Clinical Paper
Reconstructive surgery

The effect of early detection of anterolateral thigh free flap crisis on the salvage success rate, based on 10 years of experience and 1072 flaps

Q. Yang, Z. H. Ren, D. Chickooree, H. J. Wu, H. Y. Tan, K. Wang, Z. J. He, C. J. Gong, V. Ram, S. Zhang
Department of Oral and Maxillofacial Surgery, The Second Xiangya Hospital of Central South University, Changsha, Hunan, China

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Abstract. The aim of this study was to assess the effectiveness of early exploration of anterolateral thigh (ALT) free flap compromise in head and neck reconstruction and to correlate this with the salvage success rate. The perioperative data of 1051 patients with 1072 ALT flap reconstructions were reviewed retrospectively for the period January 2002 to December 2012. Outcome measures included ethnicity, defect type, incidence and timing of flap compromise, type of flap compromise, causes of vascular occlusion, and salvage rate. The success rate of free flap reconstruction was 97.3% (1043/1072). Of the 29 failures, 21 were complete and eight were partial failures (10–40% of the flap). Venous occlusions occurred in 39 flaps (83.0%) and arterial occlusions in five flaps (17.0%). Six cases were detected within 8 h postoperatively, 13 at 8–16 h postoperatively, seven at 16–24 h postoperatively, and 18 at 24–48 h postoperatively, with respective salvage rates of 66.7%, 61.5%, 28.6%, and 22.2%; three cases detected after 48 h failed. The salvage rate at ≤ 16 h (62.2%) was much higher than that at >16 h (21.4%, $P = 0.0039$). Early detection, re-exploration, and effective handling of the flap crisis increases the rate of flap salvage tremendously.

Anterolateral thigh (ALT) free flap transfers have become a classical tool in head and neck reconstruction following cancer resection, allowing greater diversity in complex reconstruction than local or regional flaps.[1] This flap can be raised as a subcutaneous flap, fasciocutaneous flap, or myocutaneous flap and can cover large defects of the head and neck. One of its main advantages is its large and long vascular pedicle, which enables its harvest with a two-team approach.[2] With

advances in surgical techniques and instruments, ALT free flap success rates at most centres have reached 96%, and in some expert hands close to 99%, making it one of the most reliable procedures in reconstructive surgery.[2–4] However, occasional flap failures still occur. In this particular study, our aims were to determine why microvascular crisis and subsequent flap failure still occurs in modern reconstruction surgery, to highlight the common mistakes leading to these events, and to identify how such outcomes can be prevented. We also suggest new techniques and provide advice regarding the management strategy for the novice surgeon who is interested in this type of operation.

Materials and methods

A retrospective review was done of 1072 ALT free flaps used for oral and maxillofacial reconstruction in 1051 patients between January 2002 and December 2012 at the university hospital. Cases of intraoperative thrombosis without further consequences were excluded. The following details were collected: patient age, gender, ethnicity, defect type, pathology of the neoplasm, and previous treatment. The timing of flap compromise, type of flap compromise (i.e. arterial or venous), causes of vascular occlusion, and salvage rate were noted and analyzed.

The 1051 patients ranged in age from 6 to 82 years, with a mean age of 51.6 years; 832 were males and 219 were females. Of the reconstructions performed, 1066 were done for the repair of defects resulting from the primary treatment of malignant neoplasms and six for defects from trauma and deformity. The procedures were performed with a two-team approach. Heparin was used during anastomosis to prevent vasospasm. Also, the temperature of the operating room was maintained at 25 °C to prevent vasospasm. Most flaps were anastomosed with two pairs of veins, unless only one vein was present. The free flap monitoring protocol was followed closely: 1072 ALT musculocutaneous flaps were monitored clinically every hour during the first 8 h after surgery; the frequency of flap monitoring was reduced to every 1.5 h in the consecutive 8–16 h after surgery and then to every 3–5 h from the end of the first day to the fifth postoperative day.

Statistics

All calculations were performed using SPSS version 17 (SPSS Inc., Chicago, IL, USA). The χ^2 test and Fisher's exact test were used to determine statistical significance for categorical data, and a P-value of <0.05 was considered statistically significant.

Results

Of the 1051 patients who underwent free flap surgery, 21 received a second flap following flap death. Thus, a total 1072 flaps were performed in all. The overall success rate of free flap reconstruction was 97.3% (1043/1072). Forty-seven flaps (4.4%) developed signs of vascular obstruction postoperatively that necessitated surgical exploration. Eighteen of those flaps were salvageable and 29 flaps were lost. Of the 29 failure cases, 21 were complete failures and eight were partial failures (10–40% of the flap).

The timing of flap compromise caused by vascular obstruction was then analyzed. A total of 29 cases were explored surgically after surgery. Six cases were detected within 8 h postoperatively, 13 at 8–16 h postoperatively, seven at 16–24 h postoperatively, and 18 at 24–48 h postoperatively, with respective salvage rates of 66.7%, 61.5%, 28.6%, and 22.2%. The three remaining cases, which were detected at >48 h postoperatively, failed (Table 1).

In three cases, the cause of failure was unknown as nothing could be found during re-exploration, despite complete evaluation of the microvascular anastomosis, perforators, and pedicle. Arterial occlusion occurred in five flaps (17.0%); arterial occlusions occurred within the first 24 h and only one was salvageable. Venous occlusions occurred in 39 flaps (83.0%) and the main causes of venous compromise were mechanical obstruction due to compression, twisting, kinking, or stretching of the vein and thrombosis of vascular anastomosis sites. The flap failures resulting from venous congestion were most likely the result of delayed surgical exploration leading to the 'no-reflow phenomenon'. It was noted that venous occlusion was more common than arterial occlusion, and we also found that the rate of successful salvage at ≤16 h (62.2%) was much higher than that at >16 h (21.4%, $P = 0.0039$).

The causes of vascular occlusion and associated salvage rates are listed in Table 2. Details of the explorations, management of complications, and outcomes of the 47 patients with flaps that were explored surgically are summarized in Table 3 (total and partial failure cases) and Table 4 (successful salvage cases).

Discussion

This was a retrospective review of 1051 patients (1072 flaps) who underwent reconstructive surgery using an ALT musculocutaneous flap in the oral and maxillofacial region. Because the thickness of this flap is adjustable, it can be raised in three different ways: a subcutaneous flap, fasciocutaneous flap, or musculocutaneous flap, which can cover large defects of the head and neck. The musculocutaneous flaps are preferred over perforator flaps as the success rate is generally higher with it. The musculocutaneous flap is always accompanied by a cuff of the vastus lateralis muscle, which decreases the risk of injury to perforators; however this also increases the risk of vascular pedicle compression during reconstruction. Hence an adequate amount

Table 1. Timing of vascular compromise and salvage success rate.

Timing	Number of flaps	Salvage rate, n %
≤8 h	6	4 (66.7%)
8–16 h	13	8 (61.5%)
16–24 h	7	2 (28.6%)
24–48 h	18	4 (22.2%)
>48 h	3	0 (0%)

Table 2. Causes of vascular occlusion and salvage success rate.

Types of venous/arterial occlusion	Flap compromise	Successful salvage	Salvage success rate (%)
Compression	17	10	58.8
Stretching of the pedicle	4	2	50.0
Twisting of the pedicle	2	0	0
Thrombosis of the vascular anastomosis sites	9	3	33.3
Negative pressure	2	0	0
Perforator injury	2	0	0
Twisting of the perforator	2	1	50.0
Kink in the perforator	2	1	50.0
Arterial embolism	4	1	25.0
Unknown reason	1	0	0
Internal jugular vein thrombosis	2	0	0
Total	47	18	38.3