BMC Oral Health

RESEARCH

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Necessity of selective neck dissection for T1-2N0 TSCC patients: a retrospective cohort study

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Abstract

Background This study aimed to assess the prognosis of T1-2N0 stage tongue cancer patients who underwent surgery for the primary lesion without elective neck dissection and to identify the risk factors for prognosis.

Methods We retrospectively analyzed early-stage tongue cancer patients in our center. Statistical analyses were performed using SPSS and R software.

Results The study reviewed 168 patients, revealing a 3-year overall survival rate of 90.5%, a 3-year cervical lymph node metastasis-free survival rate of 73.2%, and a 3-year disease-specific survival rate of 89.3%. A depth of invasion of 3 mm showed significant prognostic value for overall survival ($P=0.001$), cervical lymph node metastasis-free survival ($P=0.002$), and disease-specific survival ($P<0.001$). Patients were categorized into four subgroups (thick T1, thin T1, thick T2, and thin T2) to further explore the prognostic significance of depth of invasion across different T stage categories. The combination of T stage and a 3 mm depth of invasion demonstrated significant prognostic value in univariate analysis for overall survival ($P=0.002$), cervical lymph node metastasis-free survival ($P=0.010$), and disease-specific survival ($P<0.001$). COX regression analysis confirmed the statistical significance of T stage combined with a 3 mm depth of invasion for overall survival (OR = 10.653; 95% CI, 2.394 to 47.404; $P=0.002$) and lymph node metastasis-free survival (OR = 3.016; 95% CI, 1.365 to 6.667; $P=0.006$).

Conclusions The findings highlight depth of invasion and T stage as key prognostic factors in early-stage tongue squamous cell carcinoma. Consideration of elective neck dissection is advised for patients with T2 tumors and a depth of invasion exceeding 3 mm to potentially enhance their prognosis.

Trial registration The current research was registered in Chinese Clinical Trial Registry on April 8, 2021. The trial registration number is ChiCTR2100045188.

Keywords Tongue squamous cell carcinoma, Cervical lymph node metastasis, Elective neck dissection, Overall survival, Disease specific survival

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Background

According to estimates from GLOBOCAN 2020, lip cancer and oral squamous cell carcinoma cancer (OSCC) account for 2% of global cancer incidence and 1.9% of all cancer-related deaths [1]. With increased public health awareness and advancements for oral and maxillofacial surgery diagnostic technologies, more cases of OSCC can be detected and diagnosed at an early-stage. Tongue squamous cell carcinoma (TSCC) is the most common subtype of OSCC [2], with reported early-stage survival rates of 72–88% [3–6].

Cervical lymph node metastasis (CLNM) significantly impacts the prognosis of TSCC patients [4]. However, due to the limited sensitivity of current imaging and pathological examination techniques, occult CLNM in early-stage TSCC patients often goes undetected, with reported rates ranging from 9.25 to 42% across various studies [7–10]. While patients with T1-2N0 stage TSCC are generally considered to be in the early stage of the disease and have a relatively low risk of lymph node metastasis, the aggressive nature of tongue cancer still poses a potential risk for occult metastasis. This creates substantial challenges in treatment decision-making, particularly regarding the appropriate surgical approach.

The surgical treatment strategy for early-stage TSCC has been controversial over the past few decades, especially regarding the decision to perform elective neck dissection (END). Some studies indicate that END can reduce the risk of extracapsular spread and improve patient survival rates [11–13]. These studies emphasize the potential risks of foregoing END, particularly the risk of undetected occult metastasis and its implications for long-term patient outcomes. Conversely, other research highlights complications related to neck dissection surgery, including shoulder dysfunction, cutaneous paraesthesia, and chronic neck and shoulder pain syndrome [14]. Furthermore, in elderly patients with underlying health conditions or those who are frail, the risks of complications may be heightened, leading to prolonged surgical time and increased anesthesia risks [5]. In light of these concerns, some experts advocate for alternative monitoring strategies, such as imaging studies and regular follow-ups, to mitigate the risks associated with not performing END.

According to the latest NCCN guidelines for head and neck cancer, cervical treatment strategy in T1-2N0 stage OSCC are based on factors such as tumor origin, depth of invasion (DOI), and imaging studies [15]. The guidelines strongly recommend END for patients with a DOI exceeding 3 mm and no planned radiation therapy. However, there is no explicit recommendation for the treatment strategy of T1-2N0 stage TSCC patients, despite TSCC being more prone to CLNM among OSCC subtypes.

In this retrospective study, we aimed to investigate the prognosis of T1-2N0 stage TSCC patients who underwent surgery for the primary lesion without END. Additionally, we sought to explore the risk factors that may influence prognosis, thereby providing insights that could enhance clinical decision-making and patient management in this challenging context.

Methods

Patients and follow-up

The inclusion and exclusion criteria for this study are as follows:

1) All patients were staged as cT1-2N0M0 primary TSCC patients according to the AJCC 8th edition and were diagnosed with squamous cell carcinoma through pathological examination.
2) All patients were confirmed to have no lymph node involvement through preoperative clinical and imaging examinations.
3) All patients underwent surgery for the primary lesion with adequate safety margins. Patients who received END, as well as those who received preoperative radiotherapy or chemotherapy were excluded from the study.
4) Patients who refused follow-up and had incomplete medical records were excluded from the study.

Patients were scheduled for follow-up visits every 1–2 months during the first 24 months and every 3–6 months thereafter, up to five years post-surgery. After five years without recurrence of the primary lesion or cervical lymph node metastasis, regular follow-ups were no longer required. Patients received clear instructions regarding their follow-up visits after surgery, with reminders provided at each appointment. Additionally, dedicated follow-up personnel proactively contact patients who miss appointments to ascertain their current status. Patients were also advised to seek consultation if they experienced any discomfort. For those who missed scheduled follow-up visits, phone interviews were conducted to gather information on their survival status. Patients with CLNM detected during clinical examinations were recommended to undergo therapeutic neck dissection (TND), along with radiotherapy or chemotherapy as needed.

Data and objectives

Baseline data collected included age, gender, smoking and drinking habits, body mass index, family history of cancer, Barthel index, and comorbidities level. Tumor-related information comprises the AJCC 8th edition T stage, growth pattern, DOI, histologic grade, perineural invasion, vascular invasion, and margin status.

Table 1 Characteristics of patients at baselines

Variable	Number of T1 patients (%)	Number of T2 patients (%)	*P* value
Age(years)			
≤ 60	43 (25.6)	35 (20.8)	0.623
> 60	53 (31.5)	37 (22.0)	
Gender			
male	37 (22.0)	26 (15.5)	0.747
female	59 (35.1)	46 (24.4)	
Tobacco consumption			
yes	25 (14.9)	18 (10.7)	0.878
no	71 (42.3)	54 (32.1)	
Alcohol consumption			
yes	15 (8.9)	12 (7.2)	0.856
no	81 (48.2)	60 (35.7)	
Body mass index			
underweight	3 (1.8)	2 (1.2)	0.161
normal weight	50 (29.8)	44 (26.2)	
overweight	38 (22.6)	18 (10.7)	
obese	5 (3.0)	8 (4.7)	
Family history of cancer			
yes	10 (5.9)	4 (2.4)	0.259
no	86 (51.2)	68 (40.5)	
Barthel index			
100	88 (52.4)	65 (38.7)	0.755
< 100	8 (4.7)	7 (4.2)	
Comorbidities level			
none	47 (28.0)	42 (25.0)	0.416
mild	33 (19.7)	22 (13.1)	
moderate-severe	16 (9.5)	8 (4.7)	
Growth pattern			
exogenous	42 (25.0)	31 (18.5)	0.459
ulcerative	37 (22.0)	23 (13.7)	
infiltrative	17 (10.1)	18 (10.7)	
Depth of invasion			
≤ 3 mm	59 (35.1)	27 (16.1)	0.002
> 3 mm	37 (22.0)	45 (26.8)	
Histologic grade			
well	51 (30.3)	28 (16.7)	0.067
moderate-poor	45 (26.8)	44 (26.2)	
Perineural invasion			
yes	13 (7.7)	4 (2.4)	0.089
no	83 (9.4)	68 (40.5)	
Vascular invasion			
yes	0 (0.0)	3 (1.8)	0.077
no	96 (57.1)	69 (41.1)	
Margin status			
normal epithelial	81 (48.2)	58 (34.5)	0.517
mild-moderate dysplasia	15 (8.9)	14 (8.4)	

The primary objective of this study was to assess the prognosis of patients, including local recurrence (LR) and CLNM, 3-year overall survival (OS) rate, 3-year cervical lymph node metastasis-free survival (MFS) rate, and 3-year disease-specific survival (DSS) rate. Secondary objective was to explore the risk factors affecting prognosis.

Table 2 Prognosis of TSCC patients

	Number of alive patients (%)	Number of dead patients (%)		Total number
		Dead of TSCC	Dead of others	
Disease Free	101(60.1)	-	7 (4.2)	108
LR	16 (9.5)	3 (1.8)	3 (1.8)	22
CLNM	18 (10.7)	9 (5.3)	4 (2.4)	31
LR-CLNM	1 (0.6)	5 (3.0)	1 (0.6)	7
Total number	136	17	15	168

Statistical analysis

Statistical analyses were performed using SPSS 26.0 (https://www.ibm.com/) and R software (version 4.1.1, http://www.r-project.org/). Overall survival was calculated, and survival curves were plotted using the Kaplan-Meier method. For the multivariate analysis of factors impacting OS, MFS, and DSS, we utilized a Cox proportional hazards model. Univariate analysis was used to assess the significance of each variable, with a P-value threshold of 0.10 set for including potentially important variables in the multivariable analysis. We calculated the Variance Inflation Factor (VIF) for all variables, confirming that all VIF values were below 5. A P-value of less than 0.05 was considered statistically significant.

Results

Patients baseline data

A total of 168 patients met the criteria for this study. Demographic and pathological features of all patients are presented in Table 1. The age ranged from 21 to 85 years, with both the mean age and median ages being 61 years. Among the cohort, 43 patients had a history of smoking, and 27 had a history of alcohol consumption. Based on the AJCC 8th edition T stage criteria, 96 patients were classified as T1N0, while 72 were classified as T2N0. Tumor DOI was ≤ 3 mm in 86 patients and > 3 mm in 82 patients.

Recurrence and survival

The follow-up period ranged from 36 to 204 months, with a median duration of 76 months. The 3-year OS, MFS and DSS rates were 90.5%, 73.2%, and 89.3%, respectively. Fifty-nine patients experienced LR or CLNM: 22 had LR, 31 had CLNM, and 7 had both LR and CLNM. CLNM stands out as the primary reasons of death in early-stage TSCC patients. (Table 2)

We conducted a further analysis of patients with single CLNM, the incidence of which was 18.5% (31 out of 168 cases). CLNM developed within 1 to 80 months, with 58.1% of cases occurring in the first 6 months, 83.9%

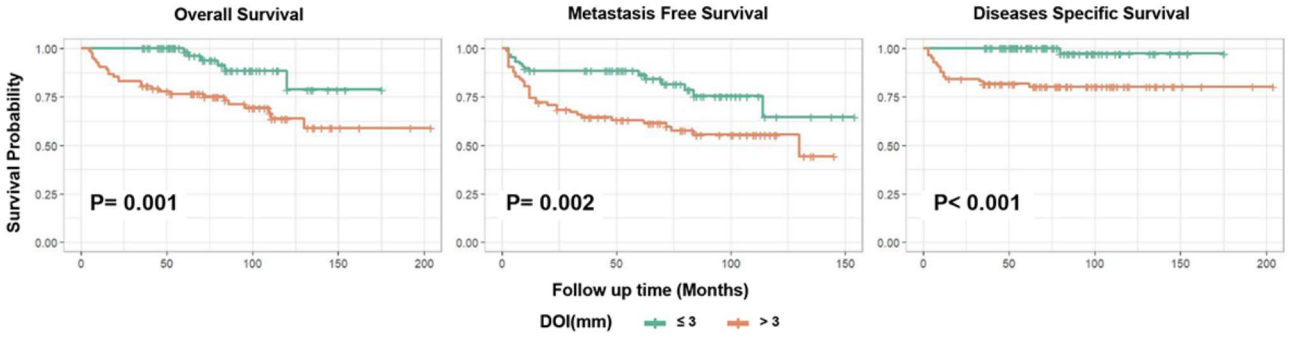

Fig. 1 Kaplan-Meier graphs showing the difference of OS, MFS and DSS between patients with group DOI > 3 mm and group DOI ≤ 3 mm

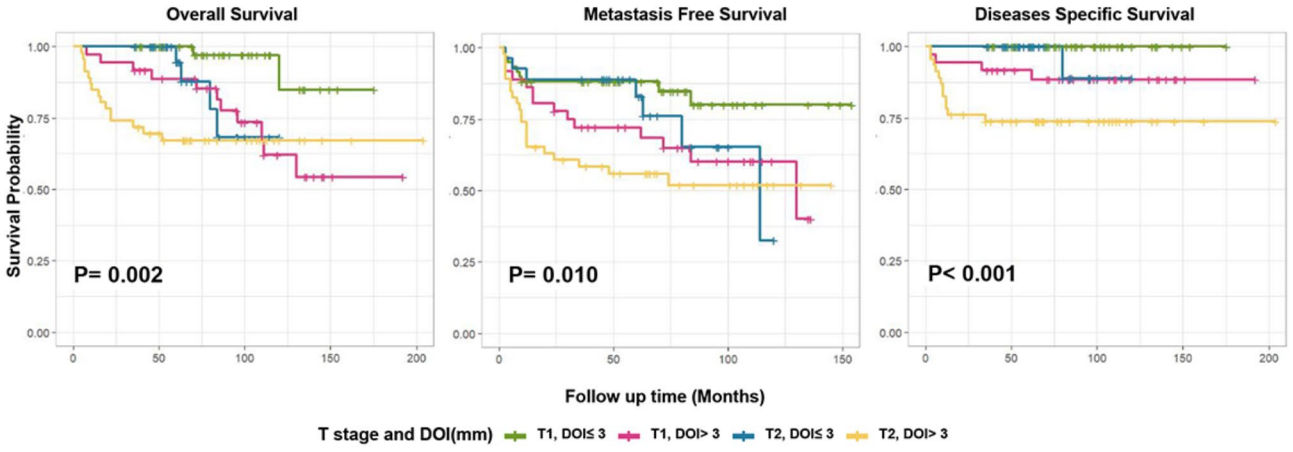

Fig. 2 Kaplan-Meier graphs showing the difference of OS, MFS and DSS between patients with groups T1, DOI ≤ 3 mm, groups T1, DOI > 3 mm, groups T2, DOI ≤ 3 mm, and groups T2, DOI > 3 mm

within 12 months, and 93.5% within 24 months. The median time to CLNM was 6 months. (Supplementary Fig. 1). Additionally, we recorded the symptoms experienced by these patients at the time of cervical lymph node metastasis, and these findings are presented in Supplementary Fig. 2.

Twenty-seven patients underwent salvage treatment for CLNM and provided complete follow-up information. The follow-up duration after salvage treatment ranged from 36 to 175 months and the 3-year DSS rate after salvage treatment was 81.5% (22/27). Twelve patients received neck dissection only, while the remaining fifteen patients received surgery combined with adjuvant radiotherapy or chemoradiotherapy. The survival rate for the neck dissection group was 75%, compared to 86.7% for those receiving additional therapy, though this difference was not statistically significant ($P = 0.489$). Three patients opted for radiotherapy or chemo-radiotherapy, with survival time after CLNM of 1, 5, and 8 months. Another patient declined further follow-up and died 10 months after the primary treatment.

Extracapsular spread was observed in five patients. Three of these patients underwent surgery in combination with adjuvant therapy and achieved successful treatment outcomes. The remaining two patients received surgical treatment alone. Regrettably, one of the two patients who only had surgery succumbed to uncontrolled neck lesions one month post operation.

Overall, the cT1-2N0 TSCC patients under neck observation demonstrated satisfactory prognosis. However, it is clear that CLNM is the primary cause of death in early-stage TSCC patients, so we conducted further analysis to explore the prognostic factors for these patients.

T stage combined with DOI predicting survival prognosis

A DOI of 3 mm showed significant prognostic value for OS ($P = 0.001$), MFS ($P = 0.002$), and DSS ($P < 0.001$) as determined by the log-rank test (Fig. 1). To investigate whether DOI retains its prognostic relevance in different T stage categories, we categorized the patients into four subgroups based on the AJCC 8th edition T stage and 3 mm DOI criteria: thick T1, thin T1, thick T2, and thin T2.

The prognostic significance of T stage combined with a 3 mm DOI was confirmed in early-stage TSCC patients, with statistically significant differences illustrated in Fig. 2. Among T1 stage patients, those with a DOI > 3 mm exhibited poor OS ($P = 0.008$) and MFS

Table 3 Cox model for OS, MFS and DSS

Characteristics	Multivariate analysis		
	Hazard Ratio	95.0% CI for Exp(B)	*P* Value for Interaction
Cox model for OS			
Age(years)			
≤ 60			
> 60	2.380	1.090–5.198	0.029
Growth pattern			
exogenous			0.168
ulcerative	1.872	0.768–4.564	0.062
infiltrative	2.329	0.958–5.662	0.018
T stage + DOI			
T1, DOI ≤ 3 mm			0.018
T1, DOI > 3 mm	6.724	1.444–31.306	0.015
T2, DOI ≤ 3 mm	5.666	1.028–31.218	0.046
T2, DOI > 3 mm	10.653	2.394–47.404	0.002
Cox model for MFS			
Growth pattern			
exogenous			0.021
ulcerative	1.839	0.910–3.715	0.090
infiltrative	2.701	1.336–5.461	0.006
T stage + DOI			
T1, DOI ≤ 3 mm			0.054
T1, DOI > 3 mm	2.134	0.903–5.045	0.084
T2, DOI ≤ 3 mm	1.784	0.662–4.809	0.253
T2, DOI > 3 mm	3.016	1.365–6.667	0.006
Cox model for DSS			
Histologic grade			
well			
moderate-poor	2.901	0.939–8.962	0.064
Growth pattern			
exogenous			0.039
ulcerative	1.343	0.359–5.032	0.661
infiltrative	4.006	1.201–13.366	0.024

($P = 0.036$) compared to those with DOI ≤ 3 mm. Patients in the thick T2 group exhibited lower rates of OS, MFS, and DSS compared to the other three groups, although some differences lacked statistical significance in pairwise comparisons.

We subsequently performed a multivariate analysis (Table 3). In the COX regression model for OS, age (OR = 2.380; 95% CI, 1.090 to 5.198; $P = 0.029$), growth pattern (OR = 2.329; 95% CI, 0.958 to 5.662; $P = 0.018$), and T stage combined with a 3 mm DOI (OR = 10.653; 95% CI, 2.394 to 47.404; $P = 0.002$) demonstrated statistical prognostic significance. In the COX regression model for MFS, growth pattern (OR = 2.701; 95% CI, 1.336 to 5.461; $P = 0.006$) and T stage combined with a 3 mm DOI (OR = 3.016; 95% CI, 1.365 to 6.667; $P = 0.006$) exhibited statistical prognostic significance. In addition, growth pattern (OR = 4.006; 95% CI, 1.201 to 13.366; $P = 0.024$) showed statistical prognostic significance in the Cox regression model for DSS.

Discussion

TSCC is the most prevalent subtype of OSCC, significantly impacting oral sensation, speech, and swallowing. As health awareness increases, more TSCC patients are being diagnosed at an early-stage. However, the aggressive nature of tongue cancer can still lead to hidden metastasis at an early-stage. This study focused on early-stage TSCC patients under neck observation. Among these patients, 18.5% experienced single CLNM, with a 3-year DSS rate of 81.5% following salvage therapy, indicating a favorable survival outcome. These findings confirm that close postoperative surveillance is a viable strategy for most patients. In contrast, the systematic review and meta-analysis by Abu-Ghanem et al. [11] suggest that a more aggressive approach, such as END, might be warranted for certain early-stage patients. This highlights the necessity for further comparative studies to assess when observation versus END is most appropriate. Additionally, exploring precise methods for predicting CLNM during the follow-up phase is essential.

Further analysis indicates that DOI significantly influences patient survival and CLNM in this study. Yu et al. [16] conducted a retrospective study on early-stage TSCC patients who underwent END without clinical or radiological signs of CLNM. Through linear regression analysis, they found that a DOI ≥ 3.211 mm was associated with an occult CLNM incidence of over 20%. This is consistent with our findings, highlighting the significance of DOI as a predictive factor. However, in contrast to the approach in our study, Yu et al. implemented END in all patients, including those presenting with tumors featuring a relatively small DOI.This discrepancy further underscores the need for a more thorough exploration of neck treatment strategies for early-stage patients.

Similar to our research, it is important to note that all DOI values in the study of Yu et al. was derived from pathological examinations, ensuring the consistency in measurement standards. However, the pathological DOI (pDOI) cannot guide preoperative surgical planning. It is crucial to utilize imaging examinations to accurately measure the radiological DOI (rDOI) and directly predict CLNM. MRI has better soft tissue resolution than other imaging methods. Antonio et al. [17] found that the average difference between rDOI and pDOI was merely 0.3 mm. However, a recent prospective study indicated that despite the significant correlation between rDOI and pDOI, rDOI is ineffective in predicting CLNM of OSCC [18]. Overall, while MRI can be employed to assess DOI in OSCC, there is still no consensus on the optimal imaging method for predicting CLNM, highlighting the need for a standardized approach to imaging that can reliably inform clinical decisions.

DOI and T stage are well-established indicators of tumor progression, with DOI reflecting the depth of

tumor infiltration and T stage providing a broader assessment of tumor size and local spread. While our primary focus is on DOI and T stage, we also recognize the critical role of tumor growth patterns, such as tumor budding and the worst pattern of invasion (WPOI), as additional prognostic factors. These indicators provide valuable pathological insights into the growth patterns of OSCC. Chang et al. [19] developed a reliable risk model utilizing a modified WPOI system and a new tumor budding scoring system, categorizing early-stage OSCC patients into distinct risk groups with significant prognostic variations. This innovative approach complements our findings, suggesting that integrating tumor growth patterns with traditional measures like DOI and T stage may enhance predictive accuracy. Future research should focus on establishing consensus guidelines on how to best combine these factors, to enhance the ability to predict outcomes and personalize treatment, thereby improving patient care.

Numerous studies have investigated neck management strategies for patients with early-stage OSCC. A systematic review and meta-analysis conducted by Abu-Ghanem et al. [11] indicated that END could significantly reduce the rate of clinically detected CLNM and improve disease-specific survival in patients with cT1-2N0 TSCC. However, this analysis did not adequately address the impact of DOI.The latest NCCN guidelines for Head and Neck Cancers recommend that T1-2 OSCC patients with a DOI exceeding 3 mm should undergo END. Nevertheless, there is a lack of guidance tailored to different subtypes based on tumor location [15]. Our study specifically targets TSCC patients, and by stratifying them using both T stage and DOI, we provide a more detailed and practical understanding of risk profiles that may be applicable to clinical practice. We found that the combined evaluation of DOI and T stage can more accurately identify high-risk patients. Notably, when a T2 tumor's DOI exceeds 3 mm and the risk of CLNM increases significantly, we recommend prioritizing END for these patients to avoid missing potential micro-metastasis.

In practice, supraomohyoid neck dissection (level I-III) is the standard approach for many centers performing END [7, 20–24]. Previous studies have shown that isolated involvement of cervical levels III and IV is rare [25], and in our cohort, none of the patients with confirmed lymph node metastasis at cervical levels IV and V. This result aligns with the current literature, which suggests that a level I-III approach is sufficient for most early-stage TSCC patients. Additionally, previous research has shown that postoperative adjuvant therapy can improve the prognosis for patients with CLNM [26]. The survival rate of the TND group was 75%, which was lower than the 86.7% observed in the TND plus adjuvant therapy group. Although this difference did not reach statistical significance, it was likely attributable to the low statistical power stemming from the small sample size.

Sentinel lymph node biopsy (SLNB) has emerged as an effective therapeutic diagnostic method that facilitates the complete removal of sentinel lymph nodes while minimizing the risk of extracapsular spread associated with fine-needle aspiration biopsy [27]. A recent randomized trial demonstrated that SLNB-guided neck dissection achieved survival rates comparable to those of END while significantly reducing postoperative neck disability in early OSCC patients [28]. Consequently, SLNB could be an alternative management strategy, particularly for lower-risk patients. However, the criteria for patient selection remain critical. It is recommended for patients who can commit to rigorous follow-up schedules; if such follow-up cannot be ensured, SLNB should not be pursued [29]. More research is needed to determine which patient demographics would benefit most from SLNB versus traditional END.

The findings of this study should be approached with caution due to several limitations. First, by concentrating on DOI and T stage as factors for early-stage TSCC patients, we may overlook other critical pathological variables. Furthermore, since this research is based on a retrospective analysis, the sample size was determined by the number of eligible patients available in our database. This limitation prevented us from conducting a priori power calculations at the study design stage. A smaller sample size makes it more difficult to detect true effects and increasing the chances of failing to identify real relationships. Moreover, the small sample size heightens the susceptibility of our results to the influence of individual outliers, which can compromise the stability and reliability of our findings. Consequently, the conclusions drawn from this limited dataset may lack generalizability, hindering our ability to extrapolate the results to a broader population. Notably, the Cox model analysis of the joint impact of DOI and T stage on DSS did not achieve statistical significance, potentially obscuring the influence of other unaccounted factors due to the limited sample size. To address these issues, future research is needed, including a planned multicenter prospective randomized controlled trial aimed at collecting a larger and more varied dataset, including imaging reports and additional pathological factors. Using advanced statistical methods, such as machine learning, will help clarify the relationships between these variables and their impact on patient outcomes. Larger studies will improve statistical strength and generalizability, providing more definitive evidence of treatment effects and ultimately guiding better clinical decision-making to improve patient outcomes in this common oral cancer type.

Conclusion

The study indicates that depth of invasion and T stage are crucial prognostic factors for early-stage tongue squamous cell carcinoma. Patients with T2 tumors and DOI exceeding 3 mm should consider elective neck dissection.

Abbreviations

OSCC	Oral squamous cell carcinoma
TSCC	Tongue squamous cell carcinoma
CLNM	Cervical lymph node metastases
END	Elective neck dissection
DOI	Depth of invasion
TND	Therapeutic neck dissection
LR	Local recurrence
OS	Overall survival
MFS	Cervical lymph node metastasis-free survival
DSS	Disease-specific survival
pDOI	Pathological depth of invasion
rDOI	Radiological depth of invasion
MRI	Magnetic resonance imaging
WPOI	Worst pattern of invasion
SLNB	Sentinel lymph node biopsy

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12903-025-05694-z.

Supplementary Figure 1. Temporal Distribution of CLNM

Supplementary Figure 2. Symptoms of CLNM

Acknowledgements

Not applicable.

Author contributions

LB, FZE and CGZ designed study. HZX and LB supervised study. CGZ and KJ analyzed the data and manufactured the figures. CGZ wrote of the manuscript. CGZ and KXP revised and edited the manuscript. All authors have read and approved the final manuscript.

Funding

This article was supported by the Beijing Municipal Administration of Hospitals Incubating Program [grant number PX2019057], the Capital's Funds for Health Improvement and Research [grant number CFH2020-2-2143], the National Natural Science Foundation of China [grant number 82370925], and the Young Scientist Program of Beijing Stomatological Hospital, Capital Medical University [grant number YSP202310].

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval statement and patient consent to participate

This study was approved by the Ethics Committee of Beijing Stomatological Hospital, Capital Medical University (approval No. CMUSH-IRB-KJ-PJ-2021-04). All the procedures performed in the study were in conformity with the provisions of the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Written informed consent was obtained from all patients.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 28 September 2024 / Accepted: 19 February 2025
Published online: 13 March 2025

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