confused due to an episode of delirium tremens.

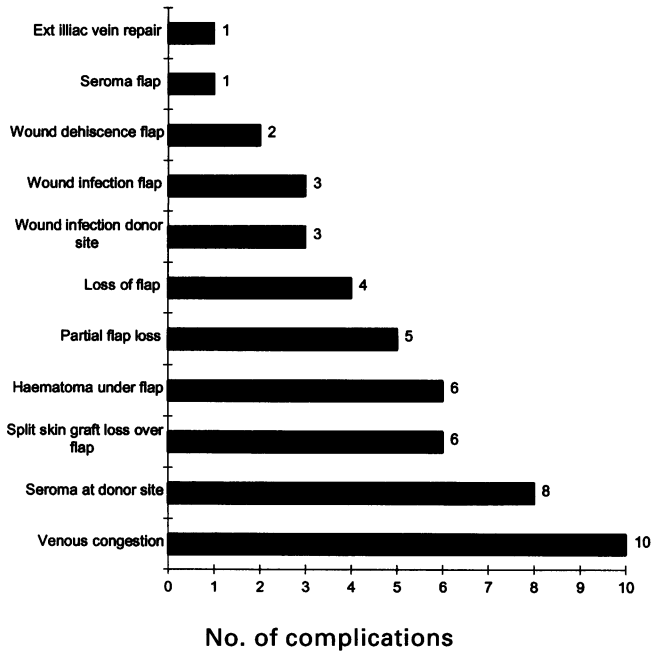
14 flaps required re-exploration (Table I). Of these 12 were salvaged. Seven required evacuation of haematoma, four venous anastamosis were redone due to thrombosis and one required a second venous anastamosis. Two of the 12 salvaged flaps required both evacuation of haematoma and revision of the venous

TABLE I

Flaps re-explored

Flap Type	*No. of flaps*	*Venous thrombosis*	*Haematoma*	*Removal of sutures*	*Flap lost*
Radial forearm	7	3	4		
TRAM	5	1	2	2	1
Latissimus dorsi	1		1		1
Gracilis	1	1			

Figure 3
Flap related complications



anastamosis. Two flaps were salvaged by removal of skin sutures on the ward to relieve venous congestion.

The most frequent flap-related complications are represented in Fig 3.

DISCUSSION

Successful free tissue transfer depends on a multitude of factors. These include preoperative consideration such as patient and donor site selection and appropriate investigations. Per-operative factors include thorough debridement of contaminated wounds, meticulous surgical technique, flap design, team organisation and avoidance of twists, kinks and length discrepancies in the vascular pedicle. Anaesthetic input is of the utmost importance in this type of surgery and such cases should only be undertaken by anaesthetists experienced in this field. Postoperative factors include avoidance of hypovolemia, hypotension, hypothermia, infection, as well as immobilisation of the pedicle and anticoagulant prophylaxis. Postoperative monitoring carried out by experienced personnel and early surgical intervention for flap congestion or ischaemia is essential to keep the salvage rate to the maximum (86% in this series).

The consequences of free flap failure are severe in that a donor site defect has been created with no advantage to the patient and that a further prolonged operative procedure with a second donor site will be required in many cases. In this third decade of free flap surgery the success rates have steadily risen to 95 percent and over. This high success rate has been achieved in specialist units, where a large number of trained microvascular surgeons are carrying out a high volume of work.[1, 16-18, 20] Our results for both flap survival and salvage rates are comparable to previously reported series (Table II).[2, 9-11, 14, 17, 21, 22] At our unit in Belfast there has been a steady increase in cases requiring free flaps. In the year 1998 the number of free tissue transfer rose to almost one per week. Not only are more and more free tissue transfers being carried out, there are increasingly wider indications.

It is worth noting that despite multiple cases developing significant complications, all the patients who had a successful free tissue transfer carried out achieved the reconstructive goal to a standard which could not have been reached using any other technique.

TABLE II

Comparison to other series

Study/Survey	*Ref No.*	*No. of centres*	*No. of flaps*	*Category*	*Failure (Percent)*	*Re-op (Percent)*	*Salvage (Percent)*
Soutar (1986)	22	1	60	Radial forearm flap	10.0	–	–
Irons (1987)	14	1	100	–	15.0	12.0	33.0
Harashina (1988)	11	1	200	–	5.2	6.0	–
Arnez (1991)	2	2	50	TRAM flap	6.0	–	–
Schusterman (1994)	21	1	308	–	5.5	6.8	19.0
Hidalgo (1995)	10	1	60	Fibular flap	1.66	6.66	75.0
Hidalgo (1998)	9	1	716	–	2.0	8.0	70.0
Khouri (1998)	17	23	493	–	4.1	9.9	69.4

CONCLUSION

Microvascular free tissue transfer is a highly specialised technique, with very little room for error. There is a steep learning curve, thus it is not safe to carry out free tissue transfer outside a specialised unit geared specifically for microvascular surgery with multidisciplinary support.

Irrespective of immaculate surgical planning and expertise there wild be occasional and disastrous failures. Close monitoring and early re-exploration is the key to keeping the free flap failures to the minimum. Thus with free flap success rates as high as 96 percent they are a safe and reliable first choice reconstructive option for complex deficits.

ACKNOWLEDMENT

We would like to thank our colleagues in the department for allowing us to include some of their cases in this series.

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