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The lingual lymph nodes in patients with tongue and floor of the mouth carcinoma: case reports summary and revision of the anatomical terminology

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A summary of clinical cases describing lesions of lingual lymph nodes in cancer of the tongue and the floor of the mouth is presented. For the first time, a revision of special anatomical terminology was performed on such material. Topographic and anatomical information on the intermuscular fascial spaces of the tongue and the floor of the oral cavity throughout which subgroups of lingual lymph nodes are distributed is provided.

Keywords: tongue cancer, floor of the mouth cancer, lingual lymph node, topographic-anatomic classification, regional metastasis

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Introduction

Among the subsites of the oral cavity, the oral tongue carries the highest risk of local or locoregional recurrence after surgical treatment, thus representing the main cause of therapeutic failure in patients with squamous cell carcinoma (SCC). This is true both for early localized processes with cN0 status and for advanced tumors with N+ involvement. Conventional diagnostic capabilities combined with current approaches of surgical treatment stage planning, do not allow for a significant shift in these prognostic trends.

As often occurs in surgery, a clinical problem has an anatomical background. The tongue in complex with the underlying floor of the mouth (FOM) possesses a very dense lymphovascular drainage network. Extra-organic lymphatic vessels literally permeate the tissues of the FOM in a web-like manner. Flowing towards the submandibular and submental triangles, the lymphatic drainage pathways from the mobile part of the tongue (anterior two-thirds) descend in a vertical direction through the sublingual fascial intermuscular spaces. These vessels provide drainage from the mucosal surfaces of the tongue, as well as from the FOM, the sublingual grooves, tongue muscles, and sublingual salivary glands (i.e., lymph from three potential primary sites – the tongue proper, FOM, and sublingual glands). Before reaching the lymph nodes of regional groups IA, IB, and IIA according to Robbins – some of the draining extra-organic trunks penetrate the mylohyoid muscle bilaterally at several points (typically in the anterior sections – corresponding to group IA; and in the posterior sections, anterior to the posterior edge of the mylohyoid muscle – corresponding to groups IB and IIA). Along the efferent path of these collectors, in the zone that actually precedes the IA, IB, IIA levels, the lingual lymph nodes (LLNs) are often found. The early anatomical descriptions of these inconstant nodes date back to P. Mascagni (1787) [1] and J. Henle (1868) [2]. Currently, LLNs are unjustly neglected by head and neck surgical specialists. The term "inconstant" should not mislead the reader into underestimating their significance or real occurrence. In fact, S.J. Ananian et al. (2015), after analyzing autopsy material (average age at death 76.3 years), found at least one LLN in almost every fourth specimen (23.8 %) [1–10].

According to experts in the field, these anatomical details of the lymphatic drainage system, which unfortunately remain relatively unknown among oncologic surgeons, may explain the unsatisfactory outcomes of specialized treatment for tongue cancer [11, 12]. P.A. Herzen (1928) recalled to this anatomical area as a "lymphatic swamp", where cancer cells accumulate in large numbers and may metastasize. Pointing to the "poor reputation" of tongue cancer, he emphasized that the reasons are: early and rapid involvement of the lymphatic system, and the "richness of the lymphatic network in the intermuscular spaces at the base of the tongue and the FOM" [13]. Although rarely cited in international English-language journals, some brief but noteworthy opinions highlighting the oncological relevance of LLNs come from respected specialists. For instance, J.A. Werner (2007) directly associates the high potential for primary tumor lymphogenic spread with the density of the local lymphovascular network [14]. L. Calabrese et al. (2003), who later proposed the "compartment" resection technique for the tongue and demonstrated a significant improvement over traditional glossectomy outcomes, had already noted in a previous publication that LLNs were found in 22 surgical specimens from en-bloc resections (combined tongue and neck tissue resections) of T2–4 stage carcinomas. A total of 5 LLNs were reported, 2 of which contained SCC metastases [15–17].

From the clinical and anatomical-pathological standpoints the reason, why the lingual lymphatic area tends to be underestimated as a cause of recurrence is that, when recurrence actually occurs, it typically involves the deeper portion of the surgical bed and becomes clinically evident only after gaining considerable size, hidden in depth or beneath reconstructive flaps. In this situation, most recurrences are classified by surgeons as rT recurrences, with the blame attributed to close surgical margins or infiltration by the primary tumor, rather than considering the possibility of an origin in the LLNs. Also, such parameters as the small size of the LLNs (mean length 4.1 mm, mean thickness was 2.8 mm according to S.J. Ananian et al.) and their position close to the primary site predispose the LLNs to be rapidly invaded and destructed by the growing tumor. This observation which was familiar to the old authors later was pointed out in the paper by J.M. Dutton et al. (2002) [10, 18, 19]. This all, each in its certain extent is responsible for remaining the LLN problem largely unrecognized among head and neck surgeons.

Apart from our 2021 paper [20], contemporary Russian literature lacks data on secondary involvement of the LLNs in SCC of the tongue and FOM. In contrast, many reports have accumulated in the world literature, most of which are nonsystematic clinical observations. It should be out-lined that Russian-language medical periodicals and surgical manuals from the first half of the 20th century possesses detailed anatomical descriptions of the LLN as well as remarks emphasizing the necessity of LLN removal in tongue cancer [21–24]. This largely reflects the international literature of that period, where, following the works of H. Küttner (1897) and G. Crile (1906), surgical management of tongue cancer and its anatomical and physiological rationale were actively debated [24–28]. In manuals and dissertational works of Soviet anatomists N.A. Semeina (1949), R.A. Kurbskaya (1959), I.M. Aizenshtein and R.I. Khudaiberdyev (1963), V.L. Temirov (1968), O.A. Mashkov (1968), and others, LLNs were consistently classified as regional lymph nodes of the tongue. These works contain anatomical study protocols with highly detailed descriptions of LLNs from both regional lymphatic anatomy and topographic aspects [29–34]. In the same year, 1968, B.A. Rudjavsky

published an influential monograph, in which the surgical approach was critically evaluated, including anatomically grounded statements regarding the impossibility of achieving true ablasticity of the intervention, and the necessity of combining surgery with radiotherapy was firmly established [35]. It should be mentioned that the combined method and its superiority over surgical treatment as the main one was stated in Russian language in 1935 in the monograph by A.A. Epstein (1935) [36]. Notably, following this publication (and probably – in accordance to it), references to LLN anatomy in Russian literature became sporadic and mostly formal, while reports of clinical cases of LLN involvement in tongue cancer, as well as discussion on their oncological relevance, have remained absent up to the present. In the English-language literature, for various reasons, LLNs were not mentioned again until the early 1970s, following the American edition of Rouviere's monograph (1938) [37–39]. In the last decade and a half, the results of large retrospective and prospective clinical studies first provided by Chinese groups of researches have become available, indicating a pronounced unfavorable prognostic value of metastases and foci of locoregional recurrence associated with the LLNs [40–42]. Individual authors have attempted topographic-anatomic LLN subdivision into subgroups [43, 44]. In 2023, we published a paper in which, based on the analysis of more than 60 anatomical sources, a topographic classification of LLNs was proposed, and has received favorable recalls in international scientific literature [45–47]. This classification is based on the specific division of the FOM and the suprahyoid region into several intermuscular spaces (unpaired median; paired intermediate – contains the lingual artery; paired lateral – contains the sublingual gland, as well as additional bilateral paired zones corresponding to the localization of the deep lobe of the submandibular gland) (fig. 1).

To overcome this harmful blind-spot in anatomic knowledge and determine the deserved role and meaning of the LLNs in diagnosis and treatment planning in patients with tongue and FOM SCC the head and neck oncology community needs to reconsider the concept of the first echelon of lymphatic drainage (sentinel lymph nodes) for the oral tongue and FOM. Specifically, the LLNs, which in the efferent lymph flow precede the submental (level IA) and submandibular (level IB) nodal groups, should be recognized as first-echelon regional nodes for these primary sites, including the sublingual glands. The probability of LLN involvement in metastatic spread should be regarded as significant (in early cases when the possibility of surgical undertreatment, resulting in LLN negligence is especially sound) and comparable to that of levels IA and IB, thus necessitating the same rigor in diagnostic evaluation and application of technological modalities.

Aim of the study – to summarize the previously described clinical cases of LLN lesion.

For the first time, these cases were reviewed and distributed in respect of the developed topographic-anatomic classification, i.e. for each documented case, depending on the location of the involved LLNs, their topographic subgroup was clarified.

Materials and methods

Publications containing case reports were selected through sequential searches using keywords in various combinations in the following scientific databases: PubMed,

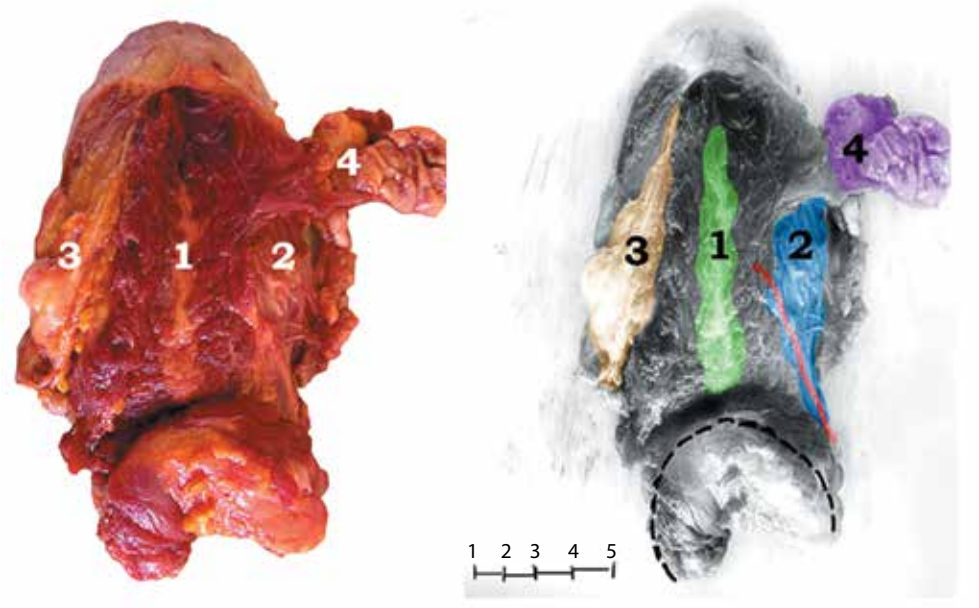

Fig. 1. *Spaces of the tongue and floor of the mouth, containing subgroups of lingual lymph nodes. 1 – unpaired median space; 2 – paired intermediate space; 3 – paired lateral space; 4 – deep aspecs of the submandibular gland*

Google Scholar, Archive.org and J-stage. After the initial selection, titles and abstracts were reviewed, followed by a full-text search and analysis. The reference lists of the selected articles were also examined for additional sources.

To allow classification of the described LLNs according to the topographic-anatomic system, paragraphs containing data on the anatomical location of affected LLNs were extracted from the full-text documents and translated. For translations from Japanese, online translators and ChatGPT were used, and a linguist was consulted when necessary. The resulting data were interpreted according to the context of the article and categorized into one of four topographic-anatomical LLN subgroups.

Since the process of adapting the originally English-language terminology of the 2023 LLN classification into Russian was not yet completed at the time of writing, original English terms are used in the summary table. In the main text, subgroup names are transliterated into Russian, which is permitted by the Terminologia Anatomica (1998) for the translation of foreign anatomical terms [48].

For better clarity and ease of memorization, brief anatomical and surgical descriptions of the fascial spaces or sagittal intermuscular gaps of the FOM are provided. As mentioned earlier, LLNs are distributed within these spaces, which forms the basis of the topographic-anatomical classification. Fig. 1 shows the macroscopic and schematic layout of these spaces, labeled 1 through 4: space 1 (unpaired median space) – contains the median LLNs; space 2 (paired intermediate space) – along the course of the lingual artery, contains intermediate parahyoid LLNs (term introduced by Japanese authors to indicate proximity to the greater horn of the hyoid bone); space 3 (paired lateral space) – contains lateral paraglandular sublingual LLNs, located near the sublingual salivary gland; space 4 (paired lateral space) – includes the deep lobe of the submandibular salivary gland and the upper-medial surface of this gland, extending between the posterior parts of the sublingual groove and the deep layers of the submandibular triangle. This space contains lateral paraglandular submandibular LLNs.

Only publications strictly categorized as clinical case reports were included. The choice to exclude larger retrospective and prospective studies, despite their substantial clinical and morphological datasets, was primarily due to the lack of precise topographic-anatomical LLN categorization in those works.

Results

A total of 23 sources were selected and included in the analysis (table 1). Published between 1985 and 2021, these works describe 28 confirmed cases of LLN involvement. Full-text documents were available in English for 13 cases and in Japanese languages for 10. Median LLNs located in space 1 were involved in 4 patients. The first reports of such involvement appeared in 1985 (S. Ozeki et al.) [49]. Intermediate parahyoid LLNs in space 2 were involved in 6 patients, with the earliest case described in 1989 (K. Omura et al.) [50]. Lateral sublingual LLNs in space 3 were involved in 20 patients, with the first report also dating back to 1985 (S. Ozeki et al.). Lateral submandibular LLNs in space 4 were found in 5 patients, with the earliest description published by M. Umeda et al. in 2009 [51].

Discussion

The modern era of research on LLNs was initiated by a publication by S. Ozeki et al. in 1985, which included descriptions of three patients – their clinical histories, timelines of diagnostic and therapeutic interventions, and survival outcomes. This was followed by several reports in the Japanese-language literature describing clinical observations of LLN involvement [48–55]. The article by J.M. Dutton et al. (2002) helped to revive interest on LLNs in the international references. After that, several more case reports were published, followed by retrospective and prospective studies. These studies reported the strongly negative prognostic impact of metastases to the LLNs [18, 40–42]. These facts highlight the need to increase clinician awareness of potential LLN involvement, which in turn necessitates the adoption of a topographic-anatomical classification.

Until recently, nearly all surgical anatomical information – including early attempts at topographic classification – was drawn primarily from anatomical monographs of the early 20th century. Most often cited is the work by H. Rouvière, Anatomie des lymphatiques de l'homme, published in Paris in 1932, with an English edition appearing in 1938 [37]. Like many other classical anatomical references on the lymphatic system, LLNs were divided simply into median and lateral types. However, with accumulating clinical experience, it became evident that LLNs can localize in four distinct zones: between the internal surfaces of the genioglossus and geniohyoid muscles; between the lateral surfaces of these muscles and the internal sides of the hyoglossus muscles along the lingual arteries; near the sublingual salivary glands; near the submandibular gland – on its deep medial surface or at its deep lobe (see fig. 1). These anatomical insights formed the basis for the development of the topographic-anatomical classification [45]. This prompted a revision of accumulated clinical data to reclassify LLN involvement based on topographic-anatomical subgroup.

Conclusion

The information presented in this article regarding the clinical, anatomical, and terminological aspects of LLN and their secondary involvement in patients with tongue and FOM SCC should, in our view, increase attention of the head and neck surgeons to this regional nodal group. Because LLNs are often overlooked, we propose that every patient with tongue and FOM carcinoma should be evaluated

Table 1. *Clinical case reports describing lingual lymph nodes (LLN) lesions in squamous cell cancer (SCC) of the tongue and floor of the mouth (FOM)*

Reference	Clinical case	Clinical data	LLN terminology used in the publication	LLN classification (2023)
S. Ozeki et al., 1985 [49]	1	A 49-year-old male with SCC of the lateral tongue surface with invasion to the base of the tongue, T3N3M0. During surgery an enlarged median LLN was spotted and resected	Median LLN	Median LLN, S-1
	2	A 54-year-old male with SCC of lateral lingual surface T1N0M0. One lateral LLN with extracapsular spread encountered in the surgical specimen	Lateral LLN	Lateral sublingual (paraglandular) LLN, S-3
	3	A 63-year-old male with SCC of the margin of the tongue, T2N1M0. One lateral LLN identified in the surgical specimen	Lateral LLN	Lateral sublingual (paraglandular) LLN, S-3
Y. Honma et al., 1986 [52]	4	A 77-year-old male with SCC of the inferior later tongue margin, T2N0M0. Two lateral LLNs represented foci of locoregional recurrence	Lateral LLN ($n = 2$)	Lateral sublingual (paraglandular) LLN, S-3
K. Omura et al., 1989 [50]	5	A 54-year-old male with SCC of lateral tongue, T2N0. One LLN at the greater cornu of the hyoid spotted during surgery	Lateral LLN	Intermediate parahyoid LLN, S-2
N. Hayashi et al., 1992 [53]	6	A 57-year-old man with recurrent tongue SCC. After an in-continuous resection one metastatic median LLN was found in the surgical specimen	Median LLN	Median LLN, S-1
Y. Kimura et al., 1993 [54]	7	A 41-year-old female patient with SCC of the tongue (T3N2b) developed a recurrence in a contralateral lateral sublingual LLN	Lateral LLN	Lateral sublingual (paraglandular) LLN, S-3
H. Kitada et al., 1999 [55]	8	A 73-year-old male with SCC of the lateral lingual margin, T3N2bM0. One metastatic lateral LLN suspected during preoperative CT and MRI	Lateral LLN	Lateral sublingual (paraglandular) LLN, S-3
J.M. Dutton et al., 2002 [18]	9	A 73-year-old male with SCC of the lateral lingual margin, T2N2b. In the surgical specimen two positive LLNs were identified	Lateral LLN ($n = 2$)	Lateral sublingual (paraglandular) LLN, S-3
Y. Ohiro et al., 2002 [56]	10	A 28-year-old male with SCC of the later tongue margin, T2N1M0. One metastatic lateral LLN identified on preoperative CT and MRI	Lateral LLN	Lateral sublingual (paraglandular) LLN, S-3
Y. Ariji et al., 2006 [57]	11	A 65-year-old male with SCC of the lateral surface of the tongue, T1N0M0 was diagnosed with a lesion of a median LLN	Median LLN	Median LLN, S-1
W. Han et al., 2008 [58]	12	A 46-year-old male with SCC of the lateral lingual margin, cT2N0M0. Two LLN noted during surgery showed metastasis on frozen section analysis	Lateral LLN ($n = 2$)	Lateral sublingual (paraglandular) LLN, S-3
K. Kawahara et al., 2008 [59]	13	A 56-year-old male with SCC of the lateral tongue, cT3N0M0. One metastatic lateral LLN was detected intraoperatively by palpation	Lateral LLN	Lateral sublingual (paraglandular) LLN, S-3
M. Umeda et al., 2009 [51]	14	A 62-year-old male with SCC of the anterior floor of the mouth, T3N2cM0. CT and MRI visualized an enlarged LLN	Lateral LLN	Lateral submandibular (paraglandular) LLN, S-4
	15	A 62-year-old male with SCC of the anterior FOM, T3N2cM0. CT and MRI visualized an enlarged LLN	Lateral LLN	Lateral sublingual (paraglandular) LLN, S-3
M. Ando et al., 2010 [60]	16	A 63-year-old male with FOM and root of the tongue SCC, three enlarged nodes shown on MRI. Three LLNs in close contact with sublingual gland and one at the root of lingual artery were encountered in the specimen	3 lateral LLNs, 1 parahyoid LLNs	Lateral sublingual (paraglandular) LLN, S-3, 1 Intermediate parahyoid LLN, S-2

End of table 1

Reference	Clinical case	Clinical data	LLN terminology used in the publication	LLN classification (2023)
T. Zhang et al., 2011 [61]	17	A 47-year-old female with ventral lingual surface SCC cT1N0M0 received three operations. 7 months after first surgery PET-CT suspected LLN lesion; second surgery and adjuvant 60 Gy radiotherapy were carried out; and (c) After 6 months the third intervention was performed for extensive locoregional recurrence	Lateral sublingual LLN	Lateral sublingual (paraglandular) LLN, S-3
	18	A 42-year-old man with ventral lingual surface SCC, T2N0MO. Surgical specimen contained one LLN metastasis with extracapsular spread	Lateral sublingual LLN	Lateral sublingual (paraglandular) LLN, S-3
M. Saito et al., 2012 [62]	19	A 81-year-old female with lateral margin of the tongue SCC, T2N0. CT-lymphography revealed a metastatic lateral LLN	Lateral LLN	Lateral submandibular (paraglandular) LLN, S-4
K. Saida et al., 2014 [63]	20	A 57-year-old male with cT2N2bM0 SCC of the left lower gingiva. Extended resection with postoperative chemoradiotherapy. No evidence of recurrence during more than 6 years	Lateral LLN ($n = 2$)	Lateral submandibular (paraglandular) LLN, S-4
Y. Watanabe et al., 2016 [64]	21	A 79-year-old man with a T2N0M0 SCC of the left lateral tongue margin SCC. 8 months after surgery, a contrast-enhanced CT scan revealed a metastasis in a lymph node located above the greater cornu of the hyoid bone on the left. He died 6 months later from disease progression	Parahyoid LLN	Intermediate parahyoid LLN, S-2
	22	A 79-year-old man with a T2N0M0 SCC of the left lateral tongue margin SCC. 7 months after surgery, a contrast-enhanced CT scan revealed a metastasis in the left supra-major hyoid node and a second metastatic lesion in the homolateral deep jugular node. 3 months after the discovery of a recurrence, he died from disease progression	Parahyoid LLN	Intermediate parahyoid LLN, S-2
T. Suzuki et al., 2017 [65]	23	A 41-year-old male with T4aN2bM0 SCC of the left lateral lingual margin. At three weeks postoperatively, metastasis to the LLN lateral to the greater horn of the hyoid was identified	Parahyoid LLN	Intermediate parahyoid LLN, S-2
İ. Kaya et al., 2017 [66]	24	A 57-year-old male with localized midline floor of the mouth SCC, T1N0M0. The primary site resection specimen contained 1 metastatic LLN	Lateral sublingual LLN	Lateral sublingual (paraglandular) LLN, S-3
N. Nishio et al., 2017 [67]	25	A 48-year-old left lateral edge of the tongue SCC. Nine months after glossectomy, a LLN lesion suspected during follow-up ultrasound. Extended Wide in-continuous resection. After 5 years of follow-up, there was no evidence of local or regional recurrence or distant metastasis	Lateral LLN	Intermediate parahyoid LLN, S-2
J. Bang et al., 2020 [68]	26	A 41-year-old male , SCC on the left posterolateral aspect of the tongue. A partial glossectomy and supraomohyoid neck dissection were planned. Intraoperative ultrasound detected a LLN lesion. Extended dissection and adjuvant chemoradiotherapy. After 3 years of follow-up, there was no evidence of locoregional recurrence or distant metastasis	Lateral LLN	Lateral sublingual (paraglandular) LLN, S-3
K. Eguchi et al., 2020 [69]	27	A 55-year-old male with lateral tongue margin SCC cT4aN0M0. During primary surgery an enlarged median LLN within the lingual septa was encountered, after that he was staged as pT4aN2b. Six months later a contralateral regional recurrence lead to a second extended surgery. 14 months asfer the primary intervention was diagnosed with multiple distant disease	Median LLN	Median LLN, S-1
M. Suzuki and K. Eguchi, 2021 [70]	28	A 59- year-old man with right margin of the tongue SCC, intraoperatively a firm LLN along the hypoglossal nerve behind the medial surface of the submandibular gland was spotted and the mass was resected independently	Lateral LLN located lateral to hyoglossal muscle behind the submandibular gland	Lateral submandibular (paraglandular) LLN, S-4

Note. *SCC – squamous cell carcinoma; CT – computed tomography; MRI – magnetic resonance imaging; S-1 – space 1; S-2 – space 2; S-3 – space 3; S-4 – space 4.*

for the presence of LLNs and their potential involvement. This assessment should be carried out using palpation and imaging techniques (computed tomography, magnetic resonance imaging, ultrasound) preoperatively, intraoperatively, and during postoperative follow-up. It is essential to abandon the perception of LLN involvement as a clinically insignificant or rare finding. Currently existing clinical, imaging and pathology protocols should be updated to incorporate LLNs into routine work-up and management of tongue and FOM SCC. The presented terminological notions are intending to clarify clinical aspects of documenting, classifying and reporting LLN lesions.

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