

Original Article

A Case Series on Lip Reconstruction Using a Novel Double-Layer, Double-Flap Technique

Choi Ji min¹, Jung Soo bin^{1*}

¹Department of Oral and Maxillofacial Surgery, Wonju Severance Christian Hospital, Yonsei University, Wonju 26426, Republic of Korea.

*E-mail ✉ jung.soobin2025@gmail.com

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ABSTRACT

Lip reconstruction after ablative surgery has traditionally relied on primary closure, with free flap transfers emerging as a more recent approach. Cheek skin flaps have often been employed to restore the cutaneous portion of the lower lip. In this study, we describe a combined reconstructive strategy using the Goldstein–Robotti technique to rebuild the vermilion, alongside a buccinator flap to restore the lip’s cutaneous layer and perioral muscles. This double-layer method enables full reconstruction of defects involving more than one-third of one or both lips, including the modiolus, while providing satisfactory functional and cosmetic outcomes. The procedure involves carefully splitting and extending the upper and lower buccinator muscle bundles, performed either individually or together, with blunt dissection to protect facial nerves and vessels and preserve blood supply and partial lip sensation. The technique remains feasible even when facial vessels are ligated during neck dissection by relying on branches of the internal maxillary artery and contralateral facial vessels. We present six cases involving upper and lower lip defects, including commissural involvement, following excision of squamous cell carcinoma or polymorphous adenocarcinoma. All reconstructions demonstrated good aesthetic results, functional recovery, and restoration of tissue symmetry in both static and dynamic states.

Keywords: Oral cancer, Lip-reconstruction, Plastic surgery, Orbicularis muscle, Buccinator muscle

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Introduction

Head and neck cancers rank as the sixth most common malignancy worldwide [1], with squamous cell carcinoma (SCC) of the lower lip accounting for over one-quarter of all oral cancers [2]. Lip SCC predominantly affects men over 45 years old and is strongly associated with chronic sun exposure, tobacco and alcohol use, systemic lupus erythematosus, cheilitis, and leukoplakia, with risk factors acting individually or synergistically [2–5]. The accumulation of DNA damage from these exposures, compounded by defects in DNA repair mechanisms, contributes to cancer development and progression, prompting recent studies aimed at identifying predictive DNA repair

biomarkers to enhance diagnosis, prevention, and treatment of lip cancer [6].

Various techniques for lip reconstruction have been documented, ranging from simple primary closure to local or free flap transfers, each offering distinct benefits and limitations. Lip reconstruction has a long-standing history in facial plastic surgery, with modern approaches often derived from or combining classical methods. Frequently employed techniques include the “fan flap” described by Gillies, the Estlander lip exchange, and Grimm’s “universal principle” for lower lip reconstruction.

Gillies’ foundational principle emphasizes “like with like” tissue replacement, using flap rotation from the opposite lip to maintain aesthetic and functional

integrity of the sphincter. However, such methods often result in microstomia, as tissue is transferred from the unaffected lip without introducing additional tissue volume.

Due to the significant aesthetic and functional impact of ablative surgery, alternative treatments for SCC have been explored, including electrochemotherapy for patients unsuitable for or unwilling to undergo surgery [7, 8]. Despite various reconstructive strategies, we advocate for the superior anatomical, functional, and aesthetic outcomes achievable with local flaps. To enhance reconstruction, we have developed a technique combining two flaps at distinct levels: the buccinator flap from the cheek to restore tissue bulk, and the orbicularis Robotti flap to reposition the elastic vermilion, addressing both functional and cosmetic requirements [9].

Lower lip SCC is aggressive, often invading muscle and, in advanced cases, bone, with metastases typically involving cervical lymph nodes. In this series, all patients had SCC except one with a polymorphous adenocarcinoma (PA), a rare malignancy of the minor salivary glands, usually arising in the palate and oral cavity, most common in women during the sixth to seventh decades. Lip localization is uncommon (~7%), and these tumors are generally around 2 cm at diagnosis with low rates of distant metastasis (4.3%) and excellent survival outcomes, for which surgery remains the primary treatment [10].

For SCC, radical surgical excision with 1.5 cm margins and neck dissection for lymph node removal remains the cornerstone of treatment [11], while chemotherapy, radiotherapy, or combined modalities, including electrochemotherapy, represent adjunct or alternative therapies [7, 12].

After lip excision, reconstruction can be performed via primary closure for small defects or through local or free flap techniques for larger resections. Compared to free flap reconstruction, primary closure and local flaps offer advantages such as reduced scar formation, better functional and aesthetic outcomes, and lower donor site morbidity. Primary closure is straightforward and produces a linear scar but is unsuitable for extensive resections, as it may result in microstomia. For larger defects, local flaps—including Abbe, Estlander, Bernard, or V-Y advancement flaps—are generally preferred [13].

Reconstruction becomes particularly challenging in full-thickness resections or extensive defects that affect multiple regions of the lips, as it requires restoration of both the skin and mucosa with matching texture, color, and associated structures. For these reasons, local flaps are considered superior to other flap types for lip reconstruction.

Current techniques face limitations when reconstructing defects that involve more than one-third of a lip, a hemi-lip, the commissure, or both lips. Many standard methods rely on tissue transfer from the opposing lip, as described by Estlander, Gillies, and Millard, to rebuild the muscular ring. This approach often results in insufficient orbicularis oris tissue, and subsequent commissuroplasty for microstomia can lead to functional and aesthetic deficits, necessitating secondary procedures [14].

The lip comprises two distinct anatomical and functional components: the cutaneous portion, which contains muscles responsible for lip mobility, and the vermilion, supported by the orbicularis oris ring essential for sphincter function during activities such as suction. Effective reconstruction requires integration of both systems to restore speech, facial expression, and mastication.

Techniques that rely solely on tissue from the opposite lip tend to produce suboptimal results, transferring defects without providing additional tissue for the orbicularis oris ring. Similarly, regional or distant free flaps fail to adequately restore the natural anatomy, aesthetics, and functional texture of the orbicularis ring.

This study presents a novel reconstruction method that combines two approaches: the Robotti technique for vermilion and orbicularis ring restoration, and a muco-myo-cutaneous cheek flap based on the buccinator muscle pedicled on either the facial or internal maxillary vessels to reconstruct the cutaneous lip portion [9, 12]. This method effectively addresses both anatomical layers of the lip. The buccinator muscle, as a direct continuation of the orbicularis oris before fiber decussation at the modiolus, provides tissue that closely matches the native lip structure, facilitating a natural and functional reconstruction following tumor resection.

Materials and Methods

Patients

From September 2016 to March 2021, the Maxillofacial Reconstructive Surgery Unit at San Giovanni di Dio and Ruggi d'Aragona University Hospitals in Salerno treated around 20 patients who required reconstruction of lip and commissure defects following ablative procedures. For this study, six cases were specifically selected for detailed chart analysis; all had been reconstructed using our combined approach, which integrates a composite buccinator cheek flap with orbicularis muscle and vermilion reconstruction flaps based on the Robotti technique (Table 1).

Table 1. Summary of Patients' Characteristics

Patient No.	Sex	Age (Years)	Diagnosis	Defect Location	Postoperative Complications	2PDT	Oral Competence	Microstomia	Dynamic Aesthetic Outcome	Symmetry	Follow-up (Months)
1	M	67	SCC	Middle portion of lower lip, ~30%	None	Protective	Very good	Absent	Very good	Very good	6
2	M	63	SCC	Right commissure, 45% upper lip & 25% lower lip	None	Protective	Very good	Absent	Very good	Very good	35
3	M	73	SCC	Left commissure, 40% lower lip & 20% upper lip	None	Protective	Good	Absent	Good	Good	40
4	M	60	SCC	Commissure of lower lip, 40% & ipsilateral upper lip, 20%	None	Protective	Good	Absent	Good	Good	24
5	M	59	SCC	Right commissure, 25% upper lip	None	Protective	Good	Absent	Good	Good	38
6	F	65	PA	Left upper lip, 30%	None	Protective	Very good	Absent	Good	Very good	1

Abbreviations: M = male; F = female; SCC = squamous cell carcinoma; PA = polymorphous adenocarcinoma; 2PDT = two-point discrimination test.

Demographic, clinical, and surgical information for all patients was gathered from medical records, clinical photographs, and patient interviews. Patients eligible for inclusion were those with malignant tumors requiring full-thickness resection of the lips. Exclusion criteria comprised patients with distant metastases, neurological disorders, tumor recurrence after previous treatments, partial-thickness lower lip defects, defects involving less than one-third of the lower lip, or incomplete medical records/follow-up.

The final cohort included six patients—five men and one woman—with a median age of 64 years. All patients exhibited post-ablative defects affecting the lower and/or upper lip exceeding 30% of the lip area, or involving the oral commissure in all but one case. All male patients had squamous cell carcinoma of the lip, while the female patient had a polymorphous adenocarcinoma, as detailed in **Table 1**.

Preoperative evaluation included computed tomography and ultrasonography, confirming local tumor extension without lymph node involvement, also verified by neck ultrasonography for the lymph node hilum. Patients were admitted the day before surgery and received prophylactic intravenous antibiotics. Due to absence of preoperative signs of lymph node involvement, no neck dissection was performed; instead, postoperative surveillance with

ultrasonography was scheduled every three months during the first 2 years and every six months thereafter. Surgical excision was full-thickness with a clinically determined 1.5 cm margin of tumor-free tissue. Post-excision, fresh biopsies of the margins confirmed the absence of tumor invasion. Reconstruction using our technique was completed in all patients during the same surgical session. Follow-up ranged from 1 month to over 3 years (mean: 24 months; median: 29.5 months). All patients provided informed consent in accordance with the 1975 Helsinki Declaration, as amended in 1983. The study received approval from the local ethics committee for institutional research (protocol n° 38/06).

Surgical reconstruction technique

The lip's functional and anatomical integrity was preserved by carefully elevating the flap with blunt dissection, maintaining most of the vascular and neural supply, while addressing the cutaneous and vermilion regions using two separate reconstruction strategies. The cutaneous segment was restored with a composite muco-myo-cutaneous flap from the cheek, and the vermilion was reconstructed via a sliding flap following the Robotti method, using the orbicularis oris muscle and vermilion from the healthy contralateral lip.

Reconstruction commenced after tumor removal with the cutaneous flap, forming a V-Y flap over the buccinator muscle. Following V-Y incisions of skin and mucosa, blunt separation of the two buccinator muscle bundles was performed, preserving facial vessels and most sensory and motor innervation. The distal portions of the bundles were divided to reconstruct the outer lip defect—affecting either the upper, lower, or both lips, including the modiolus—together with the overlying skin and mucosa. This method allowed advancement of the composite flap while safeguarding vascular and neural structures. Depending on the defect size, a single bundle could suffice for reconstruction of one lip, while both bundles were used when necessary. The neo-modiolus was recreated by suturing the buccinator bundles at the targeted location, followed by closure of skin and mucosa in a V-Y configuration.

For the vermillion, the sliding flap technique according to Robotti was employed, leveraging the flap's natural elasticity [9]. The flap was initially incised at the vermillion–skin junction, with a corresponding mucosal incision on the inner lip. The incision began 0.5 cm from the commissure of the unaffected side to preserve orbicularis vessels. The flap's elastic muscular and vascular components allowed full reconstruction of both lips. When the upper and lower lip and modiolus were involved, the two flaps were joined at the neo-modiolus formed by the contralateral buccinator bundles, with opposing flap tension naturally balancing, thus avoiding the need for traction sutures.

Results and Discussion

The outcomes are summarized in **Table 1** according to several parameters, including postoperative complications, lip sensitivity assessed by the two-point discrimination (2PDT) test (classified as normal, fair, poor, protective, or hypoesthesia), oral competence (rated poor, acceptable, good, or excellent), microstomia (absent, mild, or significant), dynamic aesthetic results (poor, acceptable, good, or excellent), and lip symmetry, evaluated both by the clinician and patient satisfaction.

- Two-point discrimination (2PDT): normal (<6 mm), fair (6–10 mm), poor (11–15 mm), protective (only one point perceived), hypoesthesia (no points perceived).
- Oral competence: excellent (normal function), very good (good lip competence with fully adequate oral sphincter function), good (adequate lip competence with acceptable sphincter function), acceptable (moderate lip competence

with limited sphincter function), poor (insufficient lip competence with poor sphincter control).

- Microstomia: absent (normal mouth opening allowing normal swallowing and prosthesis use), mild (adequate swallowing and prosthesis insertion), severe (impaired swallowing and inability to use prosthesis).
- Dynamic aesthetics: excellent (normal), very good (very good aesthetic with functional oral sphincter), good (acceptable aesthetic with good oral function), acceptable (moderate aesthetic with limited function), poor (unsatisfactory aesthetic and function).
- Symmetry: excellent (normal), very good, good, acceptable, poor.

During follow-up visits, oral competence, commissure symmetry, sphincter function at rest and during movement (chewing and speaking), and prosthesis compatibility were assessed. Overall, patients experienced an uneventful postoperative course without complications. All lesions were excised with a 1 cm safety margin, and histopathological analysis confirmed squamous cell carcinoma or polymorphous adenocarcinoma with tumor-free margins. Postoperative staging was T1N0 in all patients, and no ischemic complications were observed.

Functional outcomes included dynamic and resting symmetry, oral competence, mouth opening, prosthesis use, and lip sensitivity evaluated via 2PDT, alongside overall patient satisfaction.

Case 1: A 67-year-old male in generally good health, diagnosed with stage T1N0M0 squamous cell carcinoma, presented a lower lip defect exceeding one-third of the paramedian lower lip (**Figure 1**). Reconstruction was achieved using a modified double-layer technique, employing only the lower buccinator bundle combined with bilateral sliding orbicularis oris muscle flaps. Incisions were made along the vermillion edge and lateral skin of the unaffected lower lip, mirrored on the mucosal side, to elevate bilateral orbicularis and vermillion flaps. Blunt dissection of the buccinator flap allowed advancement of the composite muco-myo-cutaneous lower buccinator bundle without additional skin incisions, while portions of cheek skin reconstructed the cutaneous lower lip area. The procedure was mirrored on the contralateral side, followed by reconstruction of the vermillion and orbicularis using the Robotti sliding flap. The neo-modiolus was formed by suturing the upper buccinator bundle to the extended lower bundle (**Figure 2**). Blunt dissection preserved vascular and neural structures, resulting in favorable functional and aesthetic outcomes (**Figures 3 and 4**).



Figure 1. Case 1: Lower lip defect affecting over one-third of its length at the paramedian region.



Figure 2. Case 1: Post-surgical appearance.



Figure 3. Case 1: Six-month follow-up showing the lips at rest.



Figure 4. Case 1: Six-month follow-up showing the lips in motion.

Case 2: A 63-year-old male in relatively good health was diagnosed with squamous cell carcinoma affecting the right commissure and extending into both the upper

and lower lips, staged as T1N0M0 (**Figures 5 and 6**). Following tumor excision, the resulting defect involved the right commissure, approximately 45% of the upper lip and 25 percent of the lower lip, and was reconstructed in a single operation using local flap techniques. The reconstruction combined two complementary flap approaches to restore the cutaneous and vermilion components: a buccinator flap for the skin and a sliding orbicularis flap for the vermilion. The buccinator flap was modified in a V-Y advancement pattern, with the two muscle bundles separated to follow the functional anatomy of the cheek-lip complex, where each bundle integrates with the corresponding upper and lower orbicularis oris fibers at the modiolus. The upper buccinator bundle was used to reconstruct the upper lip's skin, while the lower bundle restored the lower lip's cutaneous area. The modiolus was reestablished by suturing the two bundles at their original anatomical site. Concurrently, vermilion reconstruction was achieved using two modified contralateral myo-mucosal flaps of the orbicularis and vermilion, following the Goldstein–Robotti method (**Figures 7 and 8**) [15].



Figure 5. Case 2: Squamous cell carcinoma involving the right commissure and spreading to both the upper and lower lips.



Figure 6. Case 2: Alternative view of squamous cell carcinoma affecting the right commissure and extending into the upper and lower lips.



Figure 7. Case 2: Surgical excision and reconstruction planning.



Figure 9. Case 2: Six-month follow-up showing the lips in motion from a frontal perspective.



Figure 8. Intraoperative view of reconstruction using the new technique.



Figure 10. Case 2: Six-month follow-up showing the lips in motion from a lateral perspective.

Thanks to the remarkable elasticity of the orbicularis muscle and its vascular supply, reconstruction of up to half of the lip was achieved by mobilizing muscle fibers from the healthy side toward the resected area. This approach restored the excised portion of the lip without shortening or compromising the unaffected upper or lower lip, thereby preserving the orbicularis oris ring and lip skin and preventing microstomia. Tissue harvested from the composite muco-myocutaneous cheek flap through careful blunt dissection maintained its blood supply and most innervation, allowing safe transfer to the defect site. Combined with the Robotti technique, this method enabled reconstruction of both the cutaneous base and vermilion, retaining the majority of the original lip sensitivity, mobility, and symmetry (**Figures 9 and 10**).

Case 3: A 73-year-old male presented with squamous cell carcinoma affecting the left commissure, staged T1N0M0. Surgical resection created a substantial defect involving the left commissure, 40 percent of the lower-left lip, and 20 percent of the upper-left lip. Reconstruction was achieved using a full-thickness buccinator flap combined with a contralateral vermilion sliding flap. Postoperative outcomes were satisfactory, with positive results on the two-point discrimination test, oral competence, and aesthetic evaluation at rest and during movement, and no recurrence was observed over a 40-month follow-up.

Case 4: A 60-year-old male heavy smoker with T1N0M0 squamous cell carcinoma underwent resection, resulting in a defect involving 40 percent of the lower lip, the commissure, and 20 percent of the ipsilateral upper lip. Reconstruction yielded satisfactory results, with normal two-point discrimination, oral competence, and aesthetic outcomes at rest and in motion, and no signs of recurrence after 24 months.

Case 5: A 59-year-old male with squamous cell carcinoma of the right commissure extending to 25 percent of the upper lip underwent resection and reconstruction. Postoperative outcomes were

favorable, showing good oral competence, symmetry, and mouth opening, with no recurrence after 38 months of follow-up.

Case 6: A 65-year-old female in good general health presented with a polymorphous adenocarcinoma (PA) of the left upper lip, staged T1N0M0. The patient had a small, asymptomatic swelling resembling a benign lesion (**Figure 11**). Biopsy confirmed PA with a pushing growth pattern, infiltrative areas in the fat, and perineural invasion. Preoperative CT, ultrasonography, and intraoperative sentinel lymph node assessment confirmed local invasion only, so surgical excision was selected as the sole treatment. Ablation removed 30% of the left upper lip, with frozen-section histology confirming tumor-free margins of at least 1 cm and a negative sentinel lymph node in the L1b station. Reconstruction was performed using a buccinator V-Y advancement muco-myo-cutaneous flap (**Figure 12**).

connecting the upper buccinator bundle along with its overlying skin and mucosa to the orbicularis oris muscle. The vermilion and orbicularis rings were rebuilt using an elastic sliding flap following the Goldstein–Robotti method. This technique produced excellent aesthetic and functional outcomes, retaining partial sensory and motor function as well as vascularization, without any suture breakdown, necrosis, or postoperative microstomia (**Figures 13–16**).



Figure 11. Case 6: Polymorphous low-grade adenocarcinoma of the left upper lip with surgical reconstruction planning.



Figure 12. Reconstruction of a 30% defect of the left upper lip using the newly described technique.

The approach involved making incisions on both the external cheek skin and inner mucosa, followed by careful blunt separation of the 2 buccinator muscle bundles while preserving facial blood vessels and nerve supply. The neo-modiolus was recreated by



Figure 13. Case 6: Eight-day follow-up showing the lips in motion from a frontal view.



Figure 14. Case 6: Fifteen-day follow-up showing the lips at rest from a frontal view.



Figure 15. Case 6: Six-month postoperative follow-up showing the lips at rest from a frontal perspective.



Figure 16. Case 6: Six-month postoperative follow-up showing frontal view of sphincteric muscle function.

Following Dr. Gillies' principle of reconstructing "like with like," we aimed to restore the complex lip region using tissue flaps that closely matched the resected structures, combining the buccinator flap with the Goldstein–Robotti orbicularis and vermillion flap technique [9].

Our approach challenges Bakamjian's 1964 assertion that achieving symmetric, functional, and aesthetically accurate lip reconstruction is "almost unreachable" [16]. The rationale of our method is grounded in anatomical and functional observations.

We divided the lips into two distinct components: (1) cutaneous and (2) vermillion. These regions differ in structure—the skin being thicker and less elastic, and the vermillion being delicate and highly elastic—as well as in function and mobility, particularly during smiling. To honor the "like with like" principle, we reconstructed each area using a dedicated flap: a cutaneous flap from the cheek for the skin portion and a vermillion-mucosa flap from the contralateral side of the same lip.

To preserve symmetry and the anatomy of the unaffected lip areas, we consistently used flaps from opposite sides to balance tension. By combining a buccinator flap for cutaneous reconstruction with a contralateral orbicularis sliding flap for the vermillion and sphincter function, we restored the resected lip's anatomy, aesthetics, and function in a single procedure, while maintaining the natural appearance of the unaffected lip segments and nose—an advantage over many conventional techniques.

An additional benefit is the ability to reconstruct both lips, including the modiolus, in a single stage. Anatomical continuity between the buccinator muscle bundles and the orbicularis oris after modiolus decussation supports this approach. The flap can be safely used even if the facial artery is ligated during neck dissection, as it can rely on either the facial or buccal branch of the internal maxillary artery [17].

Advancement of the buccinator bundles was facilitated by blunt dissection combined with V-Y skin and mucosa incisions.

Blunt dissection also minimized scarring compared to full-thickness techniques from the opposite lip. Furthermore, the vermillion and orbicularis reconstruction closely resembled the original tissue, as flaps were harvested from healthy portions of the lip, ensuring matching in texture, color, and structure.

Functional and aesthetic outcomes were highly satisfactory, with symmetry maintained at rest and during dynamic movements such as smiling, speaking, and chewing. Tissue texture, shape, and even partial sensory and motor nerve recovery were achieved. Importantly, the symmetry of the contralateral and unaffected lip regions was preserved, unlike many traditional flap techniques from the opposite lip, which often create traction and asymmetry affecting the nose and surrounding lip areas [15, 18–20].

Aesthetic and functional outcomes were assessed considering symmetry, shape, tissue texture, anatomical details, mouth opening, chewing ability, prosthesis use when needed, and partial preservation or recovery of neurosensory function, as presented in **Table 1**. Prior studies using similar approaches have also reported neurosensory preservation, supporting the theoretical basis of our method, although they achieved less favorable aesthetic and functional results [20].

Other authors using modified Bernard–Webster techniques reported comparable neurosensory outcomes, but their reconstructions were often unsatisfactory in appearance and function due to inadequate vermillion restoration and microstomia caused by harvesting tissue from the unaffected upper lip [20]. Similarly, a combined vermillion myomucosa and Abbe–Estlander flap technique resulted in noticeable microstomia, unlike our cases, which maintained normal oral aperture and preserved the symmetry of the alar nose [15].

Our approach also allows reconstruction of larger defects involving the modiolus and both upper and lower lips, as well as smaller, localized defects. By mobilizing tissue from the cheek, this technique avoids tension on the nose or unaffected lip areas and prevents microstomia, unlike methods that take tissue from the opposite lip, which can reduce the orbicularis oris ring. We propose that combining a buccinator muscle flap for the less elastic cutaneous portion with a vermillion–orbicularis sliding flap is the most effective solution, capable of reconstructing up to half of the lip without compromising the oral sphincter.

Conclusion

Our case series demonstrates that this technique effectively adheres to the fundamental principles of flap reconstruction, including “like with like” tissue replacement, preservation of neurosensory and vascular integrity, and maintenance of both static and dynamic symmetry of the lips—criteria often unmet by conventional methods.

The technique restores the continuity of the orbicularis oris by advancing vermilion from the contralateral lip, utilizing its elasticity to reconstruct the vermilion portion as seen during facial expressions. The cutaneous segment is reconstructed using cheek tissue and a split of the buccinator muscle bundles. Flap advancement relies on the facial or buccal artery, which is advantageous if the facial artery is ligated during neck dissection [17]. Blunt dissection combined with V-Y incisions ensures safe mobilization while preserving vascularization and innervation.

Using contralateral flaps in combination preserves functional and aesthetic symmetry, respecting the distinct anatomy and roles of the cutaneous and vermilion layers. This approach avoids using tissue from the opposite lip, maintaining the natural appearance of the unaffected lip and nose. Although results are promising, further validation with a larger patient series is necessary to confirm the technique’s effectiveness.

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