**Head and Neck**

**Management of free flap failure in head and neck surgery**

*C. COPPELLI¹, K. TEWFIK¹, L. CASSANO¹, N. PEDERNESCHI¹, S. CATANZARO¹, A. MANFUSO², R. COCCHI¹*

¹ Operative Unit of Maxillo-Facial Surgery, Otolaryngology and Dentistry, Hospital Casa Sollievo della Sofferenza, San Giovanni Rotondo (FG), Italy; ² Operative Unit of Maxillo-Facial Surgery, Federico II University, Naples, Italy

**SUMMARY**

Free flap surgery is overall considered the gold standard in head and neck reconstruction, with a success rate of about 95%. The management of a total flap necrosis and which solution, between a pedicled or a second free flap, is safer for a salvage procedure is still controversial. Object of this study is to describe the authors’ management of total free flap loss in head and neck reconstruction and compare the choices and results to those reported in the literature. From January 2012 to January 2016, 149 consecutive free flaps were performed at the Maxillo-Facial Operative Unit of the Hospital Casa Sollievo della Sofferenza in San Giovanni Rotondo (Italy) for reconstruction of head and neck defects. Of these, 6 flaps were lost due to a total necrosis. In 5 cases it was decided to harvest a second free flap, and in the remaining patient a temporalis muscle flap was used. All the free salvage flaps were successful, without complications and with a good aesthetic and functional recovery. Analysing the data obtained, and comparing them with those reported in the literature, it can be concluded that a second subsequent free flap can be considered an ideal and safe procedure in salvage surgery.

**KEY WORDS:** Free flap failure • Salvage free flap • Head and neck reconstruction • Flap loss management

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**Introduction**

Free flap surgery is overall considered the gold standard in head and neck reconstruction, with a success rate of about 95%. The most dreaded complication in this procedure is a total loss of the flap. The management of flap necrosis and which solution between pedicled or a second free flap is safer for a salvage procedure is still controversial. In a comprehensive article, Okazaki described the management of 19 flap losses on 502 free flaps. Although performing a new free flap is the best option if achievable, they observed a success rate of 89% in patients who underwent a second subsequent free flap for total necrosis. Loco-regional flaps may be considered a valid alternative when a second free flap is contraindicated or not ideal, but with some limitations including distal necrosis of the flap, wound healing and increased duration of hospitalization. The object of this pilot study is to evaluate in our experience if a second subsequent free flap can be considered a safe and reliable procedure in salvage surgery.

**Materials and methods**

From January 2012 to January 2016, 149 consecutive free flaps were performed by the same surgeon at the Operative Unit of Maxillo-Facial Surgery of the Hospital Casa Sollievo della Sofferenza in San Giovanni Rotondo.
(Italy). Our cohort consisted in 139 patients, 102 males and 38 females, with a mean age of 65.4 (36-88). Almost all the reconstructions were secondary to oncological resections. The pathological and reconstructive details are shown in Table I. The most common reconstructive options were the antero-lateral thigh (n = 50) and the radial forearm (n = 49) free flaps. Four patients underwent two free flap reconstructions because of the reoccurrence of the disease. One case had a simultaneous double free-flap transfer (fibula + ALT). In all cases flap vitality was controlled through clinical monitoring.

Functional and aesthetic outcomes were evaluated after 6 months, following the scores listed in Table II, using a questionnaire filled out by patients and as judged by a commission of three colleagues.

### Results

In a group of 149 consecutive free flaps, there were 6 flap losses in 6 different patients with an overall success rate of 96%. Of these there were 4 males and 2 females, with a mean age of 52 years (range 25 and 69 years). Table III lists the type, aetiology, clinical details of the flaps lost and subsequent treatment. We observed total necrosis of three fibula flaps, used for the reconstruction of mandibular (n = 2) and maxillary (n = 1) defects, one ALT flap, performed after a total glossectomy and two latissimus dorsi/scapular flaps performed to reconstruct maxillary defects. We did not observe any early necrosis: the first signs of necrosis were detected between the 7th and 13th day after surgery (mean time: 10.6 days). In one case (Patient 4), there was a massive haemorrhage due to the rupture of the common carotid artery: the vascular procedure performed in urgency resulted in a thrombosis of the flap’s pedicle. This was the only patient who had undergone previous radiotherapy. In one case, we observed a late infection (Patient 6) that resulted in a total flap loss. The other four cases had unknown causes of necrosis.

In five of the six patients a second subsequent free flap was performed, with a success rate of 100%. In one case, we decided to reconstruct the palate defect using a temporalis muscle flap. The donor sites of the salvage free flaps were the antero-lateral thigh (n = 3: subsequent to 1 ALT flap, 1 fibula flap and 1 combined scapula + latissimus dorsi flap), the fibula (n = 1: secondary to a fibula flap loss) and the latissimus dorsi (n = 1: after a combined latissimus-scapula free flap necrosis). The microvascular anastomoses were made on the same side in four cases (Table IV). In one patient, there was the necessity to use the contralateral neck vessels. No vessel grafts were required.

The salvage procedure was made during the same hospitalisation in four patients, within 26 days after the first surgery (mean time: 20 days). Two patients were discharged and after a mean of 44 days they were readmitted and underwent the salvage procedure with a new free flap. The mean hospitalisation time after the second surgery was 15.3 days (range: 1-20 days).

### Table I. Pathology and reconstruction characteristics.

| Pathology                        | No. flaps | Donor sites                      | No. patients | Area reconstructed | No. flaps |
|----------------------------------|-----------|----------------------------------|--------------|--------------------|-----------|
| Squamous cell carcinoma          | 122       | ALT                              | 50           | Mandible           | 41        |
| Recurrent squamous cell carcinoma| 5         | Radial forearm                   | 49           | Tongue             | 34        |
| Ameloblastoma                    | 4         | Fibula                           | 30           | Maxilla            | 15        |
| Adenoid cystic carcinoma         | 2         | Scapular + latissimus dorsi      | 8            | Cheek              | 13        |
| Keratoctytic tumour              | 2         | Iliac crest                      | 8            | Oropharynx         | 11        |
| Osteoradionechrosis              | 3         | Latissimus dorsi                 | 2            | Floor of the mouth | 12        |
| Sarcoma                          | 1         | Gracilis                         | 2            | Scalp              | 8         |
| Recurrent pleomorphic adenoma    | 1         |                                  |              | Orbito-nasal       | 3         |
| Facial paralysis                 | 2         |                                  |              | Facial reanimation | 2         |
| Osteomyelitis                    | 1         |                                  |              |                    |           |
| Secondary reconstruction         | 1         |                                  |              |                    |           |
| Free flap necrosis               | 5         |                                  |              |                    |           |

### Table II. Diet, speech ability and aesthetic scores.

| Diet               |     |
|--------------------|-----|
| 1 Poor swallow ability |     |
| 2 Liquid diet       |     |
| 3 Soft diet         |     |
| 4 Free diet         |     |
| Speech ability      |     |
| 1 Not intelligible speech | |
| 2 Difficult to understand | |
| 3 Acceptable speech |     |
| 4 Normal speech     |     |
| Aesthetic results   |     |
| 1 Poor              |     |
| 2 Acceptable        |     |
| 3 Good              |     |
| 4 Excellent         |     |
No local or systemic major complications were observed. Functional and aesthetic outcomes are shown in Table V. Speech ability was normal in three patients and acceptable in two cases. In only one patient was speech described as difficult to understand. Considering diet and swallowing ability, four patients expressed the capacity of eating a soft diet, one patient can only feed himself with a liquid diet and one patient achieved the possibility of a normal diet after implants. The commission of colleagues who assigned an aesthetic score observed excellent aesthetic results in two patients, good results in one patient and acceptable results in three cases.

### Discussion

Free flap surgery is considered a reliable and safe procedure for head and neck reconstruction. The success rate of a free flap described in the literature is about 95% \(^1\)\(^-\)\(^3\). In our cohort, we observed a rate of 96% in 149 consecutive procedures. Despite the high success rates, free flap losses still occur at a rate of about 1% to 6% \(^6\).

The risk factors for a total flap loss are still unclear. Preoperative or previous radiotherapy is reported to be associated with a higher risk of free flap failure and complications \(^7\). Radiotherapy produces, in fact, macro and microscopic alterations on vascular structures \(^8\)-\(^10\). In our

### Table III. Characteristics of failed free flaps.

| Sex | Age | Pathology                      | Pre-RT | Failed flap            | Timing of loss (days) | Causes                                      | Salvage procedure | Timing after first surgery (days) | Hospitalisation after salvage procedure (days) |
|-----|-----|--------------------------------|--------|------------------------|----------------------|---------------------------------------------|-------------------|----------------------------------|-----------------------------------------------|
| M   | 48  | Maxillary squamous cell carcinoma | No     | Scapolar + latissimus dorsi free flap | 10                   | Unknown                                     | ALT               | 26                               | 16                                             |
| M   | 25  | Mandibular ameloblastoma       | No     | Fibular free flap       | 10                   | Unknown                                     | Fibular flap      | 48                               | 11                                             |
| M   | 67  | Tongue squamous cell carcinoma | No     | ALT                    | 12                   | Unknown                                     | ALT               | 40                               | 18                                             |
| F   | 45  | Mandibular squamous cell carcinoma | Yes  | Fibular free flap       | 13                   | Common carotid artery haemorrhage            | ALT               | 26                               | 20                                             |
| M   | 69  | Maxillary squamous cell carcinoma | No    | Fibular free flap       | 7                    | Unknown                                     | Temporal flap     | 13                               | 15                                             |
| F   | 58  | Maxillary adenoid cystic carcinoma | No    | Scapolar + latissimus dorsi flap | 12                   | Infection                                   | Latissimus dorsi flap | 15                               | 12                                             |

### Table IV. Failed free flaps: vascular pedicle details.

| Sex | Age | Pathology                      | Failed flap            | Artery pedicle 1<sup>st</sup> surgery | Vein pedicle 1<sup>st</sup> surgery | Salvage procedure | Artery pedicle 2<sup>nd</sup> surgery | Vein pedicle 2<sup>nd</sup> surgery |
|-----|-----|--------------------------------|------------------------|----------------------------------------|---------------------------------------|-------------------|----------------------------------------|----------------------------------------|
| M   | 48  | Maxillary squamous cell carcinoma | Scapolar + latissimus dorsi free flap | Superior thyro-thyroid artery | Internal giugular vein | ALT | External carotid artery | Internal giugular vein |
| M   | 25  | Mandibular ameloblastoma       | Fibular free flap       | Facial artery                          | Anterior giugular vein                | Fibular flap | External carotid artery | Thyro-lingual-facial trunk |
| M   | 67  | Tongue squamous cell carcinoma | ALT                    | Facial artery                          | Thyro-lingual-facial trunk            | ALT | Lingual artery | Thyro-lingual-facial trunk |
| F   | 45  | Mandibular squamous cell carcinoma | Fibular free flap       | External carotid artery                | Inferior thyroid vein                 | ALT | Contralateral transverse cervical artery | Contralateral thyro-lingual-facial trunk |
| M   | 69  | Maxillary squamous cell carcinoma | Fibular free flap       | Facial Artery                          | External giugular vein                | Temporal flap | Latissimus dorsi flap | Lingual artery |
| F   | 58  | Maxillary adenoid cystic carcinoma | Scapolar + latissimus dorsi flap | Facial Artery | Facial vein | Latissimus dorsi flap | Thyro-lingual-facial trunk |
probably in our group of patients the reduced or absent
rate in patients aged ≥ 75 years compared to the general
population. Considering our limited series of total flap
loss we did not observe any primary vessel depletion
during the first procedure.

Several authors 12-13 have reported that age alone should
not be considered as a contraindication or an independent
risk factor when considering free-tissue transfer. Ferrari 12
observed a successful free-flap rate of 98.2% in 54 flaps
harvested in patients over 75 years of age and a successful
rate of 96.2% in 306 of the 318 flaps performed in those
under 75 years. Tarsitano 13 described a similar success rate
in patients aged ≥ 75 years compared to the general
population. Considering our limited series of total flap
loss, we observed a mean age of 52 years (range from 25
to 69) with no patient over 75 years.

Hypercoagulable states, the development of severe infec-
tion, external compression and errors in flap harvesting
and management of the pedicle can be further causes of
flap loss.

In 5 of our 6 cases, the etiology of the flap loss could not
be determined. According to Corbitt 14, who reported simi-
lar findings, both the artery and vein were thrombosed
and the detection of flap compromise occurred late (mean:
10.6 days; range: 7th-13th day after surgery).

Thrombosis on postoperative day 5 or later after micro-
vascular reconstruction (late thrombosis) is reported to
account for 10% to 28% of all thromboses 15. Even if free
flaps are believed to undergo revascularisation via the sur-
rounding tissue and are able to survive without pedicle
flow for several days after surgery, compromised recipi-
et beds (such as irradiated tissue), chronically infected
wounds and ischaemic vascular disease can interfere with
free flap revascularisation, making the flap dependent on
the pedicle for a longer period of time 15-16.

Probably in our group of patients the reduced or absent
revascularization via the surrounding tissues added to late
impairment of the pedicle (kinking, compression, misdi-
agnosed infections, etc.), which was the cause of the de-
layed loss of the flap.

Few studies have been published about the best way to
manage the loss of a free flap, and the use of a subse-
cquent salvage free flap is still a controversial issue. The
hesitation is due to concerns regarding lack of recipient
vessels, as well as increased risk of a second flap loss and
postoperative complications. Different authors, in fact,
have described higher rates of failure of a second free flap
reconstruction, with success rates varying from 28% to
89% 9-10,12. Bozikov 17 observed that free flap failure was
4.6 times more likely to occur after a salvage free flap
transfer with a success rate of 53%. Ross 18 in a series of
30 patients described a success rate of 73%, a percentage
significantly lower in comparison with second free flaps
performed for recurrences. On the contrary, our results,
even if on a small group of patients, show a higher rate
of success (100%) that mirrors the experiences of Wei of
94.1% 19, Alam and Khariwala of 100% 20 and Corbitt of
96.4% 14. Such success rates suggest that free flaps can be
still a safe option even after an initial failure.

Wei 19 reported the necessity to reach the contralateral
neck for recipient vessels in 35% of cases, and the use
of interpositional vein grafts in the 30% of cases. In our
experience, in only one patient there was the necessity
to reach the contralateral vessels, and venous or arterial
grafts were not used in any case. Accordingly to Corbitt 14,
in some cases we re-used vessels that had previously been
used for the initial free flap, without complications. More-
over, the rich vascularity of the head and neck often al-
lows finding adequate recipient vessels, even after prior
resection, neck dissection and free flap reconstruction.

The choice of the donor site should be made based on
prognosis, general conditions and functional needs. Ide-
ally, a free flap lost should be replaced by the same option
if the first selection of the donor site has been correctly
done. When prognosis is poor, the patient has comorbid-
ties and bony reconstruction is not mandatory to obtain
adequate functional rehabilitation, a soft tissue free flap
can be chosen instead of an osseous flap. It is, in fact,
characterised by lower donor site morbidity and faster re-

| Sex | Age | Pathology                             | Failed flap                      | Salvage procedure | Aesthetic results | Speech | Diet |
|-----|-----|---------------------------------------|----------------------------------|------------------|-------------------|--------|------|
| M   | 48  | Maxillary squamous cell carcinoma     | Scapolar + latissimus dorsi free flap | ALT              | 3                 | 3      | 3    |
| M   | 25  | Mandibular ameloblastoma             | Fibular free flap                | Fibular free flap | 4                 | 4      | 4    |
| M   | 67  | Tongue squamous cell carcinoma       | AL T                            | AL T             | 4                 | 3      | 3    |
| F   | 45  | Mandibular squamous cell carcinoma   | Fibular free flap                | AL T             | 2                 | 2      | 2    |
| M   | 69  | Maxillary squamous cell carcinoma    | Fibular free flap                | Temporal flap    | 2                 | 4      | 3    |
| F   | 58  | Maxillary adenoid cystic carcinoma   | Scapolar + latissimus dorsi free flap | Latissimus dorsi flap | 2              | 4      | 3    |
habilitation time. Even if the overall complication rate in patients who undergo a subsequent free flap attempt is reported to be slightly higher than those who were primarily reconstructed, in our cases we did not observe any local or systemic complications. The relatively short times of hospitalisation after the second free flap (mean: 15.4 days; range: 11-20 days) show the possibility to obtain quick rehabilitation of patients even after a salvage procedure. Moreover, satisfactory results, both in terms of function and aesthetics, were observed. We acknowledge that the relatively small number of cases in this series, particularly of patients who underwent secondary pedicled flap reconstruction, does not permit meaningful comparison between free and regional flaps. However, more extensive studies have shown that free flap reconstruction usually results in superior functional outcomes. Moreover, higher rates of local complications (fistulas, wound dehiscences, pedicle retraction, etc.) are reported in literature for pedicled flaps with respect to free flaps, both after primary and salvage harvesting. These data confirm our opinion that a second subsequent free flap should be considered as the first option after the total loss of a free flap in most cases. It represents, in fact, the technique that allows the best functional and aesthetic results, together with low complication rates and acceptable hospitalisation times. However, we agree with Corbitt in that good surgical and medical judgment, together with a careful primary selection of the patient and serious analysis of causes of loss, are crucial for the success of salvage free flaps.

Conclusions

The reconstruction of a head and neck defect after a free flap failure can be challenging for the surgeon. Even if pedicled flaps are classically considered the mandatory choice in salvage surgery after a free flap loss, accordingly with the most recent reports we consider the use of a subsequent second free flap the first option in salvage surgery. Despite major technical complexity and longer operative times, free flaps are reliable and safe procedures that bring the best aesthetic and functional results. The high success rates of the subsequent salvage free flaps and, on the contrary, the poor results and higher local complication rates of pedicled flaps, suggest that most patients would benefit from a reattempt at microvascular reconstruction.

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Address for correspondence: Chiara Copelli, Maxillo-Facial Surgery, Head and Neck Department Hospital Casa Sollievo della Sofferenza, viale dei Cappuccini 1, 71013 San Giovanni Rotondo (FG), Italy. E-mail: copkids@tin.it