Novel Technique with Double Free Flap Design for Advanced Mandibular Osteoradionecrosis: A Case Series

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Summary: Advanced mandibular osteoradionecrosis is arguably among the most challenging cases for reconstructive head and neck surgeons. Several reconstructive methods for complex mandibular defects have been reported; however, for advanced mandibular osteoradionecrosis, a safe option that minimizes the risk of renewed fistulation and infections is needed. For this purpose, we present a new technique using a fascia-sparing vertical rectus abdominis musculocutaneous flap as protection for a vascularized free fibula graft (FFG). This technique also optimizes recipient site healing and functionality while minimizing donor site morbidity. Our initial experiences from a 4 patient case series are included. Mean operative time was 551 minutes (SD: 81 minutes). All donor sites were closed primarily. Mean time to discharge was 13 days (SD: 7 days), and mean time to full mobilization was 2 days (SD: 1 days). This double free flap technique completely envelops the FFG and plate with nonirradiated muscle. It allows for the transfer of an FFG without a skin island, thus avoiding the need for split skin graft closure. This results in faster healing and minimizes the risk of fibula donor site morbidity. The skin island of the vertical rectus abdominis musculocutaneous flap has the added benefit of providing intraoral lining, which minimizes contractures and trismus. Although prospective long-term studies comparing this approach to other double flap procedures are needed, we argue that this technique is an optimal approach to safeguard the mandibular FFG reconstruction against the inherent risks of renewed complications in irradiated unhealthy tissue. *(Plast Reconstr Surg Glob Open 2020;8:e3149; doi: 10.1097/GOX.0000000000003149; Published online 24 September 2020.)*

INTRODUCTION

Advanced mandibular osteoradionecrosis (mORN) is arguably among the most challenging cases for reconstructive head and neck surgeons.[1–5] Compared with other head and neck microvascular reconstructions, mORN is typically more expensive and prone to a higher risk of complications.[1,2,4,6–9] Still, radical surgical management remains the only option for advanced mORN.[1,8,10–15] There is general consensus that it is beneficial to transfer well-vascularized nonirradiated healthy tissue into the hypovascular, hypocellular, and hypoxic fibrotic wound.[3,8,13,14,16–18]

Several reconstructive methods for complex mandibular defects have been described, including single free flaps,[6,12,13,19–29] free flaps and pedicled flaps,[30,31] and double free flaps.[1,32–37] We regularly use many of these methods as either single or double flap procedures; however, for advanced mORN, a safe option that minimizes the risk of renewed fistulation and infections is needed. We hypothesized that using a fascia-sparing vertical rectus abdominis musculocutaneous (VRAM) flap as protection for a vascularized free fibula graft (FFG) and plate would benefit wound healing with minimal donor site morbidity. In this case series, we present the surgical technique and our first results for advanced mORN.

METHODS

We reviewed data on mandibular reconstructions from our prospectively collected microvascular surgery database. We identified 4 patients with mORN who underwent a double free flap reconstruction with a vascularized FFG and a fascia-sparing VRAM flap (Table 1). According

Table 1. Patient Demographics and Ablative Surgical Procedure

Patient	Sex	Age, y	BMI	Prior Head and Neck Cancer	Prior RT	Prior Free Flap	Relevant Comorbidities	Presenting with	Ablative Surgical Procedure
1	M	49	21	'13, '14, '15, '16: Intraoral SCC	Yes	'17: osteocutaneous free fibula graft to left mandibular	None	Bilateral mORN, intraoral fibula exposure, abscess, fistula to the skin, pain	Angular to angular resection incl. fistula, abscess and fibula graft
2	M	71	25	'12: Intraoral metastatic SCC, unknown primary tumor	Yes	None	None	mORN right, intra- and extraoral fistulas, mandibular fracture, pain, trismus	Right hemimandibulectomy incl. fistulas and mucosal lining and soft tissue
3	F	76	22	'92: Carcinoma in submandibular gland '07: Tongue cancer	Yes	None	Chronic obstructive pulmonary disease	mORN right, pain, scar tissue, trismus, intraoral exposure of the mandible	Right hemimandibulectomy incl. mucosal lining and soft tissue
4	M	75	19	'14: Tonsil cancer	Yes	None	Chronic renal insufficiency Left nephrectomy 2015 Atrial fibrillation— anticoagulant treatment with Apixaban Hypertension	mORN right, mandibular fracture, intraoral exposure of the mandibular, weight loss of 6 kg 2 weeks up to surgery	Right hemimandibulectomy incl. mucosal lining and soft tissue

BMI indicates body mass index; F, female; M, male; RT, radiation therapy; SCC, squamous cell carcinoma.

to Danish law, the requirement for ethics committee approval is waived for observational studies based on quality registry data.

Technique Description

Simultaneous with ablative surgery, in a 2-team approach, an FFG flap and a VRAM flap are raised. The FFG is raised in a standard fashion with no muscle or skin allowing for primary closure of the donor site. The fascia-sparing VRAM is based on the deep inferior epigastric vessels and raised lateral to and below the umbilicus after confirming 1 or more sufficient medial or lateral skin perforators via Doppler-signal (Fig. 1). To minimize the fascial defect, the fascia is incised in close proximity to the skin perforators and with a total width of <1 cm, following which the rectus muscle is enucleated to its second cranial intersection and the pubic symphysis (Fig. 1). A skin island (circa 5 by 12–20 cm) is raised and trimmed. The fascia is closed in 2 layers with minimal tension and without any mesh: a running Monomax 1-0 loop suture is used followed by horizontal mattress Monoplus 2-0 sutures. Skin closure is done in a standard fashion. The FFG is inserted and fixated with a titanium plate. To minimize kinking and to allow for anastomoses to nonirradiated recipient vessels, the FFG pedicle is typically tunnulated subcutaneously to the contralateral facial artery and vein (Fig. 2). The VRAM flap's pedicle is anastomosed to the ipsilateral superior thyroid artery and internal jugular vein (end to side) or facial vessels (Table 2). The skin island of the VRAM flap
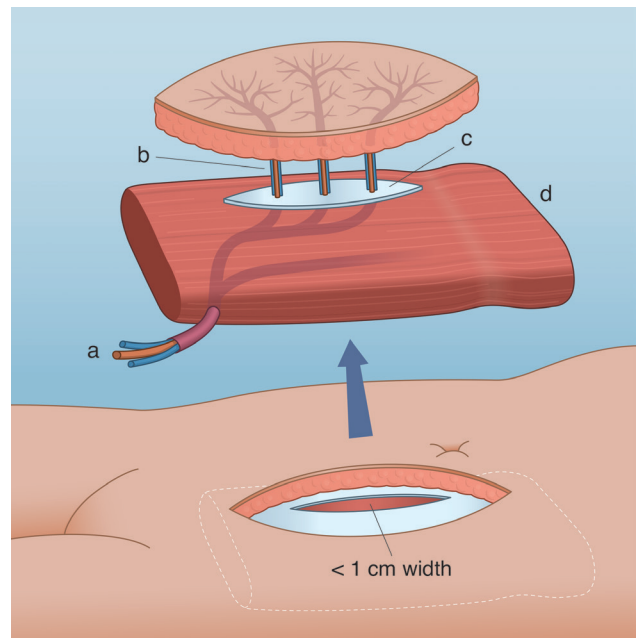

Fig. 1. A diagram illustrating the harvest of the fascia-sparing VRAM flap. The vertical rectus abdominis musculocutaneous flap is based on the deep inferior epigastric vessels (a) with 1 or more skin perforators (b). The fascia is incised in close proximity to the skin perforators and with a total width being <1 cm (c), following which the rectus muscle is enucleated to its second cranial intersection and to the pubic symphysis (d). The fascia is closed primarily without the use of a mesh. See text for more details.
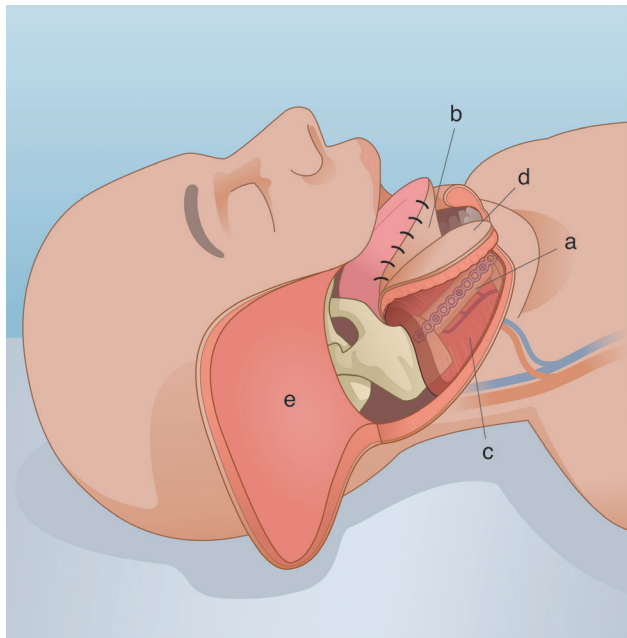
Fig. 2. Illustration of a double free flap design for mandibular reconstruction. The vascularized free fibula graft with plate in place with its pedicle tunnulated to the contralateral facial recipient vessels (a). The skin island of the VRAM flap is used as intraoral lining (b), allowing the muscle to completely envelop the fibula graft and anterior neck (c). An extended skin island flap is sometimes used to cover both intra- and extraoral defects (d), in which case the junction uniting the intra- and extraoral part is deepithelialized. This is especially useful when the irradiated skin tissue (e) is too fragile for it to reach the midline.

is used as intraoral lining, allowing the muscle to envelop the FFG and anterior neck (Fig. 2). An extended skin island VRAM flap is sometimes used to cover both intra- and extraoral defects, in which case, the junction uniting the intra- and extraoral part is deepithelialized.

RESULTS

Surgical characteristics and outcomes are presented in Table 2. Mean operative time was 551 minutes (SD: 81 minutes). All donor sites were closed primarily. One reoperation on day 10 for an abdominal fascia rupture was needed; this defect was also closed primarily. Mean time to discharge was 13 days (SD: 7 days), and mean time to full mobilization was 2 days (SD: 1 days). Patients 1 and 2 had planned minor cosmetic revisions to the external skin islands of their VRAM flaps.

DISCUSSION

To our knowledge, this is the first description of using a fascia-sparing VRAM flap to envelop and protect a vascularized FFG in the management of advanced mORN. Enveloping the FFG with muscle protects against fistulation and infection. The combination allows for the transfer of an FFG without a skin island. This avoids the need for a split skin graft closure, resulting in faster healing and a minimal risk of fibula donor site morbidity.[5,20,38] The VRAM flap also provides soft tissue coverage as in a variety of head and neck reconstructions,[23,28,39–45] and has the added benefit of providing intraoral lining using a skin island to minimize contractures and trismus, and potentially also adding external skin islands, if needed. Flap trimming is often unnecessary, as mORN patients have minimal abdominal fat due to their poor nutritional state. Owing to its long pedicle and extensive vasculature with numerous skin perforators,[43,46–48] it is considered safe and reliable, with a low complication rate.[5,43,44,46,48] A fascia-sparing approach allows for primary closure of the donor site and therefore acceptable donor site morbidity with a low risk of herniation.[32,44,46,48,49] One patient had a postoperative fascia rupture. Preoperatively, the patient was severely cachectic. At reoperation, the fascia was closed without the use of a mesh.

Table 2. Surgical Characteristics, Outcomes, and Postoperative Follow-up

Patient	Total Operative Time, min	Ischemia Time FFG, min	Ischemia Time VRAM, min	FFG Anastomosis with	VRAM Anastomosis with	FFG Donor Site Closure	VRAM Donor Site Closure	Time from Surgery to Discharge, d	Time to Full Mobilization, d	Post-OP Complications	Time Since Surgery, mo
1	635	163	32	Right FA + FV	Right STA + EJV	Primary	Primary	9	2	None	8
2	510	78	DNA	Left FA + FV	Left STA + IJV	Primary	Primary	8	1	None	5
3	600	104	51	Left STA+ IJV	Left FA + FV	Primary	Primary	23	4	Fascia rupture day 10, reoperation Minor fibula exposure, conservative healing	3
4	459	71	44	Left FA + FV	Right STA + IJV	Primary	Primary	10/69*	1	ICH day 10, suspected underlying malignancy, cause still unknown	2½

*Discharged from the Plastic and Reconstructive Department day 10, subsequent stay at the ICU (3 d), neurological department (14 d), and a neurological rehabilitation center (52 d) at which time the patient was discharged to outpatient physiotherapy with the expectation of a full recovery.
DNA indicates data not available; EJV, external jugular vein; FA, facial artery; FV, facial vein; ICH, intracerebral hemorrhage; ICU, intensive care unit; IJV, internal jugular vein; OP, operation; STA, superior thyroid artery.

Combining a VRAM flap with an FFG has been described,[32–34] but not with this optimized approach. A case series described a "sandwich" technique of an osteocutaneous fibula flap with an anterior lateral thigh flap.[36] Although useful in many cases,[1,33,35] adding muscle coverage further minimizes the inherent risks of working with irradiated tissue.

In this case series, operation time and length of hospital stay were similar to earlier reports for both single and double flap reconstructions.[1,22,25,26,30,32,33,35,37,38] One patient had an intracerebral hemorrhage on postoperative day 10, which in-hospital neurologists have assessed as unrelated to the surgical procedure.

This study's main limitations include its retrospective small case-series design and a short follow-up period. Optimally, a prospective study comprising different double flap approaches should be conducted to evaluate immediate recipient and donor site outcomes as well as long-term functionality and risk of recurrence.

CONCLUSIONS

This case series presents a new optimized technique using a fascia-sparing VRAM flap to envelop and protect a vascularized FFG for reconstruction of advanced mORN. Prospective studies are needed to compare this procedure to other single or double free flap procedures in the management of advanced mORN.

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