

Clinical Paper  
Reconstructive Surgery

# Anterolateral thigh flap with a central hole for the repair of extensive oral defects in patients treated for chemotherapy-induced trismus

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**Abstract.** Trismus is a rare complication of chemotherapy. The usefulness of a modified anterolateral thigh (ALT) flap for the repair of extensive oral defects in patients treated for chemotherapy-induced trismus was evaluated. Between 2019 and 2021, three patients with chemotherapy-induced trismus underwent scar excision. A thinned ALT flap with a central hole was designed to repair the resultant oral mucosal defects. The patients were followed up for a mean 9.3 months (range 4–18 months). The mean pre- and intraoperative maximum inter-incisal opening (MIO) was 0.7 cm (range 0–2.0 cm) and 3.6 cm (range 3.4–3.7 cm), respectively, indicating a significant operative effect. MIO at the latest follow-up was 2.4 cm (range 1.5–3.5 cm). All of the flaps survived without complications. All patients achieved a good diet and were satisfied with the aesthetics. Thorough excision of the perioral scar and restoration with a modified ALT flap achieved satisfactory mouth opening and cosmetic effects in patients with chemotherapy-induced trismus.

**Keywords:** Drug therapy; Trismus; Free tissue flaps; Reconstructive surgical procedures; Microsurgery.

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Chemotherapeutics are known to cause common side effects, including mucositis. Oral mucositis has been reported to occur in 20–40% of patients who receive chemotherapeutics.<sup>1</sup> Among those receiving very high doses of chemotherapy before bone marrow transplantation, oral mucositis is seen in

75–80%.<sup>2</sup> Severe oral mucositis and ulcers often cause scar formation and result in fibrosis, contracture, and trismus. This potentially devastating clinical manifestation leads to poor oral hygiene and makes proper dental care difficult, leading to severe impairment

of oral function and a decrease in patient quality of life.

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The treatment of chemotherapy-induced trismus requires the inciting cause to be addressed. Treatment may require release of the mucosa, submucosa, temporalis muscle, and masseter muscle, as well as coronoidectomy. The repair of defects after perioral scar release is challenging because of their extent, which includes the entire mucosa of the upper lip, lower lip, and bilateral cheek, and the fact that an improper restoration design may cause secondary fibrosis, contracture, and even trismus.

The anterolateral thigh (ALT) flap can be selected for the defect repair, based on the appropriateness of the tissue composition, size, and pliability. Moreover, no other donor site offers such a large amount of tissue with such limited donor site morbidity.<sup>3</sup> To avoid secondary contracture, the ALT flap can be designed as an integrated structure, and a central hole can be fabricated as an oral fissure. However, the traditional ALT flap is often too bulky for resurfacing chemotherapy-induced oral defects; thus, a secondary debulking procedure is often required.

The aim of this study was to report on the first patients treated at Peking University School and Hospital of Stomatology with an ALT flap with a

central hole to repair extensive oral mucosa defects and correct trismus secondary to chemotherapy.

**Patients and methods**

This study was approved by the Ethics Committee of Peking University School and Hospital of Stomatology (PKUS-SIRB-202272034). Written informed consent was obtained from each patient and the surgery was performed in accordance with the World Medical Association Declaration of Helsinki (version 2002).

From 2019–2021, three patients (two women, one man; mean age 52.7 years) were admitted to the Department of Oral and Maxillofacial Surgery, Peking University School and Hospital of Stomatology with the same chief complaint of severe trismus after chemotherapy. The three patients had received chemotherapy for an invasive mole, breast cancer, and left buccal mucosa cancer, respectively. Physical examinations were performed, including measurement of the maximum inter-incisal opening (MIO) and the extent of the perioral scars.

Surgical planning consisted of three steps: step 1 involved excision and

release of the perioral scar; step 2 was harvesting of the ALT flap with a central hole; step 3 was positioning of the ALT flap to repair the perioral soft-tissue defect (Fig. 1).

**Surgical technique**

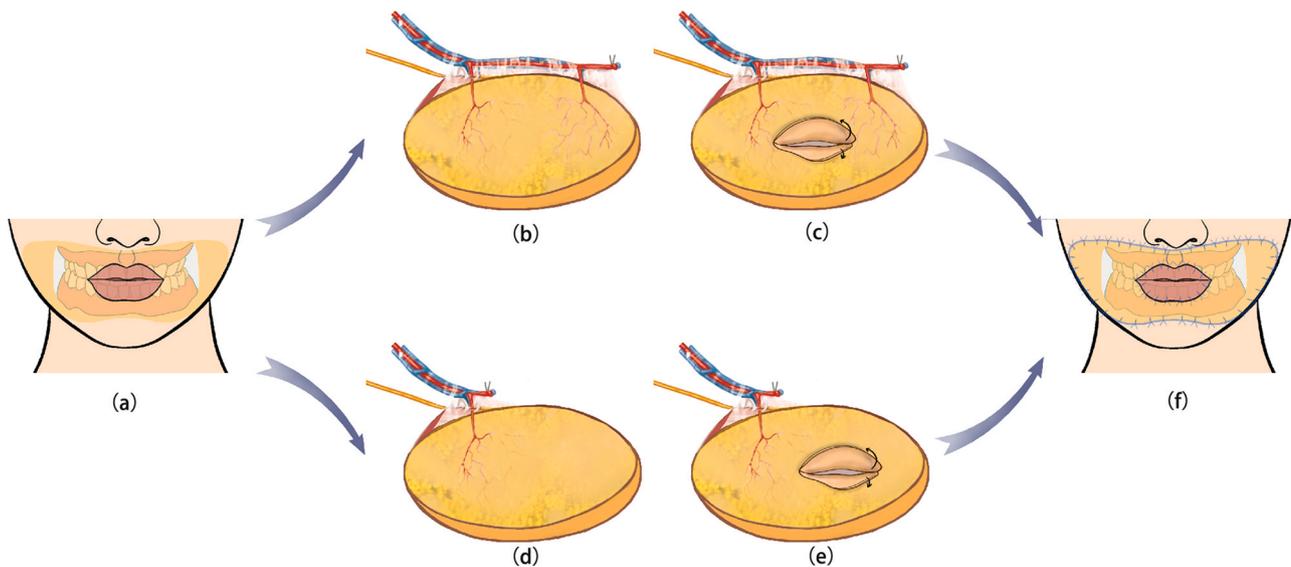
**Excision and release of contracture**

All surgical procedures were performed with a transoral approach. None of the patients required lip splits or a mandibulotomy for exposure. Trismus was addressed by release and excision of the lip and buccal mucosa, submucosa, and scar tissue, myotomy of the masticatory muscles, and coronoidectomy (Fig. 2).

**Harvesting of the ALT flap with a central hole**

The extent of the soft-tissue defect was measured after release of trismus. The ALT flap was prepared according to the size of the defect.

Regarding the location of the perforating vessels and design of the transverse incision for the central hole, if a second perforator was found distal to the main perforator, making it possible to preserve two vessels, the transverse incision was located in the middle



*Fig. 1.* Surgical design for the repair of extensive oral defects after chemotherapy-induced trismus using an ALT flap with a central hole. Step 1: Excision and release of the contracture. The defect involved the upper and lower vestibular sulcus, buccal, and even parapharyngeal areas (a). Step 2: An ALT flap of appropriate size was designed according to the range of the soft-tissue defect. If the ALT flap had two branches (b), a transverse incision in the middle of the ALT flap was designed (c). If the ALT flap had only one branch (d), a transverse incision on the opposite side of the branch was designed (e). Step 3: The ALT flap was fixed to the perioral soft-tissue defect. The parapharyngeal and the vestibular regions were sutured first. The skin side of the ALT flap was sutured towards the oral cavity, and the tissue side of the ALT flap was sutured towards the defect. Finally, the skin around the transverse incision was flipped over to repair the upper and lower lips (f).

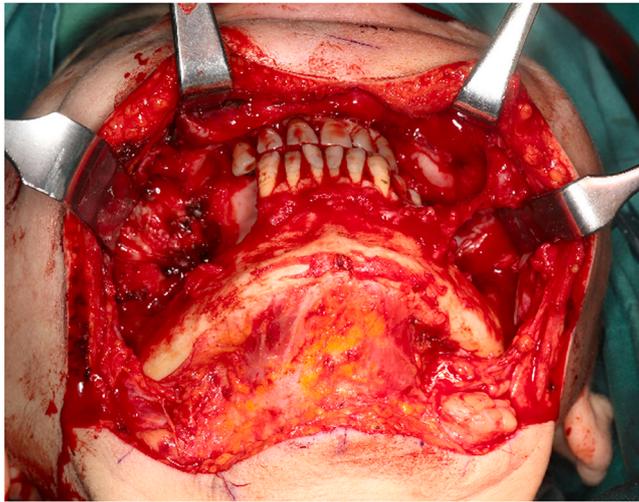


Fig. 2. Trismus was addressed by release and excision of the lip and buccal mucosa, submucosa, and scar tissue, myotomy of the masticatory muscles, and coronoidectomy.



Fig. 3. An ALT flap of an appropriate size was designed according to the extent of the soft-tissue defect.

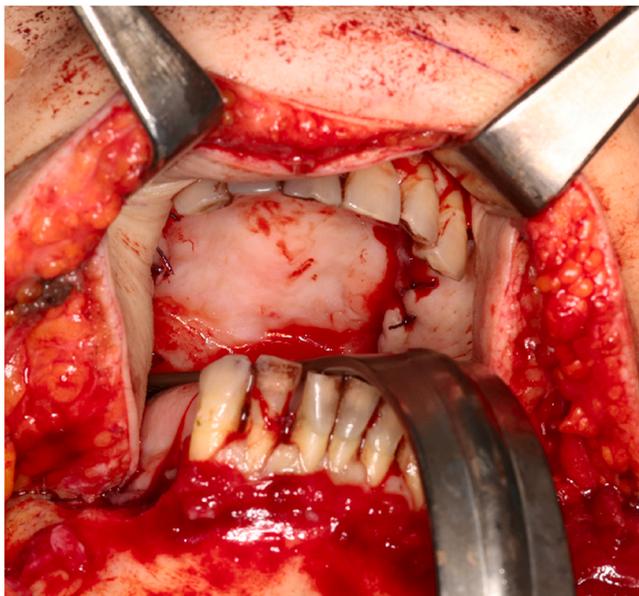


Fig. 4. The outer edge of the ALT flap was sutured to the pharyngeal side of the defect and the bottom of the vestibule. The skin side of the ALT flap was designed to be positioned towards the oral cavity as oral mucosa.

of the flap. If there was only one perforator, the transverse incision was designed to be located to the side of the flap, on the opposite side to the perforator (Fig. 3).

The ALT flap was then thinned. For intraoral defect cover, the thickness of the flap can be disadvantageous. Muscle or fatty tissue must be removed without injuring the cutaneous vessel, obtaining a flap thickness of only 3–4 mm.

#### Positioning the ALT flap

The ALT flap was positioned to restore the soft-tissue defect. In the first step, the outer edge of the flap was sutured to the pharyngeal side of the defect and the bottom of the vestibule. The skin side of the ALT flap was positioned towards the oral cavity as the oral mucosa (Fig. 4). The tissue defect was filled with the tissue side of the ALT flap. The second step was flipping over the skin around the transverse incision to accomplish the upper and lower lip reconstructions (Fig. 5). An extensive soft-tissue defect including the buccal and mandibular vestibule could be thoroughly restored using the ALT flap with a central hole (Fig. 6). MIO was measured immediately after surgery.

#### Results

The mean follow-up period for the three patients was 9.3 months (range 4–18 months). The mucosa healed well without complications. All of the flaps survived, and no recipient site or severe donor site complications were observed during follow-up. The mean pre- and intraoperative MIO was 0.7 cm (range 0–2.0 cm) and 3.6 cm (range 3.4–3.7 cm), respectively, indicating a significant operative effect. MIO at the latest follow-up was 2.4 cm (range 1.5–3.5 cm). All three patients had a better diet after the surgery and were satisfied with their aesthetics (Fig. 7).

#### Discussion

Patients with chemotherapy-induced trismus cannot eat by mouth, inevitably resulting in compromised nutrition intake, and speech and breathing function are impaired, causing severe functional deficits and psychological stress in the patient's daily life.

The most common evaluation system used to quantify the damage caused by



Fig. 5. The final appearance after surgery. The tissue side of the ALT flap with fat was sutured towards the buccal and mandibular vestibule in order to fill the soft-tissue defect. The lips were restored.



Fig. 6. The skin around the transverse incision was flipped over to imitate the upper and lower lips. An extensive soft-tissue defect including the buccal and mandibular vestibule could be thoroughly restored using an ALT flap with a central hole.

chemotherapeutics in the oral mucosa is the World Health Organization (WHO) classification of oral mucositis. Surgical treatment remains the most effective method for the management of severe and irreversible chemotherapy-induced trismus (grade 3–4 in the WHO classification of oral mucositis), which usually includes excision of the buccal fibrotic mucosa, scarred buccinator and masseter muscles, and even coronoidectomy and temporalis muscle detachment from the coronoid process.<sup>4</sup>

However, defect repair after perioral scar release is difficult. The extensive oral defect includes the entire mucosa of the

upper lip, lower lip, and both cheeks. Therefore, the flap chosen for reconstruction should provide a large amount of soft tissue. Simple methods such as healing by secondary intention and skin grafting often cause scar formation and result in fibrosis, contracture, and trismus. Vascularized tissue transfer using local, regional, or distant tissue (free tissue transfer) is an optimal method for restoring relatively large intraoral defects. The flap selection depends mainly on the amount of soft tissue required.

An ALT flap is the first choice whenever it is available and when a wider and

thicker flap is required.<sup>5</sup> This flap, which is widely used for reconstructive surgery, provides full-thickness skin for superior resurfacing and has previously been demonstrated to be reliable and safe for reconstruction in head and neck burn cases, with a technical success rate of 94%.<sup>6,7</sup> An improper restoration design may lead to secondary fibrosis, contracture, and even trismus. Therefore, the flap must have an integrated structure. Lip splits and mandibulotomy for exposure should be avoided. Nevertheless, the thigh thickness may limit the application of the ALT flap for lip and cheek reconstruction. Therefore, aggressive thinning is essential.

In the present study, lip splits and mandibulotomy were avoided to reduce scar contracture, and an oral fissure was fabricated through a hole in the centre of the ALT flap. The ALT flaps were thinned to avoid plumpness in the maxillofacial region. The drooping and loosening of the reconstructed lip, together with labial symmetry, were corrected using a fascial sling. The tension of the fascial suturing was adjusted to provide suspension to the flap by establishing anchorage to the remaining orbicularis oris muscle to achieve oral competence.

In addition to chemotherapy-related oral mucositis, there are many other diseases that may cause intraoral scar contracture and trismus, such as pseudoankylosis of the temporomandibular joint (TMJ) caused by noma and oral submucosal fibrosis. Their clinical characteristics and pathogenesis are similar to chemotherapy-induced trismus. In these patients, trismus is mainly due to inflammation or prolonged chewing of areca, which results in damage to the oral mucosa and starts a primary inflammatory reaction (mucositis). Thus, the ALT flap with a central hole may be an option for patients with TMJ pseudoankylosis or oral submucosal fibrosis. The high number of such patients – there are more than five million patients with oral submucosal fibrosis worldwide<sup>8</sup> – may promote the application and development of this technology.

If the patient cannot adhere to post-operative physiotherapy, the trismus may recur.<sup>9</sup> We recommend stretching exercises starting from 2 weeks after surgery and continuing for 12 months or even longer.

If effective prevention is applied during chemotherapy, the chemotherapy-induced mucositis may be limited to grades 1–2, which is good news for the patient. Medical evaluation,



Fig. 7. Preoperative and postoperative appearance of two patients.

immunity enhancement, and leukocyte counts should be performed during chemotherapy to help screen for potential chemotherapy-induced trismus. Medication and avoidance of irritation are helpful in the treatment of chemotherapy-induced mucositis.

The ALT flap with a central hole is the authors' first modification of the ALT flap. Further research will be conducted on the personalized design of the central hole. The treatment of chemotherapy-induced mucositis involves multiple disciplines such as medical oncology, immunology, oral and maxillofacial surgery, and rehabilitation. Future studies that focus on the multidisciplinary synthetic treatment of chemotherapy-induced trismus should be conducted. Owing to the relatively short follow-up time and limited number of patients, the study findings should be interpreted with caution.

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#### Competing interests

None.

#### Ethical approval

This study was approved by the Ethics Committee of Peking University School and Hospital of Stomatology (PKUS-SIRB-202272034).

#### Patient consent

Written informed consent was provided by all patients included in this study.

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