

Endoscopic versus open neck dissection for oral squamous cell carcinoma: a randomized controlled trial of surgical outcomes and short-term oncological safety

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Research Article

Keywords: oral squamous cell carcinoma, neck dissection, endoscopic neck dissection, open neck dissection, inflammatory stress, scar outcome

Posted Date: October 5th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10969972/v1>

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Additional Declarations: No competing interests reported.

Abstract

Objective

To compare clinical outcomes of endoscopic neck dissection (END) via a retroauricular hairline approach with conventional open neck dissection (OND) in patients with oral squamous cell carcinoma (OSCC).

Methods

This single-centre randomised controlled trial included 64 patients with OSCC treated between January 2024 and September 2025. Patients were randomly assigned to the END or OND group, with 32 patients in each group. Perioperative outcomes, inflammatory responses, postoperative complications, neck and shoulder function, scar outcomes, and 12-month oncological outcomes were compared.

Results

Baseline characteristics were comparable between groups. Compared with OND, END required a longer operative time but was associated with less intraoperative blood loss, lower postoperative drainage volume, shorter drainage duration, and shorter hospital stay. From postoperative day 1 to the day before discharge, the END group showed higher levels of hematological inflammatory markers and inflammatory cytokines and lower albumin levels than the OND group. These intergroup differences were no longer significant at 1 month after discharge. Patients in the END group had better neck and shoulder function and more favorable scar outcomes. Postoperative complication rates were low in both groups. Among patients with available follow-up data, no local recurrence, metastasis, or death occurred within 12 months.

Conclusion

In selected patients with OSCC, END was associated with less intraoperative blood loss, reduced postoperative drainage, shorter drainage duration and hospital stay, and improved functional and aesthetic outcomes, although it was accompanied by a more pronounced early postoperative inflammatory response. These inflammatory differences were transient and were no longer evident at 1 month after discharge. END demonstrated acceptable short-term oncological outcomes in this selected cohort.

1. Introduction

Oral squamous cell carcinoma (OSCC) is one of the most common malignancies worldwide and represents the predominant type of oral cancer, particularly in Asia ^[1]. With population aging and

increasing exposure to risk factors such as tobacco use and alcohol consumption, the incidence of oral cancer has continued to rise. Surgical resection remains the cornerstone of OSCC treatment, and management of cervical lymph nodes is particularly important. Previous studies have shown that standardized neck dissection can reduce the risk of cervical lymph node metastasis and improve survival ^[2].

Conventional open neck dissection (OND) remains the standard approach for cervical lymph node management in patients with oral cancer, providing reliable oncological control. However, this procedure may be associated with considerable surgical morbidity, including greater tissue trauma, prolonged postoperative recovery, functional impairment, and postoperative complications ^[4]. In addition, the cervical incision required for OND may negatively affect patients' quality of life and aesthetic satisfaction. To reduce treatment-related morbidity while maintaining adequate oncological principles, minimally invasive approaches such as endoscopic neck dissection (END) have gradually been introduced into head and neck oncology. By providing enhanced visualization through magnification and concealed access, END may facilitate precise dissection, reduce surgical trauma, and improve postoperative recovery and cosmetic outcomes ^[5].

The safety and short-term outcomes of endoscopic techniques in thyroid and head and neck surgery have been demonstrated in several studies ^[6], providing a technical and feasibility basis for their application in patients with oral cancer ^[7]. However, previous studies of END in patients with OSCC have mostly been limited by small sample sizes or single-center designs ^[8], heterogeneous outcome measures ^[9], and a lack of direct comparative evidence ^[10]. Although the present study was conducted at a single center, it adopted a randomized controlled design, included a relatively adequate sample size, and comprehensively assessed multiple clinically relevant outcomes, thereby addressing some of the limitations of existing evidence. Therefore, a systematic comparison focusing on clinical safety, nodal clearance quality, postoperative recovery, and oncological outcomes is warranted.

In this randomized controlled trial, we compared perioperative complications, adequacy of lymph node dissection, postoperative recovery, and survival outcomes between patients with OSCC undergoing OND and those undergoing END. We aimed to determine whether END could provide perioperative advantages and favorable short-term oncological safety while maintaining adequate nodal clearance and oncological control.

2. Materials and Methods

2.1 Study design and participants

This study was designed as a single-center randomized controlled clinical trial to compare the clinical outcomes of conventional open neck dissection (OND) and endoscopic neck dissection (END) in patients with oral squamous cell carcinoma (OSCC). Consecutive patients with OSCC who were treated

at Suining Central Hospital between January 2024 and September 2025 and met the eligibility criteria were screened for enrollment.

A total of 64 eligible patients were enrolled and randomly assigned in a 1:1 ratio to either the OND group (n = 32) or the END group (n = 32). The study was reviewed and approved by the local institutional ethics committee of Suining Central Hospital, Suining, Sichuan, China, and was conducted in accordance with the ethical principles of the Declaration of Helsinki. Written informed consent was obtained from all participants before enrollment.

2.2 Eligibility criteria and randomization

The inclusion criteria were as follows:

- (1) pathologically confirmed oral squamous cell carcinoma;
- (2) clinical stage classified as cT1–2N0M0 and considered suitable for selective neck dissection based on tumor site, preoperative imaging findings, clinical risk assessment, and the institutional treatment protocol, with the planned extent of neck dissection kept consistent between the two groups to ensure comparability;
- (3) age between 18 and 75 years, with a general condition sufficient to tolerate general anesthesia and surgery;
- (4) no distant metastasis or other malignancies requiring priority treatment; and
- (5) provision of written informed consent and willingness to comply with the scheduled follow-up plan.

The exclusion criteria were as follows:

- (1) previous neck surgery or radiotherapy to the neck;
- (2) inability to tolerate anesthesia or surgery;
- (3) requirement for radical neck dissection, extensive skin involvement, or other conditions that could not be safely managed within the endoscopic operative field;
- (4) pregnancy or lactation; and
- (5) inability to complete follow-up or incomplete clinical data.

Randomization was performed using a computer-generated random number table. Eligible patients were assigned to the OND group or the END group at a 1:1 ratio, with 32 patients in each group. The random allocation sequence was generated and managed by an independent research assistant who was not involved in patient treatment, outcome assessment, or statistical analysis. Allocation was concealed until eligibility had been confirmed and the surgical approach was assigned. This procedure was used to

reduce selection bias and improve baseline comparability between the two groups. A CONSORT flow diagram of patient enrollment, randomization, follow-up, and analysis is shown in Fig. 1.

2.3 Surgical procedures

Conventional open neck dissection is a commonly used surgical procedure for patients with OSCC, particularly in those requiring management of cervical lymph nodes. In the OND group, an anterior cervical incision was made, with the incision length adjusted to approximately 5–10 cm according to tumor location and the planned dissection extent. The skin, subcutaneous tissue, and cervical muscles were dissected layer by layer to expose the relevant cervical anatomical structures, including the common carotid artery, internal jugular vein, spinal accessory nerve, and vagus nerve. The planned extent of neck dissection was determined according to tumor site, preoperative imaging findings, clinical risk assessment, and the institutional surgical protocol. To ensure comparability between the two surgical approaches, the dissection extent was standardized between the END and OND groups, and selective neck dissection was performed within the same planned nodal levels for each patient.

Endoscopic neck dissection was performed as a minimally invasive surgical technique. After induction of general anesthesia and routine surgical field preparation, a concealed incision of approximately 7–10 cm was designed along the ipsilateral retroauricular hairline. Under direct endoscopic visualization, a potential space was created between the subcutaneous tissue and the deep surface of the platysma. The incision and entry plane were selected anterior to the sternocleidomastoid muscle (SCM), and dissection was gradually performed along the superficial surface of the SCM from posterior to anterior to create a subplatysmal flap and an effective working cavity.

The flap was elevated within clearly defined anatomical boundaries: superiorly to the inferior border of the mandible, inferiorly to the superior border of the clavicle, anteriorly to the submental region, and posteriorly beyond the posterior border of the SCM into the posterior cervical triangle. When required, the dissection was extended to the anterior border of the trapezius muscle to ensure adequate exposure of level V. During flap elevation, the great auricular nerve (GAN), cutaneous branches of the cervical plexus, and external jugular vein (EJV) were carefully identified and preserved.

After a stable working cavity was created, the SCM was released along the fascial plane and elevated with an intracavitary retractor to expose the planned dissection field. Neck dissection was then carried out in a standardized sequence, starting at level V and continuing through levels IV, III, II, and I in an inferior-to-superior and posterior-to-anterior direction. As the dissection proceeded from level V toward level II, the spinal accessory nerve (SAN) was carefully identified, followed, and preserved along its course. When needed, limited handling of the parotid tail was performed to improve exposure and ensure complete clearance of level IIb.

The dissection then continued along the carotid sheath in an anterosuperior direction toward the submandibular space to complete level I clearance. After the subplatysmal flap was further retracted, the anterior and posterior bellies of the digastric muscle were exposed, and the marginal mandibular branch

of the facial nerve was carefully preserved. The facial artery and vein were managed according to the reconstructive plan and were preserved whenever possible as recipient vessels. The submandibular duct was clipped and divided at the deep surface of the submandibular gland. The lingual and hypoglossal nerves were then carefully protected, and dissection of levels Ib and Ia was completed.

After neck dissection was completed, the en bloc specimen was placed in a retrieval bag and removed through the working channel. The operative field was thoroughly irrigated, meticulous hemostasis was achieved, a negative-pressure drain was placed, and the incision was closed in layers.

The primary tumour was then managed through an intraoral approach. Squamous cell carcinomas of the tongue and buccal mucosa were resected with adequate margins. For tongue defects, the lingual artery and vein were prepared in advance within the residual tongue tissue. When needed, the facial artery and vein were preserved anterior to the masseter muscle as recipient vessels. Depending on the size and configuration of the defect, reconstruction was performed using either a modified radial forearm free flap or a superficial circumflex iliac artery perforator (SCIP) flap.

When an SCIP flap was used for tongue reconstruction, the superficial circumflex iliac artery (SCIA) was anastomosed end-to-end to the lingual artery using 8 – 0 sutures. Venous anastomosis between the superficial circumflex iliac vein (SCIV) and the lingual vein was performed using a 2.0–2.5-mm coupler under microscopic guidance. For buccal defects, the SCIA was anastomosed to the facial artery using 8 – 0 sutures, and the SCIV was anastomosed to the facial vein using a 2.0-mm coupler. After patency testing confirmed satisfactory flap perfusion and venous drainage, the flap was fixed, drainage was placed, and the wound was closed.

Representative cases were documented with intraoperative and postoperative images.

2.4 Outcome measures

The main outcomes of interest were perioperative recovery-related parameters, including intraoperative blood loss, postoperative drainage volume, drainage duration, and length of hospital stay. Secondary outcomes included operative time, vascular anastomosis time, postoperative complications, perioperative hematological inflammatory markers, inflammatory cytokine levels, postoperative neck and shoulder function assessed by the NDII, scar outcomes assessed by the POSAS, and short-term oncological outcomes during follow-up.

The study outcomes covered perioperative clinical parameters, postoperative laboratory findings, functional recovery, aesthetic results, and follow-up outcomes. Perioperative parameters comprised operative time, intraoperative blood loss, postoperative drainage volume, drainage duration, and length of hospital stay. Postoperative complications were recorded, including flap-related complications, surgical site infection, chyle leakage, neurological dysfunction, and other perioperative adverse events.

To further evaluate the effects of the two surgical approaches on perioperative inflammatory stress and postoperative recovery, hematological and inflammation-related indicators were assessed, including

neutrophil percentage, white blood cell count, erythrocyte sedimentation rate (ESR), high-sensitivity C-reactive protein (hs-CRP), and albumin (ALB). Inflammatory cytokines, including tumor necrosis factor- α (TNF- α), interleukin-6 (IL-6), and interleukin-1 β (IL-1 β), were also measured. These indicators were dynamically assessed before surgery and at different postoperative time points to compare perioperative inflammatory responses and recovery between groups.

Postoperative neck and shoulder function was evaluated using the Neck Dissection Impairment Index (NDII) [11]. The NDII contains 10 items covering neck and shoulder pain or discomfort, stiffness, limitations in self-care, difficulty lifting objects, difficulty reaching overhead, overall activity level, social activities, recreational activities, and work-related limitations. Each item was scored according to the standard scale and converted to a 0–100 score, with higher scores indicating better neck and shoulder function and less impairment. In this study, NDII assessment was performed at 4 weeks after surgery or 1 month after discharge.

Aesthetic outcomes were assessed using the Patient and Observer Scar Assessment Scale (POSAS). Follow-up outcomes included local recurrence, metastasis, and survival status.

2.5 Quality control

Several measures were implemented to enhance methodological rigor and minimize potential bias. Random allocation was managed by an independent research assistant to maintain allocation concealment and reduce selection bias. All surgical procedures were performed by experienced oral and maxillofacial surgeons following standardized operative protocols. Clinical assessments were conducted by independent evaluators, and postoperative follow-up was managed using a uniform follow-up schedule to ensure data completeness and consistency. Statistical analyses were performed by dedicated personnel who were not involved in the surgical procedures or postoperative assessments.

Because of the nature of the surgical interventions, blinding of surgeons and patients was not feasible. However, outcome assessment and statistical analysis were performed independently whenever possible to reduce potential bias and improve the reliability of the study findings.

2.6 Statistical analysis

Statistical analyses were performed using SPSS version 27.0. Continuous variables were first tested for normality. Normally distributed variables are presented as the mean $\pm$ standard deviation ($\bar{x} \pm s$), and comparisons between groups were performed using the independent-samples t test. Non-normally distributed variables were analyzed using the Mann–Whitney U test. Categorical variables are presented as numbers and percentages, and intergroup comparisons were performed using the chi-square test or Fisher's exact test, as appropriate.

For laboratory indicators measured repeatedly before and after surgery, including neutrophil percentage, white blood cell count, ESR, hs-CRP, ALB, TNF- α , IL-6, and IL-1 β , intergroup comparisons were performed at each time point, with correction for multiple comparisons. When comparisons were conducted at a

single time point, the independent-samples *t* test was used together with appropriate adjustment for multiple testing. NDII scores and other single-time-point scale scores were treated as continuous variables for intergroup comparisons. All randomized patients who underwent surgery were included in the perioperative outcome analysis. For follow-up outcomes, analyses were performed among patients with available follow-up data. A two-sided *P* value < 0.05 was considered statistically significant.

3. Results

3.1 Baseline characteristics

A total of 64 patients with oral squamous cell carcinoma were enrolled and randomly assigned to the END group (*n* = 32) or the OND group (*n* = 32). Baseline characteristics, including sex distribution, age, body mass index, flap type, tumor site, TNM stage, and flap size, were comparable between the two groups, with no statistically significant differences observed (all *P* > 0.05). Detailed baseline characteristics are presented in Table 1.

Table 1
Comparison of baseline clinical characteristics between the END and OND groups

Characteristics	END group (n = 32)	OND group (n = 32)	P-value
Sex, n (%)			0.60
Male	20	18	
Female	12	14	
Age, years	54.3 ± 6.4	58.3 ± 5.2	0.08
BMI, kg/m ²	22.9 ± 3.2	24.0 ± 2.5	0.13
Flap type, n (%)			0.45
Modified radial forearm free flap	17(53.1)	20(62.5)	
Superficial circumflex iliac artery perforator flap	15(46.9)	12(37.5)	
Tumor site, n (%)			0.21
Buccal mucosa	11(34.4)	16(50)	
Tongue	21(65.6)	16(50)	
TNM stage, n (%)			0.53
T1N0M0	24(75.0)	26(81.3)	
T2N0M0	8(25.0)	6(18.7)	
Flap size, cm ²			0.11
Modified radial forearm free flap	34.35 ± 4.26	32.0 ± 4.72	
Superficial circumflex iliac artery perforator flap	33.28 ± 4.66	34.57 ± 3.75	
Note: Data are presented as mean ± standard deviation or n (%). END, endoscopic neck dissection; OND, open neck dissection; BMI, body mass index.			

3.2 Comparison of perioperative parameters

All 64 randomized patients completed perioperative outcome assessment and were included in the analysis. Compared with the OND group, the END group had a significantly longer operative time (512.70 ± 78.97 vs. 417.52 ± 63.35 min, $P < 0.01$). However, the END group had significantly less intraoperative blood loss (226.16 ± 81.14 vs. 343.50 ± 68.70 mL, $P < 0.01$), lower postoperative drainage volume (78.55 ± 12.32 vs. 186.73 ± 21.57 mL, $P < 0.01$), shorter drainage duration (5.42 ± 0.53 vs. 9.12 ± 1.15 days, $P < 0.01$), and shorter hospital stay (13.14 ± 5.08 vs. 24.42 ± 4.94 days, $P < 0.01$). Vascular anastomosis time

was also significantly longer in the END group than in the OND group (25.75 ± 4.86 vs. 21.94 ± 6.17 min, $P = 0.008$). The perioperative parameters are summarized in Table 2.

Table 2
Comparison of perioperative surgical parameters between the END and OND groups

Parameters	END group (n = 32)	OND group (n = 32)	P-value
Hospital stay, days	13.14 ± 5.08	24.42 ± 4.94	< 0.01
Operative time, min	512.70 ± 78.97	417.52 ± 63.35	< 0.01
Intraoperative blood loss, mL	226.16 ± 81.14	343.50 ± 68.70	< 0.01
Postoperative drainage volume, mL	78.55 ± 12.32	186.73 ± 21.57	< 0.01
Vascular anastomosis time, min	25.75 ± 4.86	21.94 ± 6.17	0.008
Drainage duration, days	5.42 ± 0.53	9.12 ± 1.15	< 0.01
Intraoperative conversion to open surgery, n (%)	0	0	NA
Note: Data are presented as mean $\pm$ standard deviation or n (%). END, endoscopic neck dissection; OND, open neck dissection; NA, not applicable.			

3.3 Dynamic changes in postoperative hematological inflammatory markers

Before surgery, there were no significant differences between the two groups in neutrophil percentage, white blood cell count, erythrocyte sedimentation rate (ESR), high-sensitivity C-reactive protein (hs-CRP), or albumin (ALB) levels (all $P > 0.05$).

Dynamic postoperative monitoring showed that, from postoperative day 1 to 1 day before discharge, the END group had significantly higher neutrophil percentages, white blood cell counts, ESR, and hs-CRP levels than the OND group, whereas ALB levels were significantly lower in the END group (all $P < 0.01$). At 1 month after discharge, no significant differences were observed in any of these parameters between the two groups (all $P > 0.05$). These findings indicate that the END group exhibited a more pronounced but transient systemic inflammatory response during the early postoperative period. The dynamic changes in hematological inflammatory markers are presented in Table 3.

Table 3
Dynamic changes in perioperative hematological inflammatory markers between the END and OND groups

Markers	Time point	END group (n = 32)	OND group (n = 32)	P-value
Neutrophil percentage, %	Preoperative	57.35 ± 6.53	58.72 ± 6.14	0.38
	Postoperative day 1	87.20 ± 3.80	79.20 ± 3.30	< 0.01
	Postoperative day 3	85.56 ± 2.90	77.86 ± 3.06	< 0.01
	Postoperative day 7	81.82 ± 2.77	74.71 ± 2.35	< 0.01
	Postoperative day 14	75.22 ± 2.08	69.28 ± 2.24	< 0.01
	1 day before discharge	72.96 ± 2.01	67.98 ± 1.69	< 0.01
	1 month after discharge	59.85 ± 3.03	58.77 ± 3.20	0.17
White blood cell count, ×10 ⁹ /L	Preoperative	6.26 ± 0.77	6.07 ± 0.78	0.33
	Postoperative day 1	12.09 ± 1.04	10.59 ± 0.79	< 0.01
	Postoperative day 3	11.11 ± 0.88	9.58 ± 0.65	< 0.01
	Postoperative day 7	9.95 ± 0.99	8.26 ± 0.68	< 0.01
	Postoperative day 14	8.16 ± 0.66	6.97 ± 0.55	< 0.01
	1 day before discharge	7.24 ± 0.48	6.51 ± 0.48	< 0.01
	1 month after discharge	6.23 ± 0.70	6.03 ± 0.70	0.26
Erythrocyte sedimentation rate, mm/h	Preoperative	8.03 ± 2.09	7.03 ± 2.09	0.06
	Postoperative day 1	21.03 ± 3.51	17.00 ± 2.16	< 0.01
	Postoperative day 3	24.94 ± 2.63	20.16 ± 2.29	< 0.01
	Postoperative day 7	24.50 ± 2.40	19.59 ± 2.20	< 0.01
	Postoperative day 14	21.66 ± 1.56	17.47 ± 1.57	< 0.01
	1 day before discharge	18.66 ± 1.56	15.16 ± 1.27	< 0.01
Note: Data are presented as mean ± standard deviation. END, endoscopic neck dissection; OND, open neck dissection.				

Markers	Time point	END group (n = 32)	OND group (n = 32)	P-value
High-sensitivity C-reactive protein, mg/L	1 month after discharge	8.34 ± 1.18	7.75 ± 1.50	0.08
	Preoperative	3.39 ± 1.20	3.15 ± 1.20	0.44
	Postoperative day 1	99.47 ± 13.09	67.34 ± 10.01	< 0.01
	Postoperative day 3	111.66 ± 11.00	79.72 ± 9.66	< 0.01
	Postoperative day 7	79.06 ± 8.47	55.72 ± 6.90	< 0.01
	Postoperative day 14	34.34 ± 5.57	25.22 ± 5.23	< 0.01
Albumin, g/L	1 day before discharge	21.78 ± 3.67	16.59 ± 2.78	< 0.01
	1 month after discharge	3.28 ± 0.87	3.10 ± 0.76	0.37
	Preoperative	44.86 ± 2.30	44.68 ± 2.12	0.75
	Postoperative day 1	37.12 ± 2.33	39.48 ± 1.60	< 0.01
	Postoperative day 3	36.33 ± 2.28	38.54 ± 1.40	< 0.01
	Postoperative day 7	36.70 ± 2.06	39.12 ± 1.18	< 0.01
	Postoperative day 14	38.79 ± 1.53	41.54 ± 1.59	< 0.01
	1 day before discharge	40.70 ± 1.02	43.28 ± 0.86	< 0.01
	1 month after discharge	43.84 ± 1.26	44.40 ± 1.21	0.08
Note: Data are presented as mean ± standard deviation. END, endoscopic neck dissection; OND, open neck dissection.				

3.4 Dynamic changes in postoperative inflammatory cytokine levels

Preoperative levels of tumor necrosis factor- α (TNF- α), interleukin-6 (IL-6), and interleukin-1 β (IL-1 β) were not significantly different between the two groups (all $P > 0.05$).

Postoperative dynamic monitoring showed that TNF- α , IL-6, and IL-1 β levels were significantly higher in the END group than in the OND group from postoperative day 1 to 1 day before discharge (all $P < 0.01$). At 1 month after discharge, the differences in TNF- α and IL-6 levels between the two groups were no longer statistically significant ($P > 0.05$). Similarly, no significant intergroup difference in IL-1 β levels was

observed at 1 month after discharge ($P = 0.06$). These results suggest that END was associated with a stronger early postoperative cytokine response, although this difference was transient and disappeared during subsequent recovery. Details are shown in Table 4.

Table 4

Dynamic changes in perioperative inflammatory cytokine levels between the END and OND groups

Cytokines	Time point	END group (n = 32)	OND group (n = 32)	P-value
TNF- α , pg/mL	Preoperative	5.46 $\pm$ 1.15	5.03 $\pm$ 0.97	0.11
	Postoperative day 1	2.82 $\pm$ 0.29	2.31 $\pm$ 0.21	< 0.01
	Postoperative day 3	2.50 $\pm$ 0.20	2.10 $\pm$ 0.17	< 0.01
	Postoperative day 7	1.94 $\pm$ 0.15	1.74 $\pm$ 0.12	< 0.01
	Postoperative day 14	1.68 $\pm$ 0.15	1.57 $\pm$ 0.12	0.002
	1 day before discharge	1.57 $\pm$ 0.11	1.49 $\pm$ 0.08	0.001
	1 month after discharge	1.41 $\pm$ 0.06	1.38 $\pm$ 0.06	0.11
IL-6, pg/mL	Preoperative	5.30 $\pm$ 0.82	5.04 $\pm$ 0.76	0.19
	Postoperative day 1	19.76 $\pm$ 2.57	14.47 $\pm$ 2.27	< 0.01
	Postoperative day 3	16.23 $\pm$ 1.60	11.59 $\pm$ 1.60	< 0.01
	Postoperative day 7	10.96 $\pm$ 0.94	8.34 $\pm$ 0.77	< 0.01
	Postoperative day 14	7.18 $\pm$ 0.45	6.24 $\pm$ 0.36	< 0.01
	1 day before discharge	6.46 $\pm$ 0.42	5.82 $\pm$ 0.31	< 0.01
	1 month after discharge	5.04 $\pm$ 0.50	4.97 $\pm$ 0.42	0.580
IL-1 β , pg/mL	Preoperative	11.52 $\pm$ 1.60	10.89 $\pm$ 1.09	0.070
	Postoperative day 1	16.45 $\pm$ 0.91	14.79 $\pm$ 0.87	< 0.01
	Postoperative day 3	15.35 $\pm$ 1.12	13.80 $\pm$ 1.13	< 0.01
	Postoperative day 7	14.11 $\pm$ 1.10	12.33 $\pm$ 1.10	< 0.01
	Postoperative day 14	12.37 $\pm$ 1.11	11.25 $\pm$ 0.93	< 0.01
	1 day before discharge	11.23 $\pm$ 0.64	10.41 $\pm$ 0.36	< 0.01
	1 month after discharge	10.21 $\pm$ 0.45	9.99 $\pm$ 0.46	0.06

Note: Data are presented as mean $\pm$ standard deviation. END, endoscopic neck dissection; OND, open neck dissection; TNF- α , tumor necrosis factor- α ; IL-6, interleukin-6; IL-1 β , interleukin-1 β .

3.5 Comparison of postoperative functional and aesthetic outcomes

Neck and shoulder function was evaluated using the Neck Dissection Impairment Index (NDII) at 4 weeks after surgery or 1 month after discharge. The END group had significantly higher NDII scores than the OND group (76.72 ± 6.82 vs. 71.56 ± 7.80 , $P < 0.01$), indicating better postoperative recovery of neck and shoulder function in the END group.

Among patients who completed scar assessment during the 3- to 6-month follow-up period, Patient and Observer Scar Assessment Scale (POSAS) scores were also significantly more favorable in the END group than in the OND group. The Observer Scar Assessment Scale (OSAS) score was 8.12 ± 0.33 in the END group versus 27.65 ± 4.82 in the OND group, and the Patient Scar Assessment Scale (PSAS) score was 7.24 ± 0.47 versus 36.53 ± 5.65 , respectively. Both differences were statistically significant (all $P < 0.01$). These results are shown in Table 5.

Table 5 Comparison of postoperative functional and aesthetic outcomes between the END and OND groups			
Outcomes	END group (n = 32)	OND group (n = 32)	P-value
POSAS score			
Observer Scar Assessment Scale (OSAS; range, 5–50)	8.12 ± 0.33	27.65 ± 4.82	< 0.01
Patient Scar Assessment Scale (PSAS; range, 6–60)	7.24 ± 0.47	36.53 ± 5.65	< 0.01
NDII score (range, 0–100)	76.72 ± 6.82	71.56 ± 7.80	< 0.01
Note: Data are presented as mean $\pm$ standard deviation. END, endoscopic neck dissection; OND, open neck dissection; POSAS, Patient and Observer Scar Assessment Scale; OSAS, Observer Scar Assessment Scale; PSAS, Patient Scar Assessment Scale; NDII, Neck Dissection Impairment Index. Higher NDII scores indicate better neck and shoulder function. Lower OSAS and PSAS scores indicate better scar outcomes. NDII was assessed at 4 weeks after surgery or 1 month after discharge, whereas POSAS was assessed during the 3- to 6-month postoperative follow-up period.			

3.6 Postoperative complications

The overall incidence of postoperative complications was low in both groups. Auricular numbness occurred in 4 patients in the END group (12.5%) and in 1 patient in the OND group (3.1%), with no statistically significant difference between groups ($P = 0.36$). Chyle leakage was not observed in the END group but occurred in 2 patients in the OND group (6.25%); this difference was also not statistically significant ($P = 0.49$). No cases of flap necrosis, spinal accessory nerve injury, parotid fistula, surgical site infection, or facial nerve injury occurred in either group. The postoperative complications are listed in Table 6.

Table 6

Comparison of postoperative complications, follow-up outcomes, and oncological outcomes between the END and OND groups

Outcomes	END group (n = 32)	OND group (n = 32)	P-value
Postoperative complications, n (%)			
Flap necrosis	0	0	NA
Spinal accessory nerve injury	0	0	NA
Auricular numbness	4 (12.5)	1 (3.1)	0.36
Parotid fistula	0	0	NA
Surgical site infection	0	0	NA
Facial nerve injury	0	0	NA
Chyle leakage	0	2 (6.25)	0.49
Oncological and follow-up outcomes			
Pathologically positive lymph nodes detected, n (%)	0	0	NA
Local recurrence within 12 months, n (%)	0	0	NA
Observed survival among patients with available follow-up data, n/N (%)	31/31 (100.0)	31/31 (100.0)	NA
Patients lost to follow-up at 12 months, n (%)	1 (3.1)	1 (3.1)	NA

3.7 Follow-up and oncological outcomes

During the 12-month follow-up, one patient in each group was lost to follow-up, resulting in a loss-to-follow-up rate of 3.1% per group. No pathologically positive lymph nodes were detected in either group. Among patients with available follow-up data, no local recurrence, metastasis, or death occurred during the follow-up period, and the observed survival rate was 100.0% in both groups (31/31 in each group). There were no statistically significant differences in short-term oncological outcomes between the END and OND groups. These findings are summarized in Table 6.

4. Discussion

Oral squamous cell carcinoma (OSCC) remains a major health burden worldwide, particularly in Asian populations^[12]. Although advances in prevention, diagnosis, and treatment have been achieved, the incidence and mortality of OSCC continue to represent significant clinical challenges^[13]. Cervical lymph node status is one of the most important prognostic factors in OSCC, and appropriate neck dissection

based on clinical staging remains a critical component of comprehensive treatment ^[14]. Conventional open neck dissection (OND) provides reliable oncological control; however, it may result in considerable surgical morbidity, including postoperative functional impairment, visible cervical scars, and complications that may negatively affect patients' quality of life ^[15]. With the development of minimally invasive surgery, endoscopic and remote-access approaches have gradually been introduced into head and neck oncology with the aim of reducing treatment-related morbidity while maintaining appropriate oncological principles ^[16, 17].

In this randomized controlled trial, we compared the clinical outcomes of endoscopic neck dissection (END) and OND in patients with OSCC. The major findings of this study were that END was associated with reduced intraoperative blood loss, lower postoperative drainage volume, shorter drainage duration, and shorter hospital stay compared with OND. Furthermore, patients undergoing END demonstrated improved postoperative neck and shoulder function and more favorable scar outcomes. Although END resulted in a more pronounced early postoperative inflammatory response, these differences were transient and gradually diminished during follow-up. Importantly, no short-term oncological events were observed in either group. These findings suggest that END may reduce treatment-related morbidity while maintaining acceptable short-term oncological outcomes in appropriately selected patients with OSCC.

The application of endoscopic techniques in head and neck surgery has gradually expanded with the development of minimally invasive approaches. In our previous study on endoscope-assisted resection of benign parotid tumors, we established the feasibility of endoscopic approaches in head and neck surgery ^[18]. In the present study, END was performed through a retroauricular hairline approach, which provides concealed access while allowing adequate exposure of cervical structures. Compared with conventional open surgery, END requires creation of a stable working space and dissection under magnified visualization. Therefore, appropriate patient selection, standardized surgical procedures, and sufficient surgical experience remain essential for ensuring procedural safety and reproducibility.

The longer operative time observed in the END group is consistent with previous studies of minimally invasive neck dissection ^[20]. This difference may be attributed to the additional procedures required for working-space creation, endoscopic orientation, and instrument manipulation. Although these factors increase technical complexity during the early implementation phase, operative efficiency may improve with increasing surgical experience and standardized team coordination. Therefore, the longer operative time associated with END should be considered as part of the learning curve of minimally invasive surgical techniques.

Several technical considerations are important to ensure the safety of END. During endoscopic neck surgery, careful identification and preservation of critical anatomical structures are essential to prevent complications. Previous studies have emphasized the importance of meticulous dissection and anatomical familiarity during minimally invasive approaches ^[19]. In the present study, the incidence of postoperative complications was comparable between the END and OND groups, suggesting that END

can achieve acceptable surgical safety when performed by experienced surgeons following standardized procedures.

Previous studies have reported that complications following neck dissection may involve multiple anatomical structures and require careful postoperative evaluation ^[21, 22]. In our study, no significant increase in postoperative complications was observed in patients undergoing END compared with OND. These findings further support the feasibility of END as a minimally invasive surgical option for selected patients with OSCC.

Regarding oncological outcomes, adequate cervical lymph node management remains essential for OSCC treatment. Previous studies have highlighted the importance of appropriate lymph node dissection and pathological evaluation in determining treatment quality ^[23, 24]. In the present study, END achieved satisfactory lymph node management, and no recurrence, metastasis, or death occurred during the 12-month follow-up period among patients with available follow-up data. However, because of the limited sample size and follow-up duration, further multicenter studies with larger cohorts and longer observation periods are required to validate the long-term oncological safety of END.

Patient-centered outcomes have become increasingly important in modern oncologic surgery. Yang et al. reported that endoscopic approaches may provide advantages in cosmetic outcomes compared with conventional open surgery ^[25]. Consistent with these findings, our randomized study demonstrated improved scar outcomes and functional recovery in patients undergoing END. These results indicate that END may provide additional benefits in postoperative recovery and patient satisfaction while maintaining surgical effectiveness.

Scar quality is an important component of postoperative recovery, particularly in head and neck surgery. In the present study, POSAS evaluation demonstrated improved scar outcomes in the END group. Previous studies have suggested that concealed-incision approaches may improve postoperative aesthetic satisfaction and quality of life ^[26]. Nevertheless, cosmetic outcomes should be considered as one component of comprehensive surgical quality rather than the primary goal of oncologic surgery.

The application of remote-access approaches requires careful consideration of anatomical accessibility, surgical safety, and patient characteristics. Previous studies have demonstrated the feasibility of retroauricular and related approaches in head and neck surgery ^[27, 28]. Our findings further support the potential role of END as a minimally invasive option for selected patients with OSCC, particularly when functional preservation and postoperative quality of life are important considerations.

This study has several limitations. First, although this was a randomized controlled trial, it was conducted at a single institution with a relatively limited sample size. Second, all patients had clinically node-negative disease, and no pathological lymph node metastasis was detected, limiting the assessment of END in patients with advanced nodal disease. Third, follow-up duration was limited to 12 months, preventing evaluation of long-term oncological outcomes, including recurrence and survival.

Finally, although standardized surgical protocols were applied, variations in surgeon experience and learning curves may influence operative outcomes. Future prospective, multicenter, and longer-term studies are warranted to further define the role of END in OSCC.

5. Conclusion

In selected patients with OSCC, endoscopic neck dissection through a retroauricular hairline approach was associated with less intraoperative blood loss, reduced postoperative drainage, shorter drainage duration and hospital stay, and better postoperative functional and aesthetic outcomes compared with conventional open neck dissection. These benefits were achieved at the cost of a longer operative time and a more pronounced early postoperative inflammatory response. However, the differences in inflammatory markers and cytokine levels were transient and were no longer significant at 1 month after discharge. In appropriately selected patients and experienced centers, END may therefore represent a feasible minimally invasive alternative to OND, although larger multicenter studies with longer follow-up are required to confirm its long-term oncological safety and to further clarify the clinical significance of the early inflammatory response.

Declarations

Author Contributions

Longyu Zhang: Conceptualization, Methodology, Writing – original draft, Writing – review and editing.

Jiwei Xia: Conceptualization, Writing – original draft.

Han Cheng: Conceptualization, Methodology, Writing – original draft, Writing – review and editing.

Lijuan Guo: Data curation, Formal analysis, Writing – review and editing.

Baolin Jia: Data curation, Formal analysis, Writing – review and editing.

Jun Ren: Supervision, Writing – review and editing.

Guixin Li: Conceptualization, Methodology, Writing – review and editing.

Xianjie Zheng: Data curation, Formal analysis, Writing – review and editing.

Li Guan: Writing – review and editing, Methodology.

Sen Yang: Supervision, Funding acquisition, Writing – review and editing.

All authors reviewed and approved the final manuscript.

Declaration of Conflicting Interests

The authors declare that they have no competing interests.

Funding

This work was supported by the Sichuan Science and Technology Support Program [grant number: 2022SNZY001], the Health Commission of Sichuan Province [grant number: 2022JDXM021], and the Western Stomatological Clinical Research Fund Project of the Chinese Stomatological Association [grant number: CSA-W2023-03]. In addition, this study received institutional support, including research resources and financial support, from Suining Central Hospital.

Acknowledgements

The authors thank Jiwei Xia for assistance during manuscript preparation. The authors take full responsibility for the content of this manuscript.

Ethics Statement

This study was reviewed and approved by the local institutional ethics committee of Suining Central Hospital, Suining, Sichuan, China. Written informed consent was obtained from all participants before enrollment.

Data Availability Statement

The datasets generated and/or analyzed during the current study are not publicly available but are available from the corresponding author upon reasonable request.

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Figures

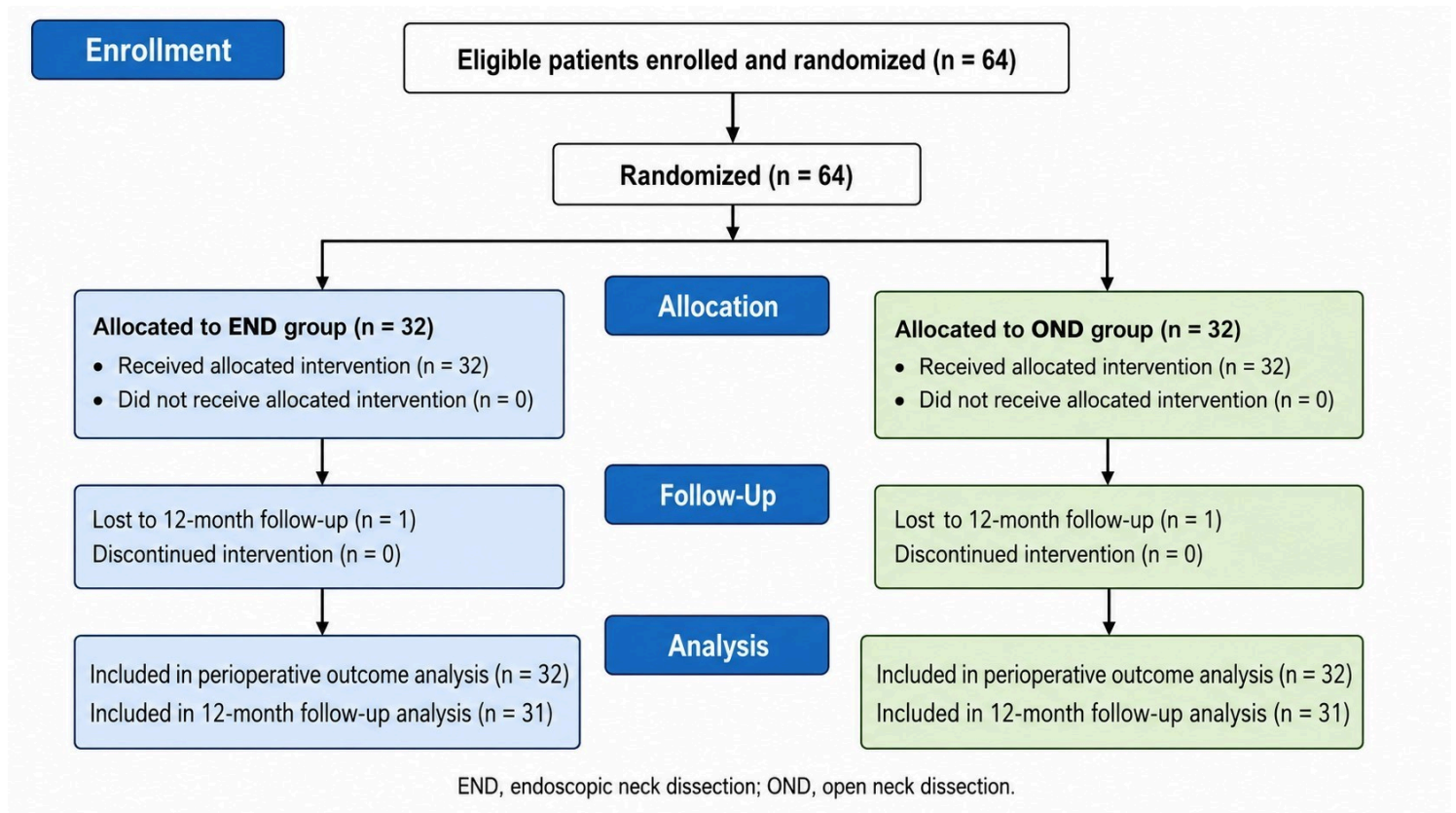


Figure 1

CONSORT flow diagram of patient enrollment, randomization, follow-up, and analysis. END, endoscopic neck dissection; OND, open neck dissection.



Figure 2

Preoperative presentation of carcinoma of the right lateral tongue and lateral facial view before surgery.

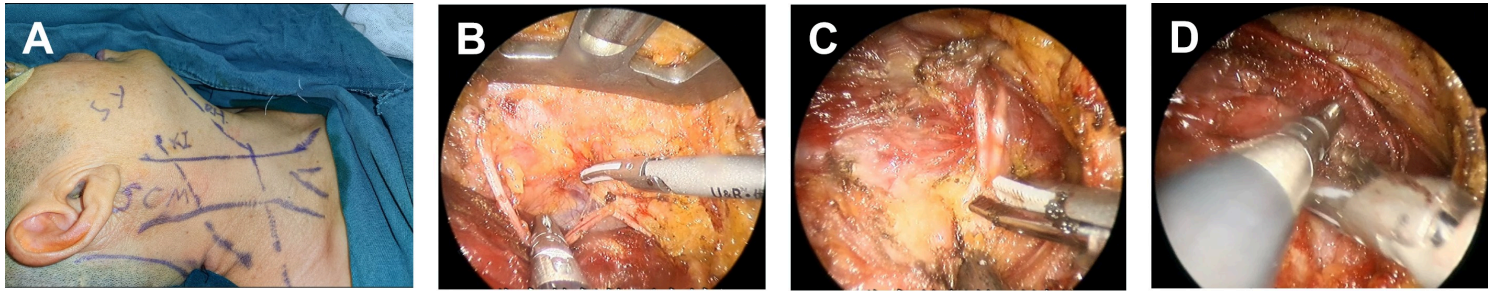


Figure 3

Intraoperative marking, working-space creation, protection of the great auricular nerve (GAN) and spinal accessory nerve (SAN), and dissection of the sternocleidomastoid muscle (SCM). (A) Intraoperative surgical marking. (B) Dissection and preservation of the great auricular nerve. (C) Dissection and preservation of the spinal accessory nerve. (D) Dissection of the sternocleidomastoid muscle.

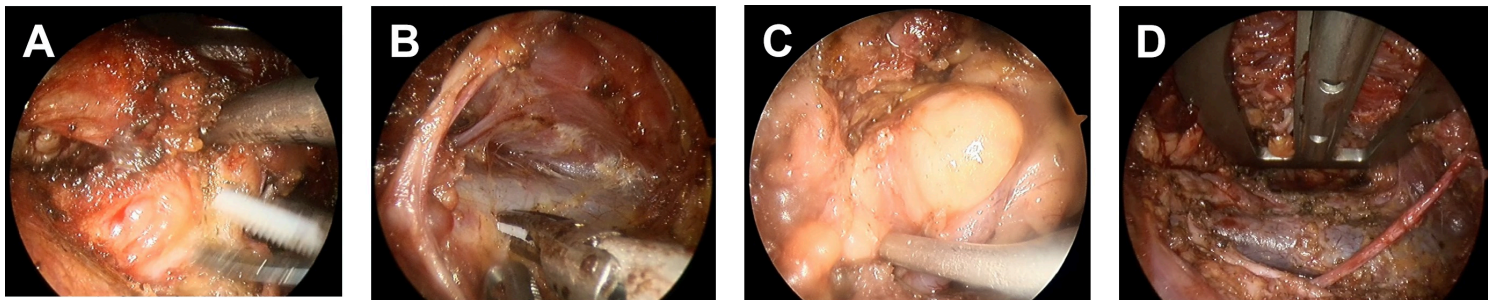


Figure 4

Progression of neck dissection, management of submandibular vessels, and operative field after lymph node clearance. (A) Dissection and preservation of the cervical plexus. (B) Removal of cervical lymphatic tissue from inferior to superior. (C) Dissection and ligation of the submandibular gland vessels. (D) Operative field beneath the sternocleidomastoid muscle.

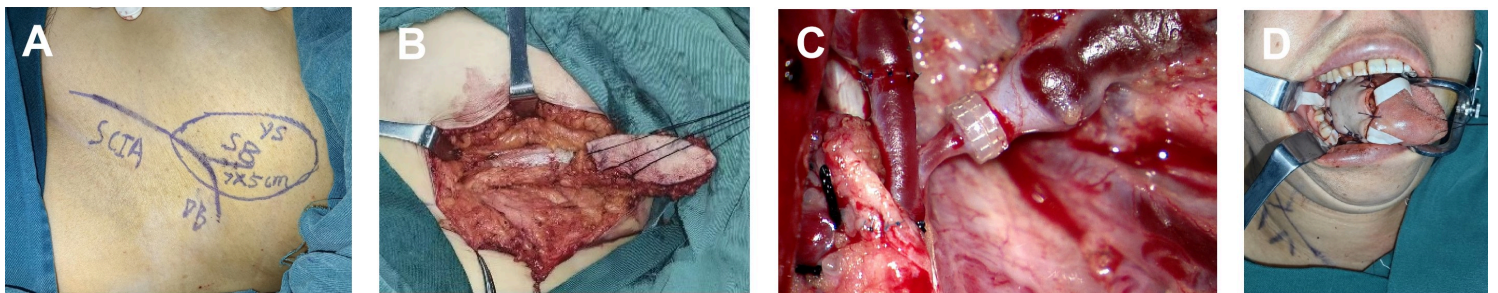


Figure 5

Design and harvest of the superficial circumflex iliac artery perforator (SCIP) flap, intraoral microvascular anastomosis, and postoperative reconstruction. (A) Preoperative marking for SCIP flap harvest. (B) Intraoperative harvest of the SCIP flap. (C) Intraoral microvascular anastomosis. (D) Postoperative reconstruction of the right tongue defect with the SCIP flap.

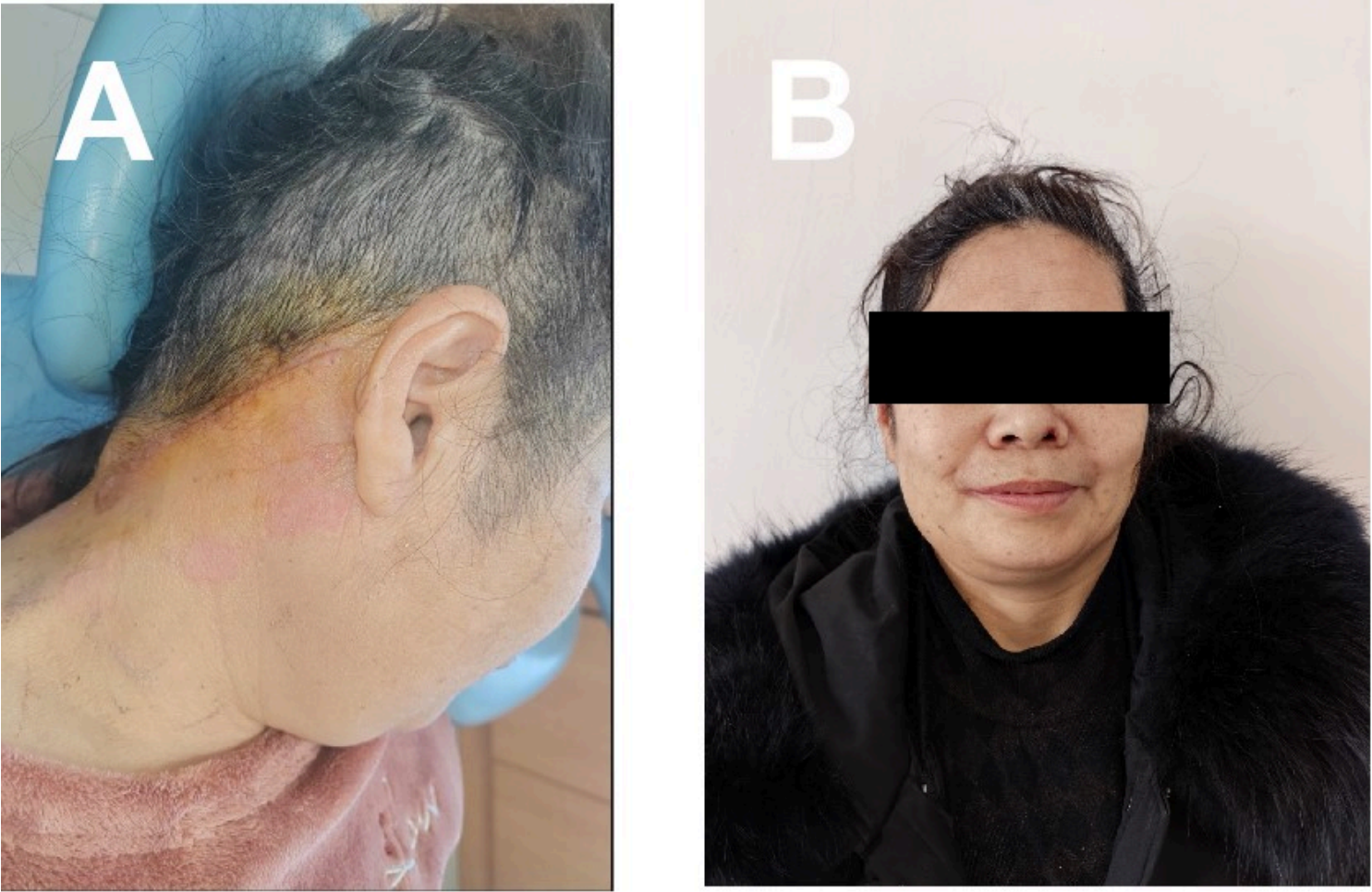


Figure 6

Healing of the retroauricular incision and postoperative facial appearance. (A) Healing of the retroauricular hairline incision. (B) Postoperative frontal facial appearance.



Figure 7

Preoperative and intraoperative views of carcinoma of the left buccal mucosa. (A) Preoperative presentation of carcinoma of the left buccal mucosa. (B) Intraoperative surgical marking. (C) Creation of the endoscopic working space under direct visualization.

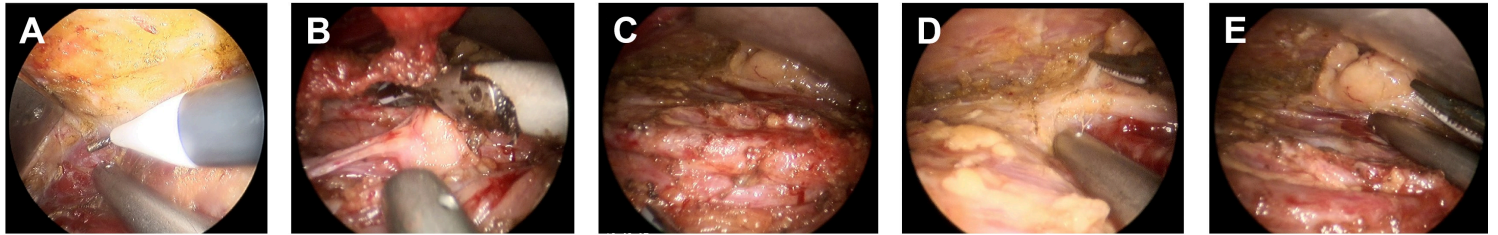


Figure 8

Intraoperative views of the working space during gasless endoscopic surgery. (A–E) Sequential intraoperative views showing the operative space created for gasless endoscopic neck dissection.

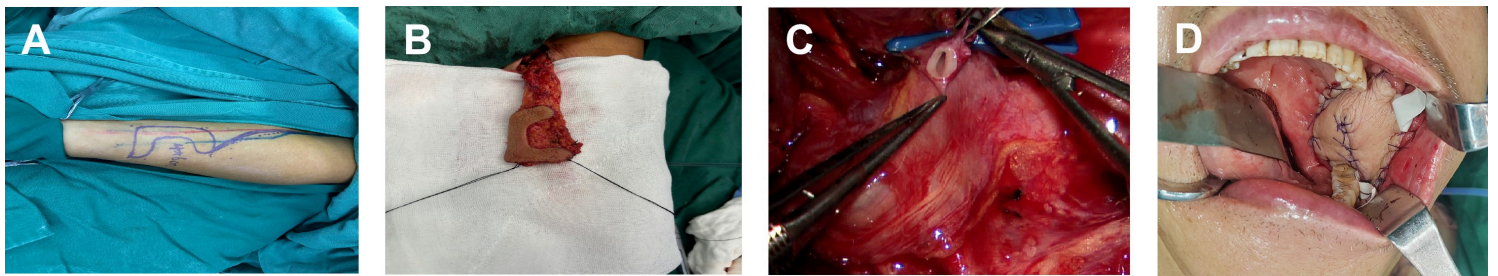


Figure 9

Design and harvest of the modified radial forearm free flap, intraoral microvascular anastomosis, and postoperative reconstruction of the left buccal defect. (A) Preoperative marking for the modified radial forearm free flap. (B) Intraoperative harvest of the modified radial forearm free flap. (C) Intraoral microvascular anastomosis. (D) Postoperative reconstruction of the left buccal defect with the modified radial forearm free flap.



Figure 10

Postoperative facial appearance. (A, B) Postoperative frontal and lateral facial views.

Supplementary Files

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- [PatientandObserverScarAssessmentScalePOSAS.pdf](#)