Surgical anatomy of the lingual lymph nodes. Systematic literature analysis and proposition for topographic classification.

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Systematic Review
Abstract

**Purpose:** Metastatic involvement of the lingual lymph nodes (LLNs) in oral cavity squamous cell cancer has recently been proven to significantly reduce locoregional control and survival. Despite recent refinements in the detection of these lesions, the understanding of the LLN topographic anatomy among clinicians is limited. A proposition of a topographic division on LLN based on a comprehensive literature search and synthesis may be helpful in this condition.

**Methods:** A literature search and election based on contemporary PRISMA guidelines was performed for sources on LLN anatomy with special attention on their subdivision.

**Results:** Four topographic LLN subgroups were defined: median – between genioglossal and geniohyoid muscles; intermediate para-hyoid – medial to the hyoglossal muscle, at the greater cornu of the hyoid bone; lateral sublingual (paraglandular) LLNs – at the sublingual salivary gland; lateral submandibular (paraglandular) LLNs – lateral to the hyoglossal muscle, at the deep surface of the submandibular salivary gland.

**Conclusion:** The development and implementation of a unified anatomical topographic classification of LLN subgroups may be among the important conditions for improving the detection and treatment of LLN lesions.

Introduction

The topic of the role of LLNs in the spread of oral tongue and floor of the mouth squamous cell carcinoma (SCC) has recently attracted the attention of clinical researchers. Modern investigation of LLN metastatic involvement started from a paper by Ozeki et al., which was followed by several reports in Japanese literature [1,2,3,4]. The results of the latest large prospective and retrospective clinical trials strongly suggest the significant negative prognostic value of these lesions in patients suffering from oral SCC [5,6,7]. Unfortunately, despite certain refinements in clinical and imaging recognition of LLN metastasis, details of their surgical anatomy are somewhat limited, and no unified topographic classification has been elaborated yet. This in turn may jeopardize the accuracy of the reported observations and results.

The purpose of this study was to perform a comprehensive search and analysis of the literature sources on the anatomy of LLNs and to determine a topographic-anatomic classification of different LLN subgroups.

Materials And Methods

The literature search and analysis were conducted in accordance with the PRISMA guidelines [8]. Varying combinations of key word searches were undertaken in the PubMed, Google Scholar, J-stage and Archive.org databases. An additional search for Russian language sources (particularly dissertational
works and articles in high school scientific periodicals) was performed in the electronic catalog of the Russian State Central Medical Library - rusmed.rucml.ru (RSCML). After the primary investigation, the titles and abstracts of the selected sources were systematically screened. Those that possessed academic interest were addressed for further full-text evaluation (Fig. 1). Reference lists of the reviewed sources were subjected to additional investigation.

The following exclusion criteria for the scientific papers were used: studies, observations, reviews devoted to the anatomic region but with no information on the specific local anatomy or tumorous involvement of the LLNs. Sources that reported on radiotherapy and/or chemotherapy of the tongue and mouth floor subunits were also excluded.

**Results**

The numbers of sources and the process of their acquisition are illustrated in figure 1 and table 3. The performed examination and additional bibliographic search resulted in 65 eligible studies for inclusion in a qualitative review and synthesis. The full text sources in English, German, Japanese, Russian and French tongues dated from 1868 to 2021. According to the explored databases, these sources were distributed in the following manner: PubMed – 15; Google Scholar – 5; J-Stage – 10; Archive.org – 23; RSCML – 12 sources.

The literary sources on LLN anatomy we divided according to their data timeline into three sequential chronological periods (Fig. 1). This was done mainly for descriptive reasons. The first period dates from 1868 to 1943 and in majority consists of fundamental monographs on human anatomy, in part these were represented by works of the old authors – found in tutorials and articles of the second part of the XIX century – early 1900s (Table 1a) [9,10]. The second period starts from observations in dissertational works of the late 1940s – early 1950s and lasts until the late 1980s [11,12]. This period is comprised of two types of sources: anatomic-topographic studies applied for means of surgical and radiation oncology with nonsystematic but sometimes detailed descriptions of LLNs and anatomy textbooks with information (sometimes not without terminological errors) gained from the works of the first period (Table 1b). The third period, which lasted until now, started in 1985 with a paper by Ozeki et al. [1,11,13]. It is characterized by the gradual accumulation of clinical experience in the diagnosis and treatment of LLN metastasis, the demonstration of a significant negative influence of these lesions on survival prognosis, and (what is more important to the present study) attempts to clarify LLN surgical anatomy (Table 1c).

**Discussion**

*Historical outline*

The first chronological period starts with Henle’s “Handbook of systematic human anatomy”, which is reasonable to highlight as the earliest anatomic description of LLNs [9]. The most essential work of this
time period, which still has up-to-date clinically relevant information, is H. Küttner’s treatise “On lymphatics and lymph glands of the tongue with relation to the spread of carcinoma of the tongue” [15]. Among other invaluable material of this work, which is going to be discussed in some detail later on the author gives an analysis of the available statistics. In a discussion on the clinical significance of LLN, Küttner gives reference to Woler’s report, which may be affirmed as the first academic mention of LLN metastasis in a patient with tongue cancer [14]. We see it necessary to bring a complete citation of this clinical observation.


This shows that more than a century ago, leading surgeons were aware of the role played by LLNs in tongue cancer progression. Rouviere’s tutorial “Anatomie des Lymphatiques de l’Homme” (1932) and its famous English edition, which was published in 1938, are dominantly appreciated by LLN researchers as the essential source of anatomic information on LLNs [16]. This eminent work is grounded on his predecessors’ heritage, Delamere, Poirier, Cuneo (1903) - authors who must be credited as the outstanding explorers of the human lymphatic system [17]. Works by Most (1906), Bartels (1907, 1909), Nekrasov (1938) and others, which belong to the first chronological period, contain important facts on LLN anatomy and topography [18-21]. Katayama, who is frequently quoted by Japanese authors, is the first to report LLN’s anatomic incidence [10].

Cadaveric studies employing lymphographic dye injections described LLNs as inconstant regional lymph nodes of the tongue [11,22]. Mashkov (1968) stated that the LLN incidence was 8.6% and included them in the regional draining lymph node group of the tongue [24]. Feind (1972) provided valuable references on LLNs position in the lymphatic drainage path flow and noted their potential role in tongue and mouth floor cancer metastatic spread [25]. Shelomentsev et al. (1974) studied the intraorganic lymphatics of the tongue and advocated wide dissection along the lingual artery and vein in conjunction with glossectomy [26].

Ozeki et al. [1] (1985) reported a comprehensive observation of three different clinical cases of patients suffering from LLN lesions. This was followed by several case reports in Japanese literature [27]. Another article in English reported the details of one case and speculated on the question of whether dissection of the LLN-bearing tissue performed in combination with glossectomy would improve local control in this group of patients [28]. Ando et al. (2009) described the clinical characteristics of para-hyoid LLNs, which lie at the greater horn of the hyoid bone [29]. Ananian et al. (2015), in an anatomic-histologic study, identified LLNs in 23.8% cadavers and found a relatively high incidence of mucous-associated lymphoid tissue (MALT) in the tongue and floor of the mouth mucosa [34]. Suzuki et al. (2016) classified LLNs into the following subgroups: median, anterior lateral (in the proximity of the sublingual gland), para-hyoid
and posterior lateral (outside the lateral sublingual space – at the inner surface of the submandibular gland). This group was mostly avoided by previous authors [35].

The reported incidence of LLN metastasis in patients with oral tongue and mouth floor SCC ranges from 1.3% to 17.1%. The results of several studies confirm a pronounced negative impact on overall survival and recurrence-free survival with up to an 8-fold decrease in prognosis [5, 6, 7, 44, 94]. As LLN lesions are often overlooked, it was postulated that every tongue and mouth floor cancer patient should be investigated for LLN existence and possible metastatic involvement by palpation, imaging or special dye tracing techniques preoperatively, intraoperatively and postoperatively [27, 32, 36, 37].

Given these figures, neither the anatomical frequency nor the rates of metastasis to these nodes may in no instance be considered low. Thus, the perception of LLNs as a clinically irrelevant issue or a rare finding must be abandoned. Special attention of clinicians should be focused on LLN in patients with tongue and mouth floor cancer. This in turn requires the development of a unified nomenclature and coordinated topographic classification.

**Clarification of general terminology**

In our view, two terminological uncertainties induce misinterpretation of general LLN nomenclature. The first, which requires clarification: the not-infrequently encountered term "sublingual lymph nodes". This issue does not cause difficulties: in the previous ones (BNA, 1895; Jena Anatomic nomenclature – Jenaer Nomina Anatomica, JNA, 1935; Paris Anatomical Nomenclature – Parisiana Nomina Anatomica, PNA, 1955) and in the modern international anatomical nomenclature (Terminologia Anatomica, 1998), LLNs are designated by the term "linguales" ("lingual") [38-41].

Another common error is caused by the term "nodules", which was often used to refer to LLNs in the specialized literature (especially in the second chronological period). Feind (1972), in his influential work, uses terms such as “interrupting nodules” and “intercalated node” to point out their position in the regional lymphatic pathway, their small size, and anatomic inconsistency [25]. These names are derived from the old German term “Schaltdrüsen – interrupted glands”, synonymous with the currently used term “in-transit” lymph node [42-44, 91].

**Topographical subgroups**

**LLNs between genioglossal and geniohyoid muscles.** Located between the inner surfaces of the genioglossal and geniohyoid muscles within the median fascial space of the sublingual region. Küttner gave descriptions of “glands inside tongue musculature between the two mm. genioglossi”. Poirier and Cuneo illustrated “ganglions intra-linguaux – intralingual node” within the tongue musculature [17]. Later, Most and Bartels referred to this group as anterior/median LLNs [18-20]. Albrecht (1925) reported the existence of an inconstant LLN between genioglossal muscles [45]. Rouviere and after him Nekrasov also imply the term median LLNs [16, 21]. Katayama studied embryos and reported an incidence of 15.1% [10]. Mashkov (1968) dissected adult cadavers and reported an incidence of 8.6% [24]. Ananian et al. did not
observe median LLNs in their cadaveric study (average age 76.3 years). These findings were explained by
senile atrophy of lymph nodes. Clinical experience with rare lesions of median LLNs suggests a negative
locoregional control prognosis, as their location assumes bilateral tumor spread [34]. Eguchi et al.
explored median LLN anatomy and described their location in the median sublingual space on each side
of the lingual septum in a sagittal position of three-fourths of the distance from the mental spine [46].

Taking into account the abovementioned facts and topographical location of this LLN subgroup,
especially that they do not have a contralateral pair (placed in the median sublingual space), the Latin
term “medianus” – median is the most accurate. This designation is used in classic fundamental works
and modern publications [47,48].

**LLNs at the greater horn of the hyoid bone along a. lingualis.** Located medially to the hyoglossal muscle
along the route of the lingual artery in the intermediate sublingual space. In their works dedicated to
tongue cancer, Wolfler (1881), Sachs (1893), and Roediger (1901) gave concise descriptions of
metastatic lymph nodes that were situated at the horn of the hyoid bone [14, 30, 31]. Wolfler left another
intriguing observation of an LLN adjacent to the wall of the lingual artery. We see it necessary to give a
full citation:

“Mann, 59, T. Infiltrierender Krebs der ganzen Zunge. Infiltration der tiefen cervicalen Drüsen. Bei Ligatur
der Lingualis muss eine Druse von der Wand der Art. lingualis entfernt warden” [14].

Aizenshtein and Khudaiberdiev (1963) reported that lateral LLNs may be found along the lingual artery
course [50]. Shelomentsev and Sushentsov found close connections of the lingual lymphatic vessels with
the sublingual gland passing through its parenchyma and draining the gland itself [50,52]. The main
extraorganic efferent lymphatic trunks were found to be located along the branches of the lingual artery
and vein. To achieve better local control, the authors advocated wide dissection along the lingual artery
system with sublingual gland removal in combination with glossectomy. Ando et al. (2009) provided
accurate clinical characteristics of “lateral para-hyoid” LLNs and observed their metastatic involvement in
6.3% of 248 patients with T1-2 tongue SCC [29,36]. Ananian et al. reported an anatomic incidence of 19%
in their 21 dissected specimens [34]. Suzuki et al. (2016, 2021) refer to these as para-hyoid LLNs [35,53].

**LLNs at the sublingual salivary gland.** These LLNs are located close to the sublingual gland on the upper
surface of the mylohyoid muscles within loose fatty tissue of the lateral sublingual space. This space is
bordered anterior-laterally by the inner surface of the mandible and harbors blood vessels, the sublingual
gland, the submandibular duct with the deep portion of the submandibular gland, and the branching
hypoglossal, mylohyoid and lingual nerves. Most terms of these lateral LLNs indicate that they may be
found near the sublingual gland [18]. Katayama reported an incidence of lateral LLN of 30.2% [10]. Feind
summarized that “the floor of the mouth and the sublingual salivary gland drain into the intercalated
sublingual nodule, the preglandular node of the submandibular group, and the subdigastric nodes of the
internal jugular chain”. Hence, this author states that LLNs are a part of the tongue and mouth floor
drainage pathway, though delineates their rare consistency [25]. In Ozeki’s report, two of the three
presented subjects presented lateral LNN metastasis, which was situated near the sublingual gland [1].
Suzuki et al.’s classification terms these LLNs as anterior lateral [35]. Ananian et al. identified these LLNs in 14.3% and termed them lateral paraglandular LLNs, which were formed by analogy with the subdivision of the submandibular nodes [34].

**LLNs behind the deep surface of the submandibular salivary gland.** There is some terminological discrepancy for this LLN subgroup. It is intriguing that despite available data in anatomic sources that LLNs may be found on the lateral surface of the hyoglossal muscles, these LLNs received little attention as a separate subgroup [9,17,22,49,54]. Nekrasov (1938) left meticulous reports of two observations of LLNs that were located on the hypoglossal nerve at the posterior digastric belly [21]. The author described these LLNs as a transfer spot of lymph drainage towards the carotid triangle and termed them “descending lateral LLNs”, as they descend from their usual position in the sublingual area. DiNardo (1998), in his extensive study of submandibular lymph nodes, provides a valuable reference [55] (Table 2). Hoshina et al. (2010) observed three metastatic LLNs of this location among their 43 patients with early-stage tongue SCC. Suzuki et al. (2016) termed these LLNs posterior lateral LLNs [35]. Suzuki & Eguchi (2021) reported a case of metastatic involvement of the lateral LLN situated outside the sublingual area and covered by the deep surface of the submandibular gland. The authors noted that these deeply situated LLNs lie in the course of the hypoglossal nerve and are topographically separated from the contents of the submandibular fascial space by the deep lamina of deep cervical fascia [53].

**The deep submandibular (intracapsular, paramandibular) lymph node**

Some authors in their discussions mention nodes that lie on the submandibular gland’s medial surface covered in the depth of the submandibular gland. These nodes should not be confused by readers with LLNs, especially the node from the previous section [32,35,55] (Table 2).

The earliest source on this lymph node is von Brunn's article “Lymph nodes of the submandibular salivary gland” [56]. Bartels' paper, which was published in 1907, gives a rare observation of a “paramandibular” lymph node unmasked after dye injection [19]. Merkel notes that submandibular nodes may be located deep and sometimes covered by the gland’s capsule [49]. Blair’s paper entitled “The deep submaxillary lymph node” is a valuable resource of information on this lymph node. According to this author, these nodes should be classified within the regional submandibular group [57]. Nekrasov presented a description of a single observation; though rare, this node was included in head neck lymph node classification [21]. Feind and later DiNardo named this lymph node, though they did not report any relevant anatomic or clinical observations [25,55].

The clinical meaning of this lymph node refers to a debate as to whether the submandibular gland can harbor metastasis of oral SCC and may be spared during neck dissection in patients with a low risk of neck metastasis. Significant scientific material accumulated to date testifies to a very low frequency of finding lymph nodes in the parenchyma of the submandibular salivary gland and even lower rates of lymphogenic lesions of the gland in oral cancer patients [59].
Terminology of this lymph node is beyond the scope of the current study, although there are three different possible terms that were already used in the literature. The deep submandibular, intracapsular submandibular or modernized from Bartels’ parasubmandibular node (the author and his teacher Bardeleben disagreed with the BNA term *glandula submaxillaris* and instead used term *glandula mandibularis*; hence, the paramandibular node reflects its affiliation with the gland) [60,61].

In the narrative of the present study, it would be rational to indicate that this lymph node, although it may exist as a very rare anatomical variation, should not be attributed to LLNs.

**LLN subgroup classification**

The performed analysis, data synthesis and topographical subdivision of LLNs were based on the explored anatomical data and on regulations of International Anatomical Terminology, in particular, that all organs that are tightly connected with each other topographically should have similar titles [62]. Existing LLN terminology was reviewed, and analogical subdivisions of other regional groups of the head and neck were taken into account. General terms such as anterior/posterior and anterior lateral/posterior lateral were put aside from the synthesis, as their utilization already caused some misunderstanding among authors.

Among all the LLN subgroups, it is the median subgroup that does not cause terminological disagreements. The term totally reflects their relative position – a parameter of topographic subdivision.

Ando et al. initially named LLNs at the greater cornu of the hyoid bone “lateral para-hyoid”. Eguchi, Suzuki termed these “para-hyoid” without the nomina generalia “lateral” [29,53]. Abou-Foul, in his systematic review, recalls these LLNs as *intermediate para-hyoid* LLNs. As they are located within the intermediate fascial space of the sublingual region, the term “intermediate – intermedius” should replace a less accurate “lateral” titling, and the full term would be “intermediate para-hyoid LLNs” [48].

For lateral LLNs, two locations should be addressed: LLNs at the sublingual gland and LLNs at the deep aspect of the submandibular gland. The topographic designation “lateral” is applicable and fully legitimate for both (especially keeping in mind the opinion that the latter nodes are “descendent” lateral LLNs). The clarifying term “paraglandular” was introduced by Ananian et al. and used in subsequent works [28,34,48]. It reflects the node’s topographical relation to the sublingual gland (as the LLNs at the submandibular gland were not explored in this study) and is formed in a similar manner to the submandibular nodes division – as retro/preglandular submandibular nodes in Feind’s classification [25]. We observed two locations, both of which are related to a salivary gland: the sublingual and submandibular glands. Thus, the titles are to be lateral sublingual paraglandular LLNs and lateral submandibular paraglandular LLNs. To avoid vocabulary piling out, the specifying “paraglandular” part may be omitted (Table 4).

On the other hand, considering the fact that the LLNs behind the submandibular gland are covered by the deep lamina of the cervical fascia [92] and in morphologic stratification are separated from the fascial...
space of the submandibular gland, the description “descending lateral LLNs” as used by Nekrasov may be an elegant alternative (Fig. 3). In this light, more sound would be Suzuki et al. surgical anatomic classification, which implies anterior – lateral and posterior – lateral identifications for LLNs at the sublingual gland and LLNs behind the submandibular gland, respectively. This approach may be more practical and successfully avoids potential overuse of nomenclature, but it definitely assumes widespread recognition of LLNs among clinicians. The practitioner, while exploring or reporting an LLN lesion, should be aware of the 4 anatomic subgroups, their precise location and topographic distribution in the complex anatomic region; thus, this terminological model may be used confidently.

Conclusion

The development and implementation of a unified anatomical topographic classification of the LLN subgroups, which would not cause difficulties and misunderstandings in use, may be among the important conditions for improving the detection and treatment of LLN lesions.

Declarations

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- Consent for publication – not applicable
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- Authors contributions:

  S.R. Gvetadze: development of the research concept, search, translation and analysis of literature on the topic of the article, article writing, scientific editing of the article; A.M. Mudunov, J. Sun: development of the research concept, scientific editing of the article; E.A. Roshchina: review and translation of literature on the topic of the article;
  
  V.A. Solodkiy, N.V. Nudnov, V.D. Chkhikvadze: scientific editing of the article; K.D. Ilkaev, Mingming Lv, Xin Yang, V.I. Sokorutov: language and scientific editing of the article.

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References


Tables

Table 1a First chronological period – anatomic data
<table>
<thead>
<tr>
<th>Year of publication</th>
<th>Authors</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1868</td>
<td>Henle J. [9]</td>
<td>Described 2-4 LLNs which are located lateral to genioglossus and hyoglossus muscles and transfer lymph to the deep jugular nodes.</td>
</tr>
<tr>
<td>1894</td>
<td>McClellan G. [63]</td>
<td>Reported that small LLNs are located along the lingual vein on the lymphatic route from the tongue mucosa to the deep jugular nodes.</td>
</tr>
<tr>
<td>1987</td>
<td>Kuttner H. [15]</td>
<td>Included “small glandul. linguales and those glands inside the tongue musculature between two genioglossal muscles” to the regional draining lymph node groups of the tongue. A case of metastatic lesion of a LLN at the hyoid horn is presented and discussed.</td>
</tr>
<tr>
<td>1902</td>
<td>Gage S.H. [64]</td>
<td>Mentioned inconstant LLNs which may be found on the ventral lymphatic pathway of the tongue, before it reaches the carotid nodal group.</td>
</tr>
<tr>
<td>1903</td>
<td>Delamere G., Poirier P., Cuneo B. [17]</td>
<td>Described lateral LLNs as &quot;paravisceral nodes&quot; of the tongue and indicated their location: close to the sublingual or deep to the submandibular glands, anywhere within the triangle formed by the anterior and posterior bellies of the digastric muscle.</td>
</tr>
<tr>
<td>1905</td>
<td>Ellis G. [65]</td>
<td>Observed few small LLNs on the outer surface of the hyoglossus muscle. These transfer lymph flow to the upper deep jugular nodes.</td>
</tr>
<tr>
<td>1906</td>
<td>Most A. [18]</td>
<td>Described inconstant anterior/median (between the two genioglossus muscles) and lateral (adjacent to the lingual artery and to the sublingual gland) subgroups of the LLNs. Affiliated LLNs to median and marginal lymphatic outflow pathways of the tongue.</td>
</tr>
<tr>
<td>1909</td>
<td>Bartels P. [20]</td>
<td>Named LLNs among regional lymph nodes of the tongue and subdivided them on anterior and lateral LLNs.</td>
</tr>
<tr>
<td>1911</td>
<td>Rauber A. [66]</td>
<td>Described LLN located lateral to the root of the tongue.</td>
</tr>
<tr>
<td>1918</td>
<td>Robinson A. [67]</td>
<td>Noted that LLNs are located on the lateral surfaces of the genioglossal and hyoglossal muscle in the pathway leading to the upper deep jugular nodes.</td>
</tr>
<tr>
<td>1918</td>
<td>Merkel F. [49]</td>
<td>Described LLNs as nodes lying in the lymphatic pathway of the tongue to the sides of hyoglossal muscles, and pointed that they may have a great value.</td>
</tr>
<tr>
<td>1922</td>
<td>Millard F.P. [68]</td>
<td>Mentioned inconstant LLNs which are positioned close to the sublingual gland.</td>
</tr>
<tr>
<td>1925</td>
<td>Albrecht W. [45]</td>
<td>Inconstant in-transit LLN, between genioglossal muscles. Lymph flow may be directed through these nodes to the contralateral side.</td>
</tr>
<tr>
<td>1936</td>
<td>Vorobiev V., Yasvoi G [54]</td>
<td>Depicted LLN lying in the lymphatic pathway which runs in between the deep surface of the submandibular gland and the hyoglossus muscle.</td>
</tr>
<tr>
<td>Year</td>
<td>Author</td>
<td>Remarks</td>
</tr>
<tr>
<td>------</td>
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</tr>
<tr>
<td>1938</td>
<td>Nekrasov S.M. [21]</td>
<td>Two times observed lateral LLN during anatomic dissections and dye injections. Located on the XII nerve at the posterior digastric belly, these were termed &quot;descending lateral LLNs&quot;. They were described as a transfer spot of the lymph drainage towards carotid lymph nodes.</td>
</tr>
<tr>
<td>1938</td>
<td>Padgett E.C. [69]</td>
<td>Between the genioglossal and above the mylohyoid muscles 1-2 LLNs are found and rarely may be palpated.</td>
</tr>
<tr>
<td>1938</td>
<td>Rouviere H. [16]</td>
<td>Subgrouped LLNs into median and lateral. Illustrated lateral posterior lymphatic pathway along the superficial and deep surfaces of the hyoglossal muscle towards superior jugular group.</td>
</tr>
<tr>
<td>1943</td>
<td>Katayama T. [10]</td>
<td>In a study of embryos found the incidence of median LLNs – 15.1%, and lateral LLNs – 30.2%.</td>
</tr>
</tbody>
</table>

**Table 1b** Second chronological period – anatomic data
<table>
<thead>
<tr>
<th>Year of publication</th>
<th>Authors</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1959</td>
<td>Kurbskaya R.A. [22]</td>
<td>Inconstant small LLNs lying on the routes of main tongue efferent lymphatics. Central LLNs lie on the medial aspects of genioglossal muscles. Lateral LLNs reside on the outer surfaces of genioglossal and hyoglossal muscles along lingual vessels.</td>
</tr>
<tr>
<td>1963</td>
<td>Aizenshtein I.M., Khudaiberdiev R.I. [50]</td>
<td>LLNs are very small in size and consistency, are divided into anterior median, between the genioglossal muscles and lateral which are found along the arteria lingualis or near the sublingual gland. Named LLNs among regional draining nodes of the tongue. Mentioned lateral LLN at the deeper surface of the submandibular gland.</td>
</tr>
<tr>
<td>1964</td>
<td>Zolotko U.L. [70]</td>
<td>Median LLN may be observed in the central fascial space of the mouth floor.</td>
</tr>
<tr>
<td>1965</td>
<td>Waldeyer A. [71]</td>
<td>LLNs are rare, they are located around genioglossal muscles.</td>
</tr>
<tr>
<td>1968</td>
<td>Temirov V.L. [23]</td>
<td>Documented one lateral LLN lying in close relation to the sublingual gland's parenchyma and draining the gland.</td>
</tr>
<tr>
<td>1968</td>
<td>Mashkov O.A. [24]</td>
<td>LLNs observed within tongue musculature in 8.6% of 104 cadavers. Outlined LLNs among regional for the tongue.</td>
</tr>
<tr>
<td>1971</td>
<td>Edwards L.F., Gaughran G.R. [73]</td>
<td>LLNs are situated between hyoglossal and genioglossal muscles.</td>
</tr>
<tr>
<td>1972</td>
<td>Feind C.R. [25]</td>
<td>Classic tutorial with valuable data on LLNs. Contains some controversial standings and old-fashioned terminology (as used in classic German and Russian sources). Classified LLNs among regional groups of the head and neck region. In another section the authors doubted if these should be put in the classification. Described a rare draining pathway of the surfaces of the tongue to pass a “sublingual intercalated nodule” before reaching a submental node. Summarized that “the floor of the mouth and the sublingual salivary gland drain into the intercalated sublingual nodule, the preglandular node of the submandibular group, and the subdigastric nodes of the internal jugular chain.</td>
</tr>
<tr>
<td>1982</td>
<td>Langman J.,</td>
<td>Depicted single small LLN lateral to the root of the tongue.</td>
</tr>
<tr>
<td>Year</td>
<td>Author(s)</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td>1985</td>
<td>Rouviere H., Delmas A. [12]</td>
<td>On the marginal routes of tongue lymphatics which pass through the sublingual gland in-transit LLNs may be found.</td>
</tr>
</tbody>
</table>

**Table 1c** Third chronological period – anatomic data
<table>
<thead>
<tr>
<th>Year of publication</th>
<th>Authors</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>Ozeki et al. [1]</td>
<td>First modern article which described LLN's metastatic lesions.</td>
</tr>
<tr>
<td>1987</td>
<td>Som P.M. [75]</td>
<td>Author noted that perhaps LLNs should not be strictly distinguished as lymph nodes, but rather as small lymph nodules located along the lymphatic vessels of the tongue and sublingual salivary glands.</td>
</tr>
<tr>
<td>1991</td>
<td>Richter E. [76]</td>
<td>Illustrated LLNs on the lower lateral surfaces of the tongue.</td>
</tr>
<tr>
<td>1998</td>
<td>Feneis H. [77]</td>
<td>LLNs are located on m. hyoglossus, drains lymph from the lower tongue aspects.</td>
</tr>
<tr>
<td>1998</td>
<td>DiNardo L.J. [55]</td>
<td>“A sixth group of submandibular nodes seldom mentioned, but found to be important in the author’s experience, shall be termed the deep submandibular nodes. Although absent from most anatomic references, these nodes have vaguely been described as existing on the deep surface of the submandibular gland The author has found these nodes to be small and inconsistently present. They are located anywhere along the undersurface of the submandibular gland but superficial to the mylohyoid muscle or posterior aspect of the hyoglossus muscle. They may be found as far superior as the attachment of the mylohyoid muscle to the mandible”.</td>
</tr>
<tr>
<td>2001</td>
<td>Hiatt J.L., Gartner L.P. [82]</td>
<td>Inconstant, no more than 3 LLNs lie on the superficial surface of the hyoglossal muscle.</td>
</tr>
<tr>
<td>2006</td>
<td>Shirochenko N.D. [79]</td>
<td>Median fascial space of the floor of the mouth sometimes contains 1-2 LLNs.</td>
</tr>
<tr>
<td>2007</td>
<td>Uflacker R.[80]</td>
<td>Named LLNs among additional lymph node groups of the upper aerodigestive tract.</td>
</tr>
<tr>
<td>2007</td>
<td>Werning J.W. [81]</td>
<td>Described in constant LLNs, which are closely connected to the sublingual gland and reside between the mouth floor mucosa and the upper surface of the mylohyoid muscle.</td>
</tr>
<tr>
<td>2008</td>
<td>Toporov G.N., Panasenko N.I. [82]</td>
<td>LLNs are situated on the level of the genioglossal muscle and follow the route of the lingual vein. They transfer lymph to the deep jugular chain.</td>
</tr>
<tr>
<td>2009, 2010</td>
<td>Ando M. et al. [29,36]</td>
<td>In detail described the location of para-hyoid lingual lymph nodes at the greater cornu of the hyoid bone.</td>
</tr>
<tr>
<td>2010</td>
<td>Hoshina Y., Hayashi T., Shingaki S. et al. [32]</td>
<td>Reported several cases of LLNs metastases beyond sublingual fascial spaces. These LLNs are covered by the deep surface of the submandibular gland lateral to the outer surface of the hyoglossal muscle.</td>
</tr>
<tr>
<td>Year</td>
<td>Authors</td>
<td>Reference</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
<td>-----------</td>
</tr>
<tr>
<td>2012</td>
<td>Shalina T.I., Petrova L.A. [83]</td>
<td>LLNs are located lateral to the root of the tongue along lingual vessels.</td>
</tr>
<tr>
<td>2015</td>
<td>Ananian S.G., Gvetadze S.R., Ilkaev K.D. [34]</td>
<td>In anatomic-histologic study of the floor of the mouth observed lateral (parahyoid and sublingual paraglandular) LLNs in 23.8% of the studied 21 cadavers.</td>
</tr>
<tr>
<td>2016</td>
<td>Suzuki M., Eguchi K., Ida S. [35]</td>
<td>Classified LLNs into following subgroups: median, anterior lateral (in the proximity of sublingual gland), posterior lateral (outside the sublingual space – at the inner surface of the submandibular gland) and parahyoid.</td>
</tr>
<tr>
<td>2019</td>
<td>Eguchi K. et al. [46]</td>
<td>Explored median LLNs, reported their location in the median mouth floor space on each side of the lingual septum in a sagittal position of three-fourth of the distance from the mental spine.</td>
</tr>
<tr>
<td>2019</td>
<td>Eguchi et al. [92]</td>
<td>Reported that lateral LLNs (especially those at the deep aspect of the submandibular gland) are separated from the contents of the submandibular space by the deep lamina of the cervical fascia.</td>
</tr>
<tr>
<td>2020</td>
<td>Obukhova L.A. [84]</td>
<td>LLNs are inconstant nodes located on the lateral surface of the hyoglossal muscle and drain lymph from the tongue mucosa.</td>
</tr>
<tr>
<td>2020</td>
<td>Abou-Foul A.K. [48]</td>
<td>Summarized data on the incidence of lateral and median LLNs to be 24-30% and 0-15.1%, respectively. Suggested the term “intermediate” for the parahyoid subgroup.</td>
</tr>
<tr>
<td>2021</td>
<td>Suzuki M., Eguchi K. et al. [53]</td>
<td>Reported a case of metastatic involvement of the lateral LLN situated outside the sublingual area covered by the deep surface of the submandibular gland. Authors noted that these deeply situated LLNs are anatomically separated from the contents of the submandibular fascial space by a thin lamina of deep cervical fascia.</td>
</tr>
</tbody>
</table>

**Table 2** Deep submandibular/intracapsular/paramandibular nodes – anatomic data
<table>
<thead>
<tr>
<th>Year of publication</th>
<th>Author/Title</th>
<th>Essentials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1903</td>
<td>Von Brunn W. [56]</td>
<td>Examined 61 submandibular glands, which were sectioned in 2-3 mm thick slices, unstained. In two glands he could observe lymph nodes which were embedded into the capsule and situated in a <em>groove formed by facial artery on the deep surface of the gland.</em></td>
</tr>
<tr>
<td>1907</td>
<td>Bartels P. [19]</td>
<td>Described a rare observation of a “paramandibular” lymph node. It was revealed after dye injection at anterior part of the oral tongue and had an unusual location: deeper to the posterior median margin of the submandibular gland, was included in the gland's capsule and at the same time separated from its parenchyma by a blood vessel. No direct lymphovascular connection was found between the injection site in the tongue and this lymph node. Apparently it got stained in a retrograde fashion from the primarily filled lymph nodes of the submandibular triangle.</td>
</tr>
<tr>
<td>1918</td>
<td>Merkel F. [49]</td>
<td>Mentioned that submandibular lymph nodes can lay in the capsule of submandibular gland and named them “Lymphoglandula paramandibularis”.</td>
</tr>
<tr>
<td>1923</td>
<td>Corning H.K. [58]</td>
<td>Reported that among submandibular lymph nodes deep seated nodes may be found, which are covered by the submandibular gland. Author notes that to achieve final resection of the submandibular lymph nodes it is necessary to keep attention to possible existence of these deep submandibular nodes.</td>
</tr>
<tr>
<td>1929</td>
<td>Blair D.M. [57]</td>
<td>Reported an original observation of a lymph node covered by capsule of the submandibular gland. According to author’s opinion, these nodes should be classified within the regional submandibular group.</td>
</tr>
<tr>
<td>1932, 1938</td>
<td>Rouviere H. [16,93]</td>
<td>Names intracapsular lymph nodes among the submandibular regional group.</td>
</tr>
<tr>
<td>1938</td>
<td>Nekrasov S.M. [21]</td>
<td>In one cadaver he observed: a tiny lymph node on lateral wall of the facial artery near the origin of the ascending palatal artery, at this point the submandibular gland surrounded the node and vessel itself. This node received blood supply from fine branches of the ascending palatal artery. Grouped these among submandibular nodes.</td>
</tr>
<tr>
<td>1972</td>
<td>Feind C.R. [25]</td>
<td>Mentioned “intracapsular submandibular nodes” and described their embryological development: “These nodes probably reach this position in development of the fetus by the same mechanism seen in the parotid group. The submandibular salivary gland migrates back from the floor of the mouth as paired primordial cords, representing the main duct. It continues back to the angle to the angle of the mandible along the floor of the mouth, then turns down and ventrally sprouts out into its lobulations containing the acini. The lymphatics are present and may become engulfed by this process, but this is a very rare happening experience”.</td>
</tr>
<tr>
<td>1998</td>
<td>DiNardo L.J. [55]</td>
<td>Reported contradictive data on these lymph nodes. Informed that in rare cases “intracapsular submandibular lymph nodes” may play role in regional spread of tongue cancer. Did not observe these lymph nodes in his anatomic material.</td>
</tr>
</tbody>
</table>
Table 3. Source distribution according to database.

<table>
<thead>
<tr>
<th>Database</th>
<th>Number of full-text publications</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>PubMed</td>
<td>15</td>
<td>1985-2021</td>
</tr>
<tr>
<td>Google Scholar</td>
<td>5</td>
<td>1938-2020</td>
</tr>
<tr>
<td>J-stage</td>
<td>10</td>
<td>1943-2016</td>
</tr>
<tr>
<td>Archive.org</td>
<td>23</td>
<td>1868-2015</td>
</tr>
<tr>
<td>Russian database</td>
<td>12</td>
<td>1914-2012</td>
</tr>
<tr>
<td>Total</td>
<td>65</td>
<td>1868-2021</td>
</tr>
</tbody>
</table>

Table 4. LLNs – topographic subdivision

<table>
<thead>
<tr>
<th>LLNs subgroup</th>
<th>Topographic anatomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median LLNs</td>
<td>In the median sublingual fascial space – between mm. genioglossi et geniohyoidei.</td>
</tr>
<tr>
<td>Intermediate para-hyoid LLNs</td>
<td>In the intermediate sublingual fascial space – along a. lingualis, medial to m. hyoglossus.</td>
</tr>
<tr>
<td>Lateral sublingual (paraglandular) LLNs</td>
<td>In the lateral sublingual fascial space – in proximity to the sublingual salivary gland.</td>
</tr>
<tr>
<td>Lateral submandibular (paraglandular) LLNs</td>
<td>Outside the sublingual region – behind the inner surface of the submandibular salivary gland, in the deep layer of the submandibular triangle.</td>
</tr>
</tbody>
</table>

Figures
Figure 1

Literature source search methodology
Figure 2

Chronological periods of LLN literature sources
Figure 3

Topographical distribution of the LLNsubgroups