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Author(s) Alternative	Sakuma, H; Takemaru, M
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# Reverse Facial-submental Artery Island Flap with Reinnervation of the Anterior Belly of the Digastric Muscle

Hisashi Sakuma, MD<sup>1,2</sup> Masashi Takemaru, MD<sup>2</sup>

<sup>1</sup> Department of Plastic and Reconstructive Surgery, Ichikawa General Hospital, Tokyo Dental College, Ichikawa, Chiba, Japan

<sup>2</sup> Department of Plastic and Reconstructive Surgery, Yokohama Municipal Citizen's Hospital, Yokohama, Kanagawa, Japan

**Address for correspondence** Hisashi Sakuma, MD, Department of Plastic and Reconstructive Surgery, Ichikawa General Hospital, Tokyo Dental College, 5-11-13, Sugano, Ichikawa, Chiba 272-8513, Japan (e-mail: prssakuma@gmail.com).

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## Abstract

Reconstruction of the upper lateral lip subunit is challenging, and use of several classical local flaps have been previously reported. However, these methods have drawbacks such as visible scarring, anatomic distortion, and functional disability. To obtain satisfactory results, preservation of perioral function is important. We report a case of functional upper lip reconstruction after tumor resection using a reverse facial-submental artery island flap with a reinnervated anterior belly of the digastric muscle (ABDM) without sacrificing the perioral structure. A 73-year-old man presented with basal cell carcinoma on the left upper lip which was widely excised, including the orbicularis oris muscle. The remaining 4 cm × 3.5 cm defect was reconstructed using a reverse facial-submental artery island flap with ipsilateral ABDM. The motor nerve of the ABDM was sutured with the stump of the buccal branch of the ipsilateral facial nerve. The postoperative course was uneventful, and good functional and esthetic recovery were observed at 12-month follow-up. This procedure may be an alternative option for reconstruction of lateral upper lip defects.

## Keywords

- ▶ plastic surgery
- ▶ carcinoma
- ▶ basal cell
- ▶ surgical flaps

The lateral lip subunit not only functions as an oral sphincter but also serves as an attachment or transition part of the lip elevators, anatomically. Therefore, when performing reconstruction including the mimetic muscles, lost muscular function should be regained without sacrificing the function of adjacent mimetic muscles including the modiolus. Conventional flaps, such as the Abbe flap and Estlander flap,<sup>1,2</sup> restore sphincter function within 1 year via reinnervation of denervated muscle from the same facial nerve.<sup>3</sup> However, it has drawbacks, such as displacing the modiolus, leaving scars on the lower lip, and making the lip tight when the

defect is large. Local flaps, including the levator labii superioris, can help regain sphincter function by its reinnervation from the buccal branch of the facial nerve, but pose concerns, such as mass movement, and decreased lip elevation function.<sup>4</sup> A nasolabial orbicularis oris myocutaneous flap, nourished by the facial artery, is created to restore oral sphincter function by advancing the orbicularis oris muscle and achieve good esthetics.<sup>5</sup> However, it has disadvantages, such as visible scarring, around the oral commissure and slightly small mouth. Free flaps conjoining the neurovascular muscle are useful for a dynamic reconstruction of moderate

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or subtotal defect of the full-thickness lip without sacrificing perioral musculature; however, these procedures are more invasive and complicated.<sup>6</sup>

Herein, we report a case of functional upper lip reconstruction after tumor resection using a reverse facial-submental artery island flap with reinnervated anterior belly of the digastric muscle (ABDM) without sacrificing the perioral structure.

## Case Report

A 73-year-old man had a 3 cm × 2.5 cm basal cell carcinoma of the left upper lip. After full-thickness excision of the skin and orbicularis oris muscle with a 5-mm surgical margin, almost the entire lateral lip subunit was resected, leaving the vermilion and oral mucosa. An 8 cm × 4 cm skin paddle with a 3 cm × 7 cm long ipsilateral ABDM, located between the digastric fossa of the mandibular internal surface and intermediate tendon, was elevated, including its feeding vessels such as the submental artery and vein (→Figs. 1A, 2A). The mylohyoid nerve, which is the motor nerve of the ABDM, was secured to obtain a nerve length of 3 cm. The submental artery and vein were dissected to the bifurcation of the trunk of the facial artery and vein, and the distal part of the facial artery and vein were severed to create a reverse-flow flap which was transferred to the upper lip through a subcutaneous tunnel. The skin paddle was rotated approximately 90 degrees to match the direction of the orbicularis oris muscle fibers to that of the ABDM (→Figs. 1B, 2B). After the stump of the mylohyoid nerve was sutured to the buccal branch of the facial nerve (→Fig. 2C), the ABDM and skin paddle were trimmed and sutured to the tissue defect (→Fig. 2D).

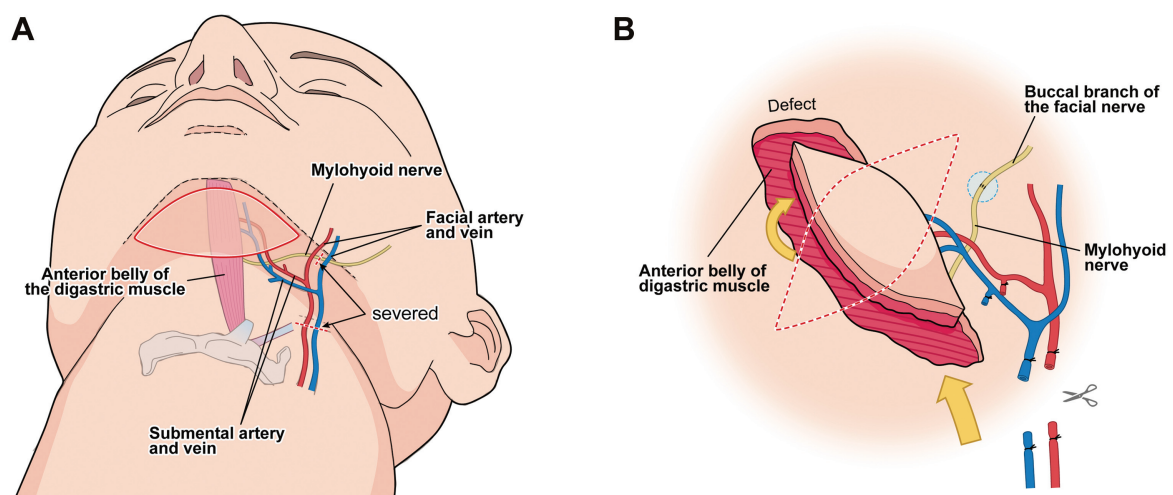
The flap showed very mild congestion but survived without necrosis. However, because of its bulkiness, defatting of

the flap was performed 3 months postoperatively. Four months postoperatively, there was contraction of the transferred muscle, and 12 months postoperatively, satisfactory voluntary contraction of the transferred muscle and color and texture match of the flap were observed (→Fig. 3A, 3B).

This study was performed with respect to the ethical standards of the Declaration of Helsinki. The patient provided written informed consent for the publication and the use of his images.

## Discussion

The reverse facial-submental artery flap has been used for reconstruction of moderate defects in the oral cavity, oropharynx, maxilla, and periorbital region where the conventional submental artery flap cannot be reconstructed by severing the distal facial vessels to increase the mobility of the vascular pedicle.<sup>7-9</sup> The hemodynamics of the reversed submental artery flap should be divided into reverse arterial inflow and venous outflow. A previous study on reverse flow demonstrated no significant change in the mean intra-arterial pressure in the facial artery after proximal ligation, and a stable reverse arterial flow was obtained by anastomosis with the contralateral upper and lower labial arteries and the lateral nasal artery.<sup>10</sup> Further, it is necessary to consider the presence of venous valves for venous outflow of the retrograde flap. While Nishihara et al reported in a study using cadavers that facial veins lack valves,<sup>11</sup> venous valves were observed at minimum of one site in the facial vein, and at three sites on an average, especially under the mandible. Using a rabbit model, Jing et al<sup>12</sup> showed that venous return is through “bypass route” in its initial course, while in the later course, the venous retrograde return is through “bypass route” and “incompetent valves route.” In our case, since the



**Fig. 1** Operative schema of a reversed facial-submental artery flap with ipsilateral ABDM. (A) The skin paddle with the ABDM is elevated and its motor nerve, mylohyoid nerve is severed. The vascular pedicle is severed at the distal trunk of the facial artery and vein. (B) After the flap is transferred to the upper lip defect, the skin paddle (red dotted flap) is rotated ~90° to match the direction of the orbicularis oris muscle fibers to that of the ABDM (slanted line). The ABDM is trimmed and sutured to the defect of the orbicularis oris muscle, and the mylohyoid nerve is sutured to the stump of the left buccal branch of the facial nerve in end-to-end fashion (light blue dotted circle). ABDM, anterior belly of the digastric muscle.



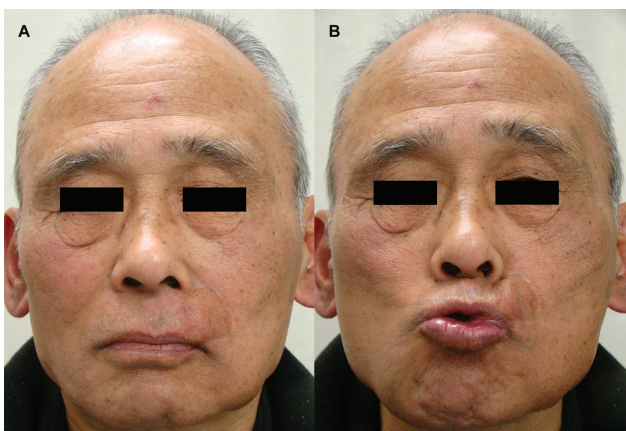


**Fig. 2** Intraoperative views. (A) The reversed facial-submental flap with ABDM was elevated. (B) The flap was transferred to the upper lip defect. (C) The mylohyoid nerve was sutured to the stump of the left buccal branch of the facial nerve in end-to-end fashion, and the ABDM was sutured to the muscular defect. (D) The redundant skin was trimmed and sutured. ABDM, anterior belly of the digastric muscle.

congestion was very mild and transient, it is possible that the venous valve in the lower margin of the mandible was drained by regurgitation.

The ABDM originates from the digastric fossa on the inner surface of the mandible and passes downward and backward and inserts or turns into the intermediate tendon which

attaches to the hyoid bone.<sup>13</sup> The ABDM could be classified as a type-II muscle with a major pedicle and two minor pedicles, according to the system of Mathes and Nahai.<sup>14,15</sup> The artery courses over the posterior surface of the anterior belly of the digastric muscle, giving off the major dominant pedicle of the muscle, approximately 1 cm after exiting behind the submandibular gland, before the middle region of the muscle. Faltaous and Yetman<sup>15</sup> studied 24 cadavers and reported that the submental artery runs deep into the ABDM in 70% of cases and runs superficial to the ABDM in 30% of cases. The mylohyoid nerve is a branch of the mandibular nerve that arises from the inferior alveolar nerve, just before it enters the mandibular canal. The nerve consistently contributes to the ABDM without branches until it appears at the posterior border of the mylohyoid muscle. Since the ABDM is 2-cm longer than the zygomaticus major, it has sufficient length to replace this muscle.<sup>13</sup> It can also separate nerves and vascular pedicles independently, and it has the potential for dynamic reconstruction of the mimetic muscles lost after tumor ablation, trauma, and facial nerve paralysis.<sup>16</sup> Terzis and Kalantarian demonstrated the reconstruction of lower lip depressors with ABDM.<sup>17</sup> Both the mandibular origin and the tendinous insertion were severed



**Fig. 3** Postoperative views. (A) Postoperative views 12 months after the surgery, at rest. (b) Upon pursing the lips.

and split into four slips while preserving the neurovascular pedicles. They also reported a method of reinnervating ABDM by suturing its motor nerve with a cross-facial nerve graft in an end-to-end fashion near its entry point into the muscle but limiting it to the reconstruction of the lower lip depressors. The submental flap is widely used for the upper lip reconstruction, but to the best of our knowledge, this is the first to report the combination of the submental flap and reinnervated ABDM.

The procedure followed in our case has certain drawbacks such as the skin flap becoming bulkier and sometimes requiring secondary correction and nonsuitability for cases of regional metastatic disease involving the ipsilateral level-I lymphatic tissue bed. However, there are advantages that it is safe, quick, and simple to elevate; it allows a well-hidden donor site scar with minimal morbidity; the elongation of the vascular pedicle by its proximal ligation increases the flexibility of muscle placement, so it can be used for dynamic reconstruction of not only the lower lip depressor muscle but also the orbicularis oris and the lip elevators or orbicularis oculi muscle; even if the mimetic muscle defect is large, it can obtain reliable reinnervation of the transferred muscle by motor nerve coaptation; both the upper lip skin and orbicularis oris muscle complex can be reconstructed without sacrificing the perioral structure and the flap including the mustache.

## Conclusion

The reverse facial-submental artery island flap with ipsilateral ABDM may be a versatile and reliable option for functional and esthetic reconstruction of lateral upper lip defects.

### Author Contributions

Conceptualization: S.H. Methodology: S.H. and T.M. Preparing original draft: S.H. Approval of final manuscript: S.H. and T.M.

### Ethical Approval

This study was approved by the relevant institutional review board and performed in accordance with the principles of the Declaration of Helsinki.

### Patient Consent

Informed consent was obtained from all individual participants included in the study.

### Conflict of Interest

None declared.

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