

# Neck Dissection Technique Commonality and Variance: A Survey on Neck Dissection Technique Preferences among Head and Neck Oncologic Surgeons in the American Head and Neck Society

Shirin M. Hemmat<sup>1</sup> Steven J. Wang<sup>2</sup> William R. Ryan<sup>3</sup>

<sup>1</sup>School of Medicine, UCSF, San Francisco, California, United States

<sup>2</sup>Department of Otolaryngology - Head and Neck Surgery, University of Arizona, Tucson, Arizona, United States

<sup>3</sup>Department of Otolaryngology - Head and Neck Oncologic/Endocrine/Salivary Surgery, University of California San Francisco, San Francisco, California, United States

Address for correspondence William R. Ryan, MD, FACS, Department of Otolaryngology, UCSF, 1825 4th Street, 4th Floor Box 1703, San Francisco, CA 94158, United States (e-mail: william.ryan@ucsf.edu).

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## Abstract

**Introduction** Neck dissection (ND) technique preferences are not well reported.

**Objective** The objective of this study is to educate practitioners and trainees about surgical technique commonality and variance used by head and neck oncologic surgeons when performing a ND.

**Methods** Online survey of surgeon members of the American Head and Neck Society (AHNS). Survey investigated respondents' demographic information, degree of surgical experience, ND technique preferences.

**Results** In our study, 283 out of 1,010 (28%) AHNS surgeon members with a mean age of 50.3 years (range 32–77 years) completed surveys from 41 states and 24 countries. We found that 205 (72.4%) had completed a fellowship in head and neck surgical oncology. Also, 225 (79.5%) respondents reported completing more than 25 NDs per year.

ND technique commonalities (>66% respondents) included: preserving level 5 (unless with suspicious lymph nodes (LN)), only excising the portion of sternocleidomastoid muscle involved with tumor, resecting lymphatic tissue en bloc, preservation of cervical sensory rootlets, not performing submandibular gland (SMG) transfer, placing one drain for unilateral selective NDs, and performing a ND after parotidectomy and thyroidectomy and before transcervical approaches to upper aerodigestive tract primary site. Variability existed in the sequence of LN levels excised, instrument preferences, criteria for drain removal, the timing of a ND with transoral upper aerodigestive tract primary site resections, and submandibular gland preservation. Results showed that 122 (43.1%) surgeons reported that they preserve the submandibular gland during the level 1b portion of a ND.

**Conclusions** The commonalities and variances reported for the ND technique may help put individual preferences into context.

## Keywords

- ▶ neck dissection
- ▶ graduate medical education
- ▶ survey and questionnaires
- ▶ surgical instruments

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## Introduction

The current literature - including texts, articles, and conference presentations - does not convey well the commonality and variance in neck dissection (ND) technique across surgeons.<sup>1,2</sup> Though operative technique training is supported by a trainees' own preparation through reading and lecture-based sources of information, the bulk of education is through experiential learning. Surgical experiential education generally consists of receiving verbal teaching, observing the technique, and a graduating level of supervised participation within the operating room under the guidance of a single or group of surgeons of varying sizes at 1 to 3 institutions during medical school, residency, and, perhaps, a fellowship in possibly different programs. This form of idiosyncratic learning and teaching can present the trainee with significant differences in technique preferences within and across institutions. Moreover, individual surgeons in practice (who have followed a particular training scheme at a certain time in history and since then had a particular unique set of personal experiences) likely have an incomplete understanding of the array of technique preferences by other surgeons across their surgical field. ND technique preference variation may include preservation or resection of anatomic structures, use of instruments, sequence and extent of resection, and post-operative management.<sup>3-8</sup>

The objective of this study is to evaluate the commonality and variance of surgical techniques preferences used when performing a ND through a survey sent out to current surgeon members of the American Head and Neck Society (AHNS). This study also aims to determine whether there are relationships between respondents' demographic characteristics and their surgical technique preferences. We were specifically interested in demographic variables that may represent a higher level of expertise, including a higher yearly volume of procedures, completion of fellowship training, shorter operative times, and increased age. We analyzed the potential influence of these characteristics over a variety of aspects of ND technique preferences reported in the survey. We hope this data will educate current practitioners and surgical trainees on how their particular techniques stand in the context of colleagues across the United States and internationally.

## Methods

### Study Design

Institutional review board approval for this study was obtained from the Committee on Human Research at [INSTITUTION LEFT BLANK FOR REVIEW PURPOSES].

The survey was designed to elicit details of various technical decision points made when performing a ND. We first distributed the survey to a small cohort of head and neck surgeons at UCSF to verify respondent understanding and clarity of questions. Then, we incorporated respondent input into the survey. The finalized survey and study protocol was reviewed, revised, and approved by the American Head and Neck Society (AHNS) Research Committee.

### Participants

The AHNS sent the survey to its member physicians via electronic mail. Respondents received in their correspondence a link to the SurveyMonkey (SurveyMonkey, Palo Alto, U.S.A.) page for completion of the survey. Participants consented to participate in the research study. Respondents were asked to self-identify as either a medical oncologist, radiation oncologist, or a head and neck oncologic surgeon. We excluded from the survey respondents who selected medical or radiation oncologist. We anonymously collected and analyzed all survey responses.

### Questionnaire

The survey was a 40-question web-based questionnaire that aimed to identify respondent demographic characteristics and preferred techniques when performing a ND. Questions were, for the most part, in reference to a non-irradiated, isolated, unilateral neck dissection. A copy of the questionnaire is available for review in *Appendix A*.

### Statistics

This study aimed to provide descriptive statistics of the reported practices of surgeons. For this study, a vast majority and commonality was defined as greater than or equal to 66% of respondents, and variance defined as anything less than 66%. The second aim of this study was to test the hypothesis that certain technique preferences will be based on the level of a surgeon's level of expertise. Expert demographics were considered to be aged over 50, an annual surgical volume of more than 50 NDs a year, fellowship trained in head and neck oncologic surgery, and have efficient self-reported operative times (defined as completing a Levels 1-3 ND in 1.5 hours or under). We then determined statistically significant associations between these expert demographics and the surgeon's technique preference using chi-square and two tailed *t*-tests.

## Results

The survey received 367 (36.3%) responses from the ANHS 1,010 surgeon members. 283 (out of 367) surgeons completed more than half the survey for a completion rate of 77%. Surgeons from 41 states and 24 countries participated. ► **Table 1** summarizes demographic characteristics, ND surgical volume, and ND operative times of respondents.

Surgeons who completed more than 50 NDs a year had statistically significantly shorter operative times in all three types of selective NDs compared with those who performed fewer NDs ( $p < 0.001$ ) (1.4hrs versus 1.6hrs for levels 1-3; 1.6hrs versus 1.9hrs for levels 1-4; 2.1 hour vs. 2.5 hour for levels 1-5;  $p < 0.01$ ). This operative time was in reference to performing a ND without taking into consideration any extra time needed for teaching trainees or students. The completion of a fellowship and age over 50 were not associated with a significant increase or decrease in ND operative time.

► **Table 2** demonstrates the frequency and reasoning for submandibular gland (SMG) and internal jugular vein (IJV) excision. Respondents over the age of 50 were statistically significantly more likely to preserve the SMG than individuals

**Table 1** Demographic information, neck dissection surgical volume, and neck dissection operative times of survey respondents

Characteristic	
Total number of individuals who responded to the survey	367 (36.3%)
Number of respondents who finished more than half the survey	283 (77%)
Age	Mean: 50.3 years (Range 32–77)
Sex	
Men	255 (90.1%)
Women	28 (8.9%)
Current Level of Training	
Fellow	29 (10.3%)
Attending	254 (89.7%)
Type of Residency Training	
Otolaryngology- Head and Neck Surgery	235 (83.1%)
Non-Otolaryngology-Head and Neck Surgery	48 (16.9%)
Completed a Fellowship in Head and Neck Oncologic Surgery	
Yes	205 (72.5%)
No	78 (27.5%)
Number of Neck Dissections Per Year	
Less than 10	18 (6.4%)
11–25	50 (17.6%)
26–50	110 (38.9%)
Greater than 50	105(37.1%)
How long does it take to complete a neck dissection preserving SCM, IJV and CN 11, of the following levels?	
Levels 1–3	Mean: 1.56 hours (Range 1–2.5, SD 0.47)
Levels 1–4	Mean: 1.89 hours (Range 1–3, SD 0.55)
Levels 1–5	Mean: 2.38 hours (Range 1.5–4, SD 0.67)

under 50 years of age (50% vs. 35%;  $p < 0.01$ ). ND volume, ND operative time, and completion of a fellowship were not found to be related to SMG preservation or excision preference. When asked specifically about regularly excising the IJV during a neck dissection, a near unanimous amount [ $n = 270$  (95.4%)] of surgeons stated that they only excise the IJV when involved with tumor. The majority [ $n = 205$  (72.2%)] only excise the sternocleidomastoid (SCM) when involved with tumor, excising only such a portion.

Variation existed between surgeons for the sequence of lymph node level excision during an isolated unilateral level 1–4 ND. The majority [ $n = 149$  (52.6%)] of respondents stated they followed an order of Level 1 -> Level 2 -> Level 3 -> Level 4 when removing lymph node regions. The next most common sequence of excision was Level 2 -> Level 3 -> Level 4 -> Level 1 [ $n = 59$  (20.8%)]. Eighteen (6.3%) of the surgeons stated that they had no standard sequence for lymph node removal. Most surgeons, when asked how frequently they kept the lymph nodes together as one en bloc resection, answered either “always” [ $n = 118$  (41.5%)] or “often” [ $n = 102$  (35.9%)], which together equals 76.4%. Completion

of a fellowship, age, and surgeon volume were not predictive of whether or not an individual resected lymph nodes en bloc.

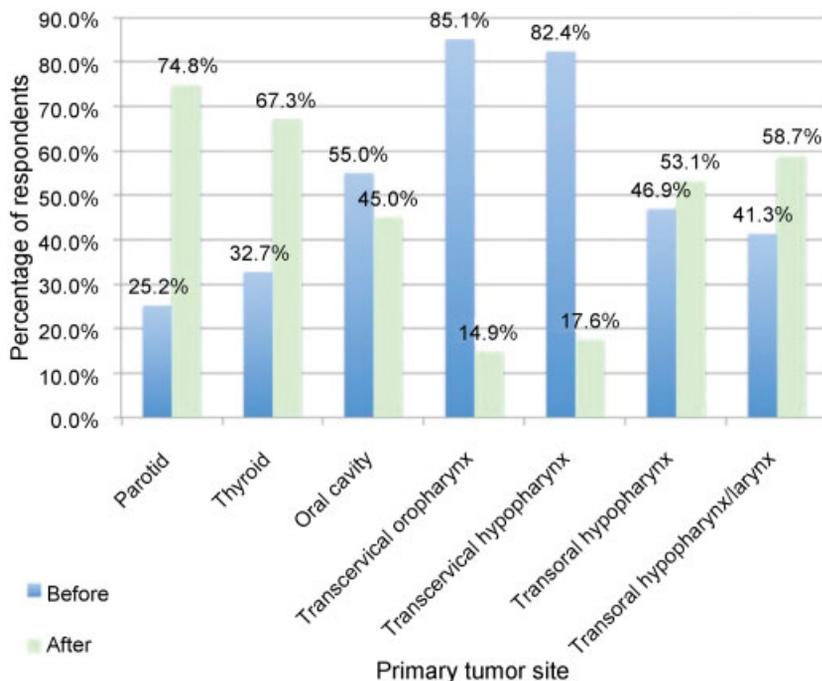
► **Fig. 1** summarizes respondents’ preferences to perform a ND before or after specific primary tumor site resections. Preferences differed depending on the location of the primary tumor site. Surgeons over the age of 50 compared with those under the age of 50 were more likely to perform a ND before primary tumor resection in the oral cavity (66.9% vs. 42.1%;  $p < 0.01$ ), transcervical oropharynx (89.6% vs 79.8%;  $p < 0.03$ ), transcervical hypopharynx/larynx (87.7% vs. 76.6%;  $p < 0.03$ ), transoral oropharynx (55.8% vs 37.1%;  $p < 0.01$ ), and transoral hypopharynx/larynx (54.3% vs 27.8%;  $p < 0.01$ ). Surgeons who reported completing a ND of levels 1–3 in 1.5 hours or less were more likely to perform a ND before primary tumor resection if the primary tumor was located in the parotid (29.6% vs. 16.6%), transcervical oropharynx (88.9% vs. 76.8%), and transcervical hypopharynx/larynx (88% vs. 71%;  $p < 0.03$ ).

Surgeons were asked about their indications for completing a level 5 ND for upper aerodigestive tract mucosal squamous cell carcinoma (mSCC). Seventy-three (25%) of respondents always excise level 5 during NDs for mSCC.

**Table 2** Aggregated responses to select questions regarding preservation of the submandibular gland (SMG), sternocleidomastoid muscle (SCM) and internal jugular vein during a neck dissection

Submandibular Gland		
Do you perform SMG transfer?		
Yes	19 (6.7%)	
No	264 (93.2%)	
When you do not preserve the SMG during an ND, what are your reasons? (Choose all that apply)	Usually Preserve SMG	Do not usually Preserve SMG
Concern for incomplete lymph node removal	79 (65.8%)	138 (86.3%)
Preserving the gland would increase the difficulty of the resection of the primary cancer	54 (45%)	28 (17.5%)
Need to access level 1B for a free flap or pedicle reconstruction	58 (48.3%)	68 (42.5%)
Worried that it will be time consuming	7 (5.8%)	13 (8.1%)
Never trained to do so	5 (4.2%)	47 (30.6%)
Worried that presence of SMG will be concerning for a palpable lymph node during surveillance	9 (7.5%)	53 (33.1%)
Doubt that the SMG will work well after resection of lymph nodes around it	10 (8.3%)	16 (10%)
Doubt that the SMG will work well after radiation	23 (19.2%)	50 (31.3%)
Total # of Surgeons	120 (42.9%)	160 (57.1%)
Internal Jugular Vein		
Excise routinely; in most cases		
6 (2.1%)		
Excise when performing a salvage (post-radiation) neck dissection		
23 (8.1%)		
Excise only when involved with a tumor		
271 (95.4%)		

Abbreviations: 11 ND, neck dissection; CN 11, Cranial Nerve; IJV, Internal Jugular Vein; SCM, Sternocleidomastoid; SMG, Submandibular Gland.



**Fig. 1** Sequence preferences for performing a neck dissection before or after primary carcinoma resection.

Surgeons over the age of 50 [ $n = 47$  (32.2%)] were more likely than those under the age of 50 [ $n = 24$  (17.5%)] to always complete a level 5 ND for MSCC ( $p < 0.01$ ). Surgeons who performed less than 50 NDs a year (29.2%) were also more likely to always excise level 5 during ND when compared with individuals who completed more than 50 NDs (18%) a year ( $p < 0.05$ ). For respondents who *do not usually* excise level 5, indications for excising level 5 included the presence of suspicious lymph nodes in level 5 [ $n = 146$  (51.5%)], suspicious lymph nodes close to the anterior border of level 5 in levels 2b, posterior 2a, 3, or 4 [ $n = 140$  (49.5%)], and during a salvage ND for post radiation failure [ $n = 52$  (18.4%)].

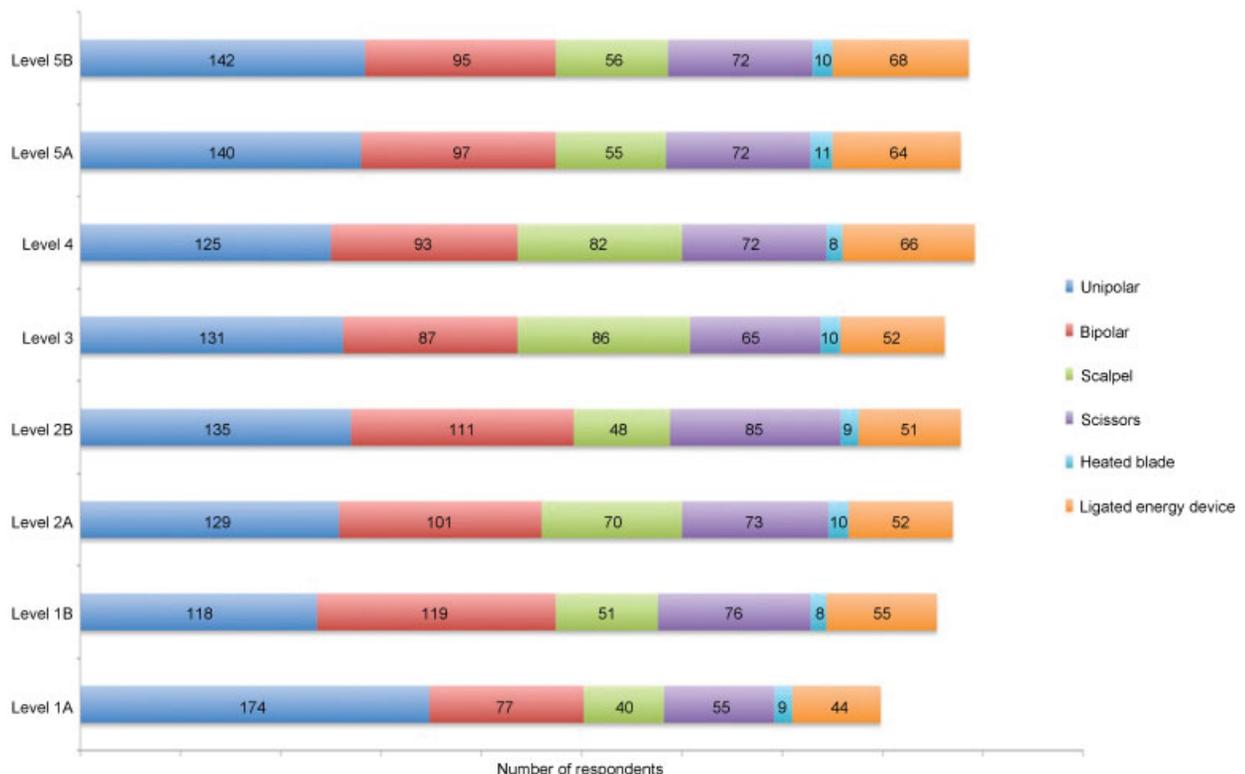
When managing blood vessels, a vast majority of surgeons stated that preserving as many blood vessels as possible was important or very important during a ND [ $n = 222$  (78.4%)] on a 5-point scale ranging from unimportant to very important. Surgeons who completed a fellowship [ $n = 82$  (39.3%)] were more likely to state that vein preservation was important or very important than individuals who did not complete a fellowship [ $n = 18$  (24.3%)] ( $p = 0.02$ ). Surgeons who reported taking 1.5 hours or less to perform a ND of levels 1–3 were more likely to preserve venous vessels than individuals who reported spending more than 1.5 hours on a ND of levels 1–3 (40% vs. 26%;  $p = 0.02$ ).

Surgeons were asked about cervical sensory nerve rootlet management during a ND. When asked about whether respondents routinely divided the cervical sensory rootlets, most respondents divide these rootlets “rarely” [ $n = 107$  (37.7%)] or “sometimes” [ $n = 104$  (36.6%)]. Of the 71 individuals who usually excised level 5 during a therapeutic ND for mSCC, 29

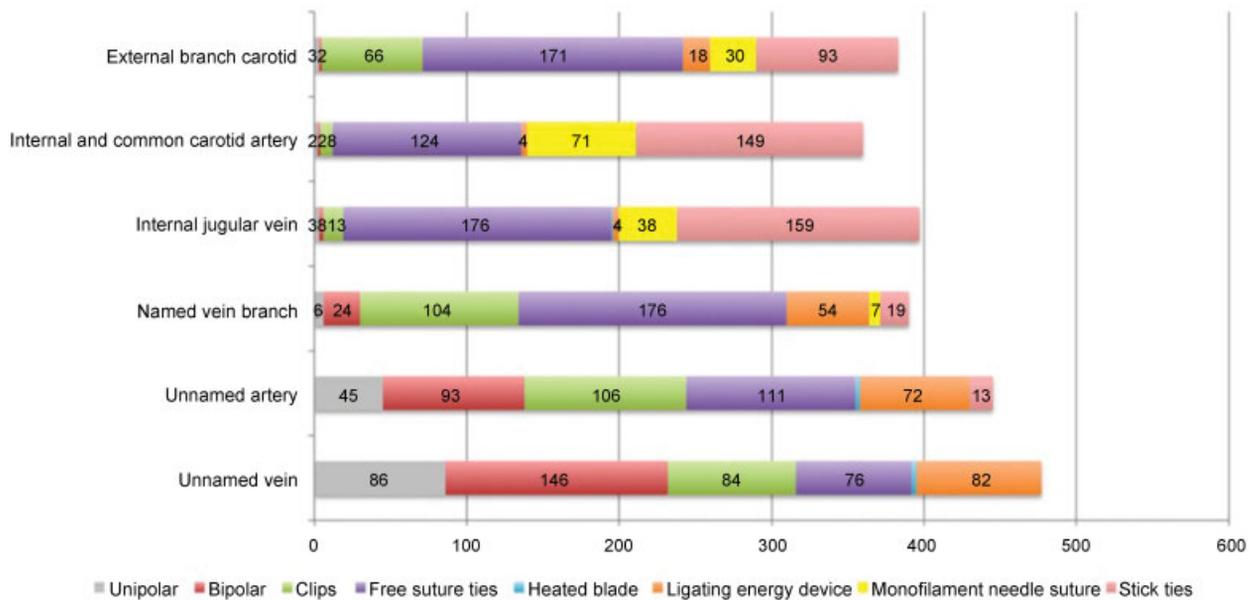
(40.8%) of them also regularly divide the cervical sensory rootlets, which was statistically significantly more than the 30 (14%) surgeons who do *not* routinely perform a level 5 ND and regularly divide the cervical sensory rootlets ( $p < 0.01$ ). Surgeons over the age of 50 [ $n = 46$  (31.5%)] were more likely to divide the cervical sensory rootlets than those under 50 years old [ $n = 15$  (11%)] ( $p < 0.01$ ). Surgeons who perform less than 50 NDs a year [ $n = 47$  (26.4%)] were more likely to divide the cervical sensory rootlets than individuals who performed more than 50 NDs [ $n = 14$  (13.3%)] a year ( $p = 0.01$ ).

We asked surgeons about instruments they use on specific regions of a ND (raising subplatysmal skin flaps, dissecting fibrofatty lymph node tissue away from the IJV, excising levels 1a, 1b, 2a, 2b, 3, 4, 5a, and 5b and the ligation of various types of blood vessels). Multiple instruments were allowed in the survey to be preferred for a given lymph node level. When raising subplatysmal skin flaps, surgeons generally reported using the unipolar cautery [ $n = 201$  (71%)], scalpel [ $n = 117$  (41.3%)], and scissors [ $n = 28$  (10%)]. When dissecting lymph nodes off the IJV, surgeons mainly used a scalpel [ $n = 128$  (47.1%)], dissector and unipolar cautery [ $n = 50$  (18.5%)], and scissors to dissect and cut [ $n = 32$  (11.9%)].

Instrument preferences for use when excising lymph nodes levels are summarized in **Fig. 2**. No single instrument was used by a vast majority (66.6% or more) of the surgeons surveyed for a particular neck level. In only three instances a majority (over 50%) of the surgeons use a particular instrument for a specific level: the use of unipolar cautery in level 1A (64.7%), 5A (52.6%), and 5B (53.6%). Unipolar cautery was used most often for all levels (the range for different levels



**Fig. 2** Respondent preferences of instrument for dissection of lymph nodes by level.



**Fig. 3** Instrument preferences for ligation/cauterization of a blood vessel during a neck dissection.

was 44.0 to 64.75%) except that the bipolar was most often used in level 1b (44.4%). Depending on the level, the bipolar was used by 28.6 to 44.4%, the scalpel was used by 19 to 32%, scissors were used by 20 to 31.5%, ligating energy devices were used 16.4 to 25.7%, and the heated blade was used by 3.0 to 4.1% of surgeons (in descending order of frequency of use for each instrument).

Instrument preferences when ligating blood vessels are summarized in ►**Fig. 3**. Instrument use for ligating blood vessels was varied but some trends included using free suture ties and stick ties to ligate the IJV and branches of the carotid artery. Smaller arteries and veins were ligated using a bipolar, ligating energy device, free suture ties, or clips.

We asked surgeons about drain placement in a non-irradiated, isolated, unilateral ND. A vast majority of surgeons reported that they preferred to place one drain for NDs (as opposed to two drains) involving levels 1–3 [ $n = 226(84.6\%)$ ], levels 1–4 [ $n = 196(73.4\%)$ ] or levels 2–4 [ $n = 217(82.8\%)$ ]. A majority of surgeons [141 (52.8%)] placed 2 drains (as opposed to 1) for a similar ND that encompassed levels 1–5. When two drains were used, 52.5% ( $n = 82$ ) of surgeons placed both drains deep to the SCM while 47.4% ( $n = 74$ ) placed one deep to the SCM and one superficial. The number of drains a respondent placed during a ND was independent of age, completion of a fellowship, surgical volume or operative time.

Surgeons were also asked a free response question on their criteria for drain removal. A majority [123 (60.2%)] stated that the criterion for removal was less than 30mL of output from the site in 24 hours (often with the comment that the fluid looked clear or without the appearance of bright blood or chyle). Some surgeons preferred less than 20mL of drainage in 24 hours [ $n = 45(15.9\%)$ ] or less than 50mL in 24 hours [ $n = 28(9.9\%)$ ]. Other criteria stated by respondents included being greater than three days post-op [ $n = 13(6.4\%)$ ] and having the patient tolerate a full diet with no evidence of a chyle leak [ $n = 10(4.9\%)$ ].

►**Table 3** summarizes the main commonalities and variances of ND technique preferences among the head and neck oncologic surgeons surveyed.

## Discussion

This study represents the first attempt to define the commonality and variance of ND technique that is practiced by current surgeon members of the AHNS. We surveyed the AHNS surgeon members because we felt they best define surgeons with a high level of expertise and experience with performing the ND operation. This study provides a unique perspective of the varied elements of ND operative technique. Likely, an individual's preferences are a personal amalgamation of interpretations of various observations during training and from the surgeon's current institution specific preferences. The range of varied idiosyncratic preferences are not likely conveyed well in textbooks or verbal instruction. Thus, we felt that a survey study, such as contained in this report, could better communicate the current range of ND technique preferences to readers. Notwithstanding, the results of this report do not necessarily reflect the authors' opinions nor are intended to necessarily advocate that particular surgical preferences are more evidence-based than others. Given the constraints of an appropriate length of the survey, we allowed for only sparse information about rationale behind technique preferences.

One significant finding of this survey study was that respondents were almost evenly split between preservation and resection of the SMG. We were surprised by this finding, given the fact that most operative technique text books (usually by single authors) describe excising the SMG.<sup>9</sup> Those that stated that they never performed SMG preservation cited incomplete nodal removal as a main concern when performing the surgery among the others listed. A prospective

**Table 3** Commonalities, controversies and variance in neck dissection operative technique as determined by the percentage of surgeons that employ each practice

Category	Commonality in ND technique preferences performed by most (>66%) surgeons (n, %)	Variability in ND technique preferences (<66%) (n, %)
Sequence	<ul style="list-style-type: none"> <li>- ND after resection of parotidectomy (193, 75%) and thyroidectomy (169, 67.3%)</li> <li>- ND before transcervical oropharynx (217, 85.1%) and hypopharynx / larynx (211, 82.4%)</li> </ul>	<ul style="list-style-type: none"> <li>- Level 1\2\3\4 sequence (143, 52.6%)</li> <li>- Level 2\3\4\1 sequence (59, 20.8%)</li> <li>- No standard levels excision sequence (18, 6.3%)</li> <li>- ND after oral cavity (142, 55%) and transoral hypopharynx / larynx (148, 58.7%)</li> </ul>
Technique	<ul style="list-style-type: none"> <li>- Do not perform SMG transfer (265, 93.3%)</li> <li>- Do not excise level 5 unless involved by suspicious LNs (211, 74.5%)</li> <li>- Generally excise LNs en bloc (220, 77.7%)</li> <li>- Do not excise SCM in salvage cases unless involved with tumor (248, 87.7%)</li> <li>- If SCM involved with tumor, only excise portion involved (205, 72.2%)</li> <li>- Only excise IJV involved with tumor (271, 95.4%)</li> <li>- Find importance in preserving venous blood vessels as much as possible ND [n = 222 (78.4%)]</li> </ul>	<ul style="list-style-type: none"> <li>- Preserves the submandibular gland (123, 43.3%)</li> </ul>
Instruments	<ul style="list-style-type: none"> <li>- Unipolar for raising subplatysmal skin flaps (192, 71.1%)</li> </ul>	<ul style="list-style-type: none"> <li>- Scalpel for removing LNs from IJV (128, 47.4%)</li> <li>- Unipolar (131, 50%) and bipolar (95, 35.8%) for excising LN from neck levels</li> </ul>
Drain	<ul style="list-style-type: none"> <li>- Placing one drain, instead of two for NDs of levels 1–3 (226, 84.6%), levels 1–4 (196, 73.4%) and levels 2–4 (217, 82.8%)</li> </ul>	<ul style="list-style-type: none"> <li>- 2 Drains for levels 1–5 (141, 52.8%)</li> <li>- Removing drain for output of less than 30cc a day (148, 60.2%)</li> </ul>

anatomical study conducted by Dhiwakar et al. specifically aimed to address this concern among Head and Neck Surgeons, demonstrated that it was technically possible to remove all lymph nodes in Level IB and perform SMG preservation.<sup>8</sup> However, even though SMG preservation may be possible with adequate lymph node removal, participants are valid in their concern with at least one study showing that greater preservation of structures during a ND may lead to a decrease in the amount of lymph tissue resected and poorer oncologic outcomes.<sup>7,9</sup>

Another significant finding in this study was that respondents who performed more than 50 neck dissections a year also self-reported a statistically significant decreased amount of time to complete a ND of levels 1–3, 1–4, 2–4, or 1–5. Surgeons with greater volumes may self-report faster procedure times, increasing their ability to perform a greater number of procedures in a given time period. This leads to the macroscopic finding described by Kim et al that high volume hospitals performed a proportionally greater amount of NDs than their low volume hospital counterparts.<sup>10</sup> Notwithstanding, there may be a significant amount of recall bias and even self-promotion bias since this study asked surgeons to self-report their operative times.

This survey allowed precise documentation of instruments that surgeons use during different parts of the ND. As we expected, there was a significant amount of variation between respondents on their use of particular instruments for certain situations. Surgeons' preferences for particular instruments are important to consider as technology improves and as attention to cost containment grows. This information may be particularly valuable to surgical trainees who may observe inter-educator

variability in the choice of instrument during a ND. Instrument choice may be made on safety, efficiency, blood loss, ease of use, cost, ergonomics, comfort, familiarity, and experience.

Variability in drain management and the placement of a drain with respect to the SCM are likely due to a paucity of evidence available to guide decision making. Drain removal has become more pertinent to the discussion of cost effective medical care as pressure increases to decrease hospital stay. It has been shown that the amount of intraoperative blood loss is one of the biggest predictors of postoperative drainage, however, no participants volunteered this as a criteria taken into account when removing a drain.<sup>11</sup> No guidelines currently exist regarding the policy of drain removal. The range of 20–50cc/24 hours with a downward trend, with the patient having oral intake and showing no chyle or new blood is possibly a good policy at this time, however, further investigation is necessary to clarify the best policy.

Respondents classified by this survey as belonging to an "expert" demographic group differed in opinion regarding level 5 lymph node resection and cervical sensory rootlet preservation. Surgeons older than 50 tended more often to report that they always resect level V lymph nodes for mSCC, while high volume surgeons were less likely to resect level 5 compared with low volume surgeons. This variability exists despite research that has shown that Level 5 lymph nodes may be preserved in a ND for head and neck squamous cell carcinoma with less than N2a staging in the neck.<sup>12,13</sup>

Respondents over the age of 50 were also more likely to divide the cervical sensory rootlets while respondents with higher volume were more likely to preserve the cervical sensory rootlets during a ND. Previous studies have shown

that division of the cervical sensory nerve rootlets leads to a larger area of anesthesia of the neck than if the roots were preserved.<sup>14</sup> These differences between two “expert” demographic groups may be explained by generational differences in instruction at the time of training and also a surgeon’s personal experience influencing their preference on whether to preserve these rootlets or not.

Each of the various policies of the sequence of primary site resection and ND have advantages and disadvantages. Performing a ND prior to a parotidectomy (25.5% of respondents preferred this sequence) has the potential advantages of exposing the inferior and deep aspects of the parotid and facial nerve more fully, ligating blood vessels to the parotid to decrease bleeding, and exposing the dissected facial nerve to less potential traction and drying injury. A potential disadvantage in performing the ND prior to parotidectomy is that the surgical team may be more fatigued and less focused for the facial nerve dissection or the exact pathology. Thus, the need for a ND may be reliant on intraoperative frozen section biopsies. Performing a ND prior to a thyroidectomy (32.7% preferred this sequence) has the potential advantages of exposing the ipsilateral thyroid lobe, parathyroid glands, and superior and recurrent laryngeal nerves more fully, ligating blood vessels to the thyroid, and exposing the vagus nerve for stimulation confirmation during nerve monitoring. A potential disadvantage is, again, that the surgical team may be more fatigued and less focused for the recurrent laryngeal nerve dissection. Performing a ND after transoral oral cavity (45.5% preferred this sequence), transcervical approaches to oropharynx tumor resection (14.9% preferred this sequence), and transcervical approaches to the larynx/hypopharynx tumor resection (17.8% preferred this sequence) has the potential advantages of time efficiency with reducing some wasted time when waiting for frozen section margins analysis by performing the ND during this time. Another advantage is creating less potential mucosal edema when a ND is performed first which could cut off lymphatic circulation from the primary site. A potential disadvantage is that the surgeon would be unable to ligate the lingual artery ahead of time if this was considered an important step. If done during the same operation, performing transoral oropharynx and larynx/hypopharynx resections prior to NDs (53.1% and 58.7%, respectively) offers the same potential benefits and drawbacks. If staged, performing NDs prior to transoral oropharynx or larynx/hypopharynx (46.9% and 41.3%, respectively) has the potential advantages of ligating the lingual artery ahead of time to decrease the bleeding risk during the primary resection and determining the presence or absence of extracapsular spread which may eliminate the need for a primary site resection.

We acknowledge that this study has several limitations. Although the response rate of 28% was in typical range of survey studies, this low response rate limits the variability and breadth of surgical techniques captured with this survey. However, we feel we were able to collect data from a wide array of surgeons in different demographic and geographical categories. Respondents were not asked to explain every response provided in the survey, which could have provided additional rationale on a surgeon’s preference for a particular instrument or style of procedure. We wanted to maximize the

breadth of information while maintaining a reasonable time needed to complete the survey to reduce the risk of survey fatigue. Recall bias could have limited the validity of the results. It is possible that operative time, the use of instruments, and the preservations of structures during a ND vary in reality from what surgeons responded in the survey. Another limitation of this study is that it captures technique preferences in one point of time and does not reveal trends of technique over time. It is possible that a repeated identical survey conducted several years from now could have fairly different results.

## Conclusions

A vast majority of head and neck oncologic surgeons have the following technique preferences when performing a ND: preserve level 5 during a therapeutic ND (unless involved by suspicious LNs), resect LNs en bloc, do not resect the IJV unless involved with tumor, excise only a portion of the SCM involved with tumor, preserve cervical sensory rootlets, perform a ND after parotidectomy and thyroidectomy, perform ND before transcervical primary site resection for oropharynx, hypopharynx, and larynx carcinoma, do not perform SMG transfer, and place one drain (instead of two) for NDs of levels 1–3, 1–4, and 2–4. There is variance among head and neck oncologic surgeons on the following aspects of a ND: sequence of LN levels excised, instrument preference for various LN regions and blood vessel types, preservation of venous blood vessels (besides IJV), preservation versus resection of the SMG during level 1b dissection, performing a ND before or after transoral primary site resection of oral cavity, oropharynx, hypopharynx, and laryngeal carcinoma, the drain number (1 or 2) used for NDs of levels 1–5, and the threshold criteria for drain removal. Age, surgical volume, efficiency, and completion of a head and neck oncologic fellowship may influence some technique preferences when performing a ND.

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