

An Imaging-Based Classification for the Cervical Nodes Designed as an Adjunct to Recent Clinically Based Nodal Classifications

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Over the past 18 years, numerous classifications have been proposed to distinguish among the diverse nodal levels. Some classifications have used surgical landmarks, others physical assessment criteria. These classifications do not agree precisely and exhibit sufficient variation that competent physicians could arrive at slightly different staging of the patient's nodal disease. In the past 2 decades, computed tomography and magnetic resonance imaging have offered progressively more refined anatomical precision, reproducibility, and visualization of deep, clinically inaccessible structures. Because the majority of patients with head and neck malignancies presently undergo sectional imaging prior to treatment planning, we felt a need to integrate anatomical imaging criteria with the 2 most commonly used nodal classifications: those of the American Joint Committee on Cancer and those of the American Academy of Otolaryngology–Head and Neck Surgery. The imaging-based nodal classification proposed herein has been developed in consultation with surgeons interested in such classifications in the hope that the resultant classification would find ready acceptance by both clinicians and imagers. It is our desire that the best attributes of imaging, combined with those of the physical assessment, can result in a better and more consistently reproducible nodal staging than is possible by either approach alone.

Arch Otolaryngol Head Neck Surg. 1999;125:388-396

The definition of a classification is “a systematic arrangement in groups or categories according to established criteria.”¹ This definition implies that there are, in fact, established criteria. However, when it comes to nodal classifications, such well-accepted criteria are often difficult to identify.

For nearly 4 decades, the most commonly used classification for the cervical lymph nodes was that developed by Rouviere² in 1938. His work followed an earlier classification by Trotter³ in 1930, which was based on an even earlier work by Poirer and Charpy⁴ in 1909. Many of the landmarks used in these classifications had their origin in the superficial tri-

angles of the neck, areas that were easily accessible to palpation and referred to by familiar names. In 1981, Shah et al⁵ suggested that the anatomically based terminology should be replaced with a simpler “level”-based system. Since then, a number of clinically and radiologically based classifications have been proposed that use such nonanatomical terminology.⁵⁻¹⁵

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However, when these varied classifications are reviewed and compared, there remain several areas that either are not precisely defined or are defined so variously that the present systems preclude precise classification of nodal disease in these areas and potentially could lead to confusion. We believe that the anatomical precision offered by current-day computed tomography (CT) and

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magnetic resonance imaging (MRI) can resolve some of these issues and can contribute significantly to an improved classification of nodal disease. The contribution of imaging may be especially germane to those lymph nodes that are situated deeply and that, by their very location, are difficult, if not impossible, to palpate.

To this end, our classification was initially designed to be used adjunctively with the American Joint Committee on Cancer (AJCC) classification. However, history shows that nodal classifications are continuously evolving, with modifications constantly being proposed to better allow surgeons to plan the most appropriate surgery for nodal disease. Most recently, Robbins¹⁶ modified and updated the 1991 American Academy of Otolaryngology–Head and Neck Surgery (AAO-HNS) guidelines, and we hope that our proposed imaging-based nodal classification will be used as an adjunct to both the AJCC and the AAO-HNS classifications. It is also our desire that the best attributes of both the physical and the imaging assessments of the patient can be used conjointly to arrive at a more consistently reproducible and accurate classification than is possible by either method alone.

STATING THE PROBLEMS

Based on the classifications cited above, there were 10 specific points that we believed needed to be addressed to add consistency and accuracy to a nodal classification, while maintaining consistency with the prior staging literature.

1. What terminology should be used to refer to the various nodal areas? The tendency in the literature over the past 2 decades has been to use a descriptive term such as *level*,^{5,7,11,13,17} *region*,^{10,14} or *zone*¹⁵ rather than the anatomical terminology used by Rouviere.² Of these terms, *level* is the one that is most frequently used and the one that is used by the AJCC; therefore, we will use it in the following section.

2. How can one consistently differentiate between a posterior level I node and a level II node?

3. Is it preferable to group the submental and submandibular nodes together as level I nodes, or should there be an option to distinguish between these 2 nodal groups. If so, what should the imaging landmarks be?

4. For clarity and reproducibility, there should be well-defined, consistent divisions between level II, III, and IV nodes. However, in the present classifications, level II has been defined variably as extending from the skull base to either the “hyoid bone,”^{8,13,14,17-19} the “bottom of the hyoid body,”¹⁵ the “top of the greater cornu of the hyoid bone,”²⁰ the “common facial vein,”^{2,13} or “the carotid bifurcation.”^{2,11-13,19,20}

5. From which portion of the skull base do level II nodes begin, and how can one differentiate a high level II node from a retropharyngeal node, a nodal group not discussed in most of these classifications?

6. The demarcation between level III and level IV nodes has been given variably as the “cricoid cartilage,”^{8,17} the “top of the cricoid cartilage,”⁶ the “bottom of the cricoid arch,”¹⁵ the “cricothyroid membrane,”^{13,14} the “cricothyroid notch,”¹² or the level at which the “omohy-

oid muscle crosses the internal jugular vein.”^{10-12,19,20} Of these landmarks, is there one that is easily seen on axial images and that anatomically is consistent with the division used to separate level II and III nodes?

7. What are the lower limits of level IV and V nodes, and is it necessary to distinguish these nodes from supraclavicular nodes on imaging studies?^{2,13} This point becomes relevant when the recent AJCC classification for staging nasopharyngeal carcinomas is being used.

8. How does one define level V nodes on imaging studies, while maintaining consistency with the prior classifications?

9. If one is to include in the classification the ability to differentiate level V nodes into subgroups, should there be 3 subgroups (upper, middle, and lower)¹³ or just upper and lower subdivisions (VA and VB)?¹⁶ Furthermore, what landmark(s) should be used to define these groups?

10. On clinical examination, the suprasternal notch is a well-defined region. However, on axial imaging studies, it is vaguely defined and may extend over several centimeters in craniocaudal extent.^{2,13} Is there a better imaging landmark that one can use to differentiate level VI from level VII nodes?

DISCUSSING SOLUTIONS

Patients who have very small or superficial tumors may be assessed well by physical examination alone. However, in our experience, most of the patients have more deeply situated head and neck cancers, and, at present, these cases require either a CT or an MRI study before treatment planning can be finalized. Thus, we believed that it was practical to incorporate the precise anatomical information provided by these imaging studies into a nodal classification.

Regarding terminology, one can only state a preference concerning the use of the terms *level*, *region*, or *zone*. Review of the literature of the past 2 decades clearly indicates preferential usage of the term *level*. Although this in itself does not make *level* the “best” term, its use by the AJCC helped us to select it as the one term that would be the most consistent with the majority of the prior classifications and with most of the otolaryngological literature.

In his detailed nodal description, Rouviere² noted that the inferior jugular nodal group extended to the base of the internal jugular vein and that the transverse cervical nodes were situated at the level of the clavicle and connected the caudal spinal accessory nodes with the internal jugular nodes at the level of the jugulosubclavian junction. Although there are some potential problems with patient positioning, we chose the level of the clavicle, as seen on each axial image, to represent the caudal end of level IV and V nodes. Nodes at or below the clavicle will be considered supraclavicular nodes. The top of the manubrium can serve to differentiate between level VI and VII nodes as defined in the 1997 AJCC system, because it is a more precisely defined landmark than the suprasternal notch.

An area that has been addressed by only 2 prior classifications is the precise distinction between level I and

level II nodes.^{14,15} We agree with van den Brekel¹⁴ and Curtin et al¹⁵ that the posterior edge of the submandibular gland is a consistent landmark that can be easily used to differentiate between level I and level II nodes. The posterior edge of the submandibular gland is also a more consistent landmark than the anterior border of the sternocleidomastoid muscle, which can change position relative to the submandibular gland with mild head turning, muscle atrophy, or muscle hypertrophy. Since we believe that the separation of the submental nodes from the submandibular nodes may be useful in further studies, we chose to offer subclassifications of level I nodes into levels IA and IB.

Regarding the problem of distinguishing level II from level III nodes and level III from level IV nodes, for consistency we chose to use the bottom of the hyoid body as the landmark to separate level II from level III nodes and the bottom of the cricoid arch as the landmark to separate level III and level IV nodes, both of these landmarks being seen in the axial plane. By using the bottoms of both the hyoid body and the cricoid arch, we provide concise, consistent, and easily detectable landmarks for delineating these nodal levels. The lower margin of the cricoid arch can also be used to differentiate level V nodes into 2 subgroups: upper (VA) and lower (VB) nodes, as we also believe that the subclassification of the level V nodes may provide useful information in future studies (see "Level V" section).

REGARDING THE PROBLEM of how to consistently differentiate internal jugular nodes from spinal accessory nodes, we noted that Rouviere² and others have stated that any distinction between the upper internal jugular nodes and the upper spinal accessory nodes may be impossible, because these groups of nodes merge at this level. We decided that any new classification should recognize that distinction between these 2 nodal groups may be impossible, especially in the upper neck area, and that artificial criteria would be necessary to give reproducibility to the classification. Using the definition of level V nodes given in most clinically based classifications, we chose to define a posterior triangle nodal group using the classic definition of the posterior triangle. Thus, especially in the upper and middle areas of the neck, our level II, III, and IV nodes include the internal jugular nodes and those spinal accessory nodes deep to the sternocleidomastoid muscle. The posterior triangle nodes are those nodes posterior to the posterior border of the sternocleidomastoid muscle and anterior to the trapezius muscle.

Initially, we defined the posterior border of the level II, III, and IV nodes as a transverse line drawn through the posterior border of the sternocleidomastoid muscle on each axial scan. Any node lying posterior to this line would be considered to be a level V node. However, this led to a problem regarding the classification of the lowest jugular nodes, which, as Rouviere noted, were located on the anterior scalene muscle and which therefore were often referred to as the *prescalene nodes*.^{2,21} In many people, the posterior border of the sternocleido-

mastoid muscle lies anterior to the anterior scalene muscle on axial scans of the lower neck area. In such cases, if the posterior border of the sternocleidomastoid muscle were to be used as the division between the lowest level IV and V nodes, it would result in these scalene nodes being classified as level V nodes. Such classification would be contrary to the classic classification of the scalene nodes as being part of the internal jugular chain. Therefore, to separate level IV and level V nodes caudal to the bottom of the cricoid arch, we decided to use an oblique line extending from the posterior border of the sternocleidomastoid muscle to the lateral posterior edge of the anterior scalene muscle. Such a line would always place the scalene nodes in the internal jugular chain. The nodal classification that results from using these new landmarks is completely consistent with the recent AJCC classification and virtually all previous clinically based classifications.

Trying to address the point raised by Robbins¹⁶ concerning the separation of the lower level IV nodes into those that lie deep to the sternal head (IVA) and those that lie deep to the clavicular head (IVB) of the sternocleidomastoid muscle proved a difficult challenge. Although the 2 heads of the sternocleidomastoid muscle can be seen on the most caudal scans through the muscle, the medial margin of the clavicle so closely approximates the sagittal plane of the carotid artery that distinction between level IVA and level VI nodes is impossible. If this subclassification eventually proves useful, it may be a distinction best left to clinical differentiation.

Again in response to Robbins, it was also deemed appropriate to subdivide the level II nodes into internal jugular (IIA) and spinal accessory (IIB) nodes. To best approximate these 2 subgroups, we classified as level IIB those nodes that lie posterior to the internal jugular vein and that are separated from the vein by a fat plane. By definition, therefore, level IIA nodes are those nodes that lie posterior to the internal jugular vein and are inseparable from the vein, or they are nodes that lie anterior, medial, or lateral to the vein.

There was also a slight difference between the subclassification of level V nodes as described by the AJCC and the AAO-HNS. In the AJCC classification, there were 3 subgroups to level V: upper, middle, and lower. The planes used to separate these groups were the same as those used to separate levels II and III and levels III and IV. The AAO-HNS classification suggests that it is more practical to simply divide the level V nodes into upper (VA) and lower (VB) groups. This simpler approach was suggested because there are actually few, if any, nodes in the AJCC upper level V region. We elected to follow the guidelines of the AAO-HNS classification, and in our system the plane dividing VA and VB nodes is the bottom of the cricoid arch.

For the purposes of this categorization, we define the portion of the skull base at which level II nodes start as the inferior bony margin of the jugular fossa. Immediately inferior to the skull base, we define a node that lies anterior or lateral to the carotid sheath as a high level II node. A node that lies medial to the internal carotid artery is defined as a lateral retropharyngeal node. We thought that this distinction was clinically relevant, be-

Table 1. Summary of the Imaging-Based Nodal Classification*

Level I	The submental and submandibular nodes. They lie above the hyoid bone, below the mylohyoid muscle, and anterior to the back of the submandibular gland.
Level IA	The submental nodes. They lie between the medial margins of the anterior bellies of the digastric muscles.
Level IB	The submandibular nodes. On each side, they lie lateral to the level IA nodes and anterior to the back of each submandibular gland.
Level II	The upper internal jugular nodes. They extend from the skull base to the level of the bottom of the body of the hyoid bone. They are posterior to the back of the submandibular gland and anterior to the back of the sternocleidomastoid muscle.
Level IIA	A level II node that lies either anterior, medial, lateral, or posterior to the internal jugular vein. If posterior to the vein, the node is inseparable from the vein.
Level IIB	A level II node that lies posterior to the internal jugular vein and has a fat plane separating it and the vein.
Level III	The middle jugular nodes. They extend from the level of the bottom of the body of the hyoid bone to the level of the bottom of the cricoid arch. They lie anterior to the back of the sternocleidomastoid muscle.
Level IV	The low jugular nodes. They extend from the level of the bottom of the cricoid arch to the level of the clavicle. They lie anterior to a line connecting the back of the sternocleidomastoid muscle and the posterolateral margin of the anterior scalene muscle. They are also lateral to the carotid arteries.
Level V	The nodes in the posterior triangle. They lie posterior to the back of the sternocleidomastoid muscle from the skull base to the level of the bottom of the cricoid arch and posterior to a line connecting the back of the sternocleidomastoid muscle and the posterolateral margin of the anterior scalene muscle from the level of the bottom of the cricoid arch to the level of the clavicle. They also lie anterior to the anterior edge of the trapezius muscle.
Level VA	Upper level V nodes extend from the skull base to the level of the bottom of the cricoid arch.
Level VB	Lower level V nodes extend from the level of the bottom of the cricoid arch to the level of the clavicle, as seen on each axial scan.
Level VI	The upper visceral nodes. They lie between the carotid arteries from the level of the bottom of the body of the hyoid bone to the level of the top of the manubrium.
Level VII	The superior mediastinal nodes. They lie between the carotid arteries below the level of the top of the manubrium and above the level of the innominate vein.
Supraclavicular nodes	They lie at or caudal to the level of the clavicle and lateral to the carotid artery on each side of the neck, as seen on each axial scan.
Retropharyngeal nodes	Within 2 cm of the skull base, they lie medial to the internal carotid arteries.

*The parotid nodes and other superficial nodes are referred to by their anatomical names.

cause the identification of retropharyngeal nodes affects treatment planning. Furthermore, the retropharyngeal nodes represent a nodal group whose identification is almost solely in the purview of imaging.

Distinction between supraclavicular and low level IV and V nodes has become important, since the 1997 AJCC staging for nasopharyngeal cancer has shown that supraclavicular nodes specifically affect staging of these tumors. The AJCC defined the supraclavicular fossa as the Ho triangle, a triangular plane defined by 3 points: (1) the upper sternal end of the clavicle, (2) the upper lateral end of the clavicle, and (3) the point at which the posterior portion of the neck meets the shoulder.¹³ It is interesting to observe that the AJCC also noted that the caudal portions of levels IV and V were included within this triangle, and recognized the difficulty in differentiating between these nodal groups.

However, because of the slope of the shoulder and neck junction, it is difficult on axial imaging to identify a consistent anatomical level by which to separate a supraclavicular node from a low level IV or V node. That is, the Ho triangle cannot reliably be identified on axial images. Also, the plane of the clavicle is tilted with respect to the axial plane: the clavicle's anterior end lies more caudal than its posterior margin. As a result, the entire clavicle is not seen on a single axial image. Lastly, any elevation of the patient's shoulder, as commonly occurs on imaging, will cause the clavicle to be seen on more cranial images than normal, and this may lead to an erroneous localization of the level of the supraclavicular fossa.

Despite all these problems, we still decided that the visualized portion of the clavicle, as seen on each of the axial images through the region, remains the most reliable imaging marker of the supraclavicular fossa. Thus, if a node is located at or below the level of the portion of the clavicle seen on a specific image, that node can be placed in the supraclavicular fossa. Using the clavicle as the inferior border of levels IV and V also maintained consistency with both the AJCC and the AAO-HNS classifications.

Based on the decisions discussed above, we suggest the following imaging-based nodal classification system (**Table 1**). A comparison of the new classification with the 1997 AJCC classification and the 1998 modification of the 1991 AAO-HNS classification is shown in **Table 2**. The axial plane referred to in this imaging-based classification should be with the patient's head in a "neutral" position, with the axial images aligned in the inferior orbitomeatal plane. If possible, the examination should be performed as a postcontrast study to allow the best possible differentiation of nodes from vessels. With CT, the examination is performed as contiguous 3-mm scans from the skull base to the manubrium or as a spiral study reconstructed as contiguous 2- or 3-mm slices. With MRI, the scans should be no thicker than 5 mm, with a 1-mm interslice gap. For consistency, and because the axial image is the basis of this classification, the terms *anterior* and *posterior* will be used rather than *ventral* and *dorsal*. **Figure 1** diagrams the pertinent anatomy and the landmarks used for the classification. For consistency, **Figure 2** through **Figure 7** are all CT scans that demonstrate the use of the new classification; MRIs could as easily be used.

Table 2. Comparison of AJCC, AAO-HNS, and Imaging-Based Nodal Classifications*

1997 AJCC		1998 Modification of the 1991 AAO-HNS
Level I	Contains the submental and submandibular triangles bounded by the posterior belly of the digastric muscle, the hyoid bone inferiorly, and the body of the mandible superiorly.	Submental and submandibular nodes from the mandible to the hyoid bone and anterior to the posterior bellies of the digastric muscle.
Level IA		Submental nodes between the anterior bellies of the digastric muscles, above the hyoid bone and below the mandible.
Level IB		Submandibular nodes between the anterior and posterior bellies of the digastric muscle below body of mandible.
Level II	Contains the upper jugular lymph nodes and extends from the level of the skull base superiorly to the hyoid bone inferiorly.	Upper jugular nodes from the skull base to either the carotid bifurcation or the hyoid bone. Anterior to the posterior border of the sternocleidomastoid muscle and posterior to the lateral border of the stylohyoid muscle.
Level IIA		Level II nodes anterior to the spinal accessory nerve.
Level IIB		Level II nodes posterior to the spinal accessory nerve.
Level III	Contains the middle jugular lymph nodes from the hyoid bone superiorly to the cricothyroid membrane inferiorly.	Middle jugular nodes from the hyoid bone or carotid bifurcation to the cricothyroid membrane or where the omohyoid muscle crosses the internal jugular vein. They are anterior to the posterior border of the sternocleidomastoid muscle and posterior to the lateral border of the stylohyoid muscle.
Level IV	Contains the lower jugular lymph nodes from the cricothyroid membrane superiorly to the clavicle inferiorly.	Lower jugular nodes from the level where the omohyoid muscle crosses the internal jugular vein to the level of the clavicle. Anterior to the posterior border of the sternocleidomastoid muscle and posterior to the lateral border of the sternohyoid muscle.
Level IVA		Level IV nodes deep to the sternal head of the sternocleidomastoid muscle.
Level IVB		Level IV nodes deep to the clavicular head of the sternocleidomastoid muscle.
Level V	Contains the lymph nodes in the posterior triangle bounded by the anterior border of the sternocleidomastoid muscle anteriorly and the clavicle inferiorly. For descriptive purposes, level V may be further subdivided into upper, middle, and lower levels corresponding to the superior and inferior planes that define the levels II, III, and IV.	Posterior triangle nodes lying between the posterior border of the sternocleidomastoid muscle, the anterior border of the trapezius muscle, and above the clavicle.
Level VA		Level V nodes lying above the level of the posterior belly of the omohyoid muscle.
Level VB		Level V nodes lying below the level of the posterior belly of the omohyoid muscle.
Level VI	Contains the lymph nodes of the anterior compartment from the hyoid bone superiorly to suprasternal notch inferiorly. On each side, the lateral border is formed by the medial border of the carotid sheath.	Central compartment nodes extending from the hyoid bone to the suprasternal notch and lying between the medial border of each carotid sheath.
Level VII	Contains the lymph nodes inferior to the suprasternal notch in the upper mediastinum.	
Supraclavicular nodes	They lie between the level of the Ho triangle.	
Retropharyngeal nodes		

*AJCC indicates American Joint Committee on Cancer; AAO-HNS, American Academy of Otolaryngology–Head and Neck Surgery. The parotid nodes and other superficial nodes are referred to by their anatomical names for all classifications.

THE NEW CLASSIFICATION

Level I

Level I includes all the nodes above the hyoid bone, below (superficial to) the mylohyoid muscles, and anterior to a transverse line drawn on each axial image through the posterior edge of the submandibular gland (Figure 3). Thus,

level I nodes include the submental and submandibular nodes. If the line drawn along the posterior edge of the submandibular gland transects a node, this node will be classified as a level I node if the majority of its cross-sectional area lies anterior to this line. If the majority of the nodal cross-sectional area is posterior to this line, the node will be regarded as a level II node. Level I nodes can be subclassified into levels IA and IB.

1999 Imaging

The submental and submandibular nodes. They lie above the hyoid bone, below the mylohyoid muscle, and anterior to the back of the submandibular gland.

The submental nodes. They lie between the medial margins of the anterior bellies of the digastric muscles.

The submandibular nodes. On each side, they lie lateral to the level IA nodes and anterior to the back of each submandibular gland.

The upper internal jugular nodes. They extend from the skull base to the level of the bottom of the body of the hyoid bone. They are posterior to the back of the submandibular gland and anterior to the back of the sternocleidomastoid muscle.

A level II node that lies either anterior, medial, lateral, or posterior to the internal jugular vein. If posterior to the vein, the node is inseparable from the vein.

A level II node that lies posterior to the internal jugular vein and has a fat plane separating it and the vein.

The middle jugular nodes. They extend from the level of the bottom of the body of the hyoid bone to the level of the bottom of the cricoid arch. They lie anterior to the back of the sternocleidomastoid muscle.

The lower jugular nodes. They extend from the level of the bottom of the cricoid arch to the level of the clavicle. They lie anterior to a line connecting the back of the sternocleidomastoid muscle and the posterolateral margin of the anterior scalene muscle. They are also lateral to the carotid arteries.

The nodes in the posterior triangle. They lie posterior to the back of the sternocleidomastoid muscle from the skull base to the level of the bottom of the cricoid arch and posterior to a line connecting the back of the sternocleidomastoid muscle and the posterolateral margin of the anterior scalene muscle from the level of the bottom of the cricoid arch to the level of the clavicle. They also lie anterior to the anterior edge of the trapezius muscle.

Upper level V nodes extend from the skull base to the level of the bottom of the cricoid arch.

Lower level V nodes extend from the level of the bottom of the cricoid arch to the level of the clavicle, as seen on each axial scan.

The upper visceral nodes. They lie between the carotid arteries from the level of the bottom of the body of the hyoid bone to the level of the top of the manubrium.

The superior mediastinal nodes. They lie between the carotid arteries below the level of the top of the manubrium and above the level of the innominate vein.

They lie at or caudal to the level of the clavicle and lateral to the carotid artery on each side of the neck, as seen on each axial scan.

Within 2 cm of the skull base, they lie medial to the internal carotid arteries.

Level IA. Level IA represents the nodes that lie between the medial margins of the anterior bellies of the digastric muscles, above the hyoid bone and below the mylohyoid muscle.

Level IB. Level IB represents the nodes that lie below (superficial to) the mylohyoid muscle, above the hyoid bone, posterior and lateral to the medial edge of the anterior

belly of the digastric muscle, and anterior to a transverse line drawn on each axial image tangent to the posterior surface of the submandibular gland on each side of the neck.

Level II

Level II extends from the skull base, at the lower level of the bony margin of the jugular fossa, to the level of the lower body of the hyoid bone. Level II nodes lie anterior to a transverse line drawn on each axial image through the posterior edge of the sternocleidomastoid muscle and posterior to a transverse line drawn on each axial scan through the posterior edge of the submandibular gland. If a node situated within 2 cm of the skull base lies anterior, lateral, or posterior to the carotid sheath, it is classified as a level II node. If the node lies medial to the internal carotid artery (ie, a coronal plane tangent to the medial margin of the internal carotid artery), it is classified as a retropharyngeal node (Figure 2). Caudal to 2 cm below the skull base, level II nodes can lie anterior, lateral, medial, and posterior to the internal jugular vein. When either of these transverse lines transects a node, the node is a level II node if the majority of its cross-sectional area is posterior to the submandibular gland line and anterior to the sternocleidomastoid muscle line. Level II nodes can be subclassified into levels IIA and IIB.

Level IIA. Level IIA nodes lie posterior to the internal jugular vein and are inseparable from the vein, or they are nodes that lie anterior, medial, or lateral to the vein.

Level IIB. Level IIB nodes lie posterior to the internal jugular vein and have a fat plane separating the nodes and the vein.

Level III

Level III nodes lie between the level of the lower body of the hyoid bone and the level of the lower margin of the cricoid cartilage arch. These nodes lie anterior to a transverse line drawn on each axial image through the posterior edge of the sternocleidomastoid muscle. If the transverse line transects a node, the node is considered a level III node, provided that most of its cross-sectional area is situated anterior to this line; otherwise, it is considered a level V node (Figures 4 and 5). Level III nodes also lie lateral to either the common carotid arteries or the internal carotid arteries, which separate level III and level VI nodes.

Level IV

Level IV nodes lie between the level of the lower margin of the cricoid cartilage arch and the level of the clavicle as seen on each axial scan. These nodes lie anterior and medial to an oblique line drawn through the posterior edge of the sternocleidomastoid muscle and the lateral posterior edge of the anterior scalene muscle on each axial image (Figure 6). The common carotid artery is

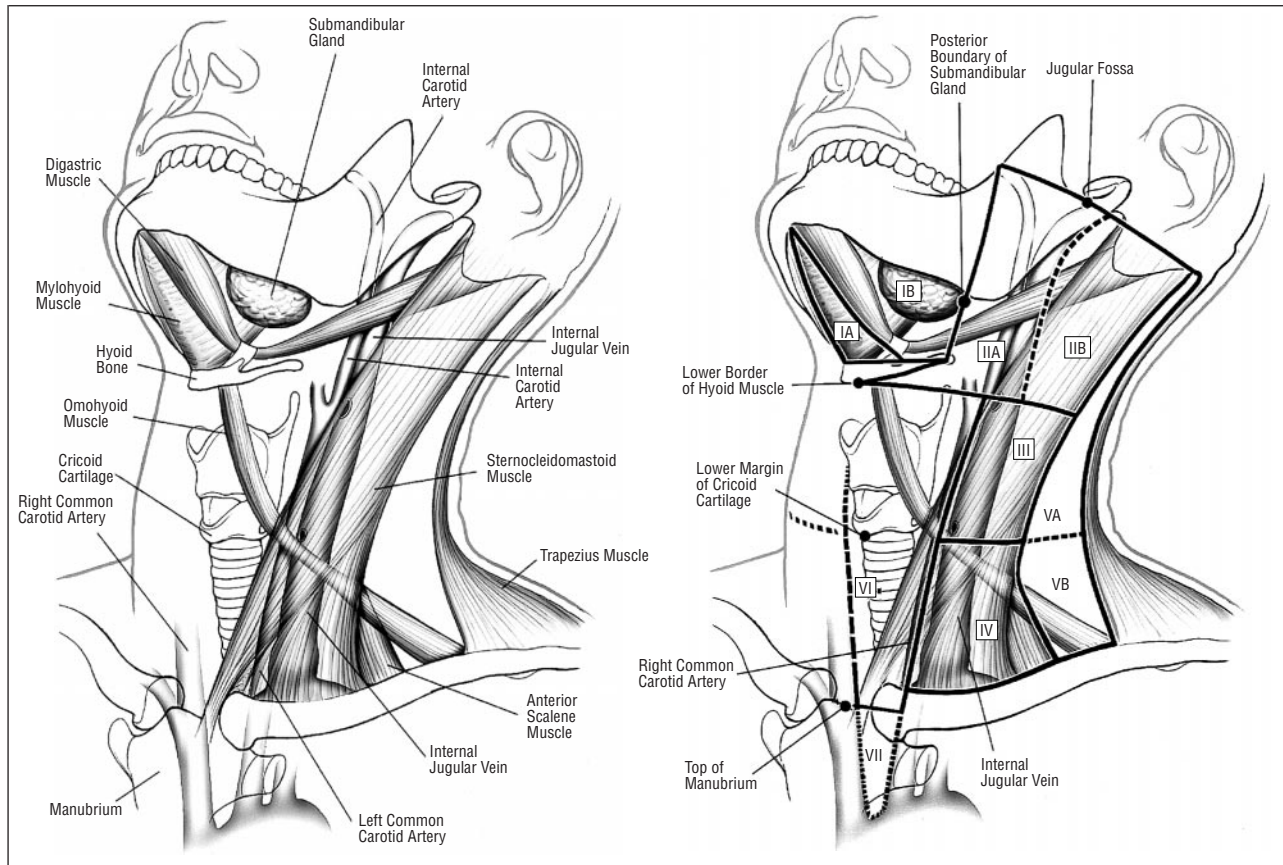


Figure 1. Diagram of the neck as seen from the left anterior view. Left, The pertinent anatomy that relates to the nodal classification. Right, An outline of the levels of the classification. Note that the line of separation between levels I and II is the posterior margin of the submandibular gland. The separation between levels II and III and level V is the posterior edge of the sternocleidomastoid muscle. However, the line of separation between levels IV and V is an oblique line extending from the posterior edge of the sternocleidomastoid muscle to the posterior edge of the anterior scalene muscle. The posterior edge of the internal jugular vein separates level IIA and IIB nodes. The top of the manubrium separates levels VI and VII.

the landmark that separates level IV nodes, which lie lateral to this artery, from level VI nodes, which lie medial to the common carotid artery. When the oblique line transects a node, the node is considered a level IV node if the majority of its cross-sectional area is anterior to this line; otherwise, it is considered a level V node.

Level V

Level V nodes extend from the skull base, at the posterior border of the attachment of the sternocleidomastoid muscle, to the level of the clavicle as seen on each axial scan. Level V nodes all lie anterior to a transverse line drawn on each axial scan through the anterior edge of the trapezius muscle. Between the levels of the skull base and the bottom of the cricoid arch, these nodes are situated posterior to a transverse line drawn on each axial scan through the posterior edge of the sternocleidomastoid muscle. Between the axial level of the bottom of the cricoid arch and the level of the clavicle, level V nodes lie posterior and lateral to an oblique line through the posterior edge of the sternocleidomastoid muscle and the lateral posterior edge of the anterior scalene muscle (Figures 4-6). If either of these anterior lines transects a node, then that node is considered a level V node, provided that the majority of the nodal cross-sectional area lies posterior to the lines. If the

majority of the nodal cross-sectional area lies anterior to these lines, the node is classified as a level II, III, or IV node, depending on its craniocaudal location. The level V nodes can be subdivided into VA (upper) and VB (lower) level V nodes.

Level VA (Upper Level V). Level VA nodes lie between the skull base and the level of the lower margin of the cricoid cartilage arch.

Level VB (Lower Level V). Level VB nodes lie between the level of the lower margin of the cricoid cartilage arch and the level of the clavicle as seen on each axial scan.

Level VI

Level VI nodes lie inferior to the lower body of the hyoid bone, superior to the top of the manubrium, and between the left and right common carotid arteries or the internal carotid arteries. They are the visceral nodes.

Level VII

Level VII nodes lie caudal to the top of the manubrium in the superior mediastinum, between the left and right common carotid arteries (Figure 7). These are the supe-



Figure 2. Axial postcontrast computed tomographic scan of the neck through the level of C2 shows a sagittally oriented white line drawn along the medial edge of the internal carotid artery (IC). Within 2 cm of the skull base, any node medial to this line is classified as a retropharyngeal node, while a node lateral to this line is a level II node. RN indicates a necrotic lateral retropharyngeal node.

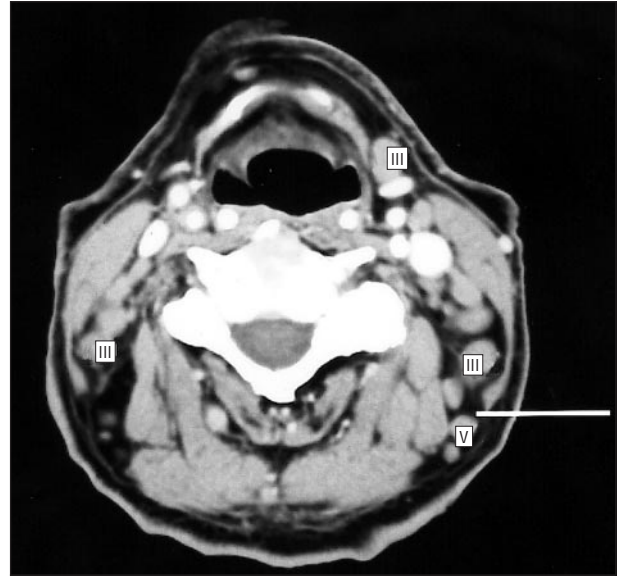


Figure 4. Axial postcontrast computed tomographic scan of the neck just caudal to the hyoid bone. A transverse white line has been drawn through the posterior edge of the left sternocleidomastoid muscle. Note that level III nodes lie anterior to this line and include those nodes anterior to the carotid sheath structures (internal jugular nodes) as well as those deep to the sternocleidomastoid muscle (spinal accessory nodes). Posterior to the transverse line are level V nodes.

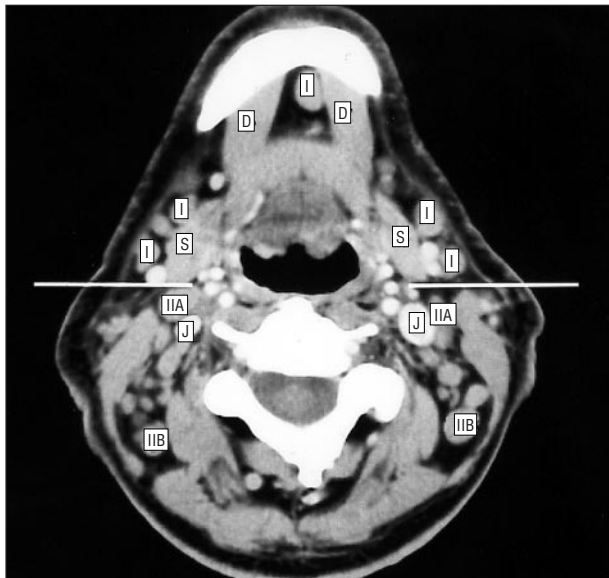


Figure 3. Axial postcontrast computed tomographic scan of the neck just cranial to the hyoid bone. A transverse white line has been drawn through the posterior edge of each submandibular gland (S). The nodes anterior to this line are level I nodes, while the nodes posterior to this line are level II nodes. The node between the anterior bellies of the digastric muscles (D) can be subclassified as level IA, while the other level I nodes lateral to the medial edge of each anterior digastric belly can be subclassified as level IB nodes. The level II nodes anterior to and/or touching the internal jugular vein (J) are subclassified as level IIA. Those level II nodes posterior to the vein and not touching it are subclassified as level IIB.

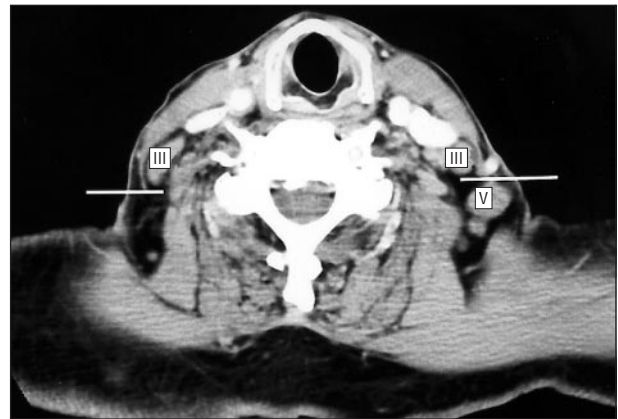


Figure 5. Axial postcontrast computed tomographic scan of the neck through the level of the cricoid cartilage, cranial to the lower border of the anterior cricoid arch. A transverse white line has been drawn through the posterior edge of each sternocleidomastoid muscle. Nodes anterior to this line are level III, while nodes posterior to this line are level V.

rior mediastinal nodes, and they extend caudally to the level of the innominate vein.

For consistency with the prior classifications, the following nodal groups, as well as the other superficial nodes, will still be referred to by their anatomical names, eg, su-

praclavicular, retropharyngeal, parotid, facial, occipital, and postauricular.

CONCLUSIONS

Today, CT and MRI form an integral part of the assessment of most cases of head and neck cancer. The imaging findings clearly complement the physical examination. We hope that the new definitions that we propose will establish clearly defined, easily reproducible, and easily documented nodal levels and enable more accurate and reproducible classification of nodal disease. Also, we hope that this proposed classification will provide the radiologist with clinically acceptable guidelines with which to classify the cervical nodes and then to

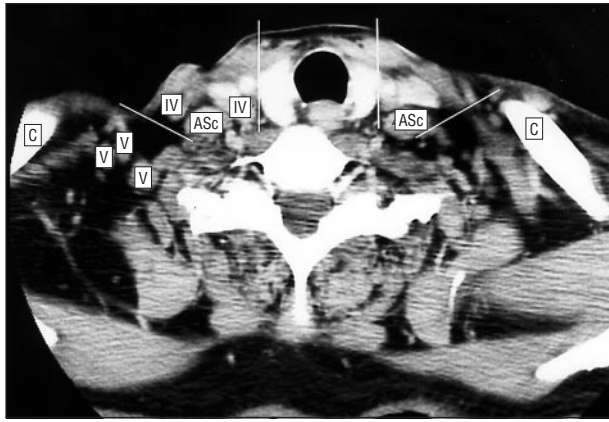


Figure 6. Axial postcontrast computed tomographic scan of the neck through the thyroid gland, caudal to the lower border of the cricoid cartilage arch. Oblique white lines on each side have been drawn from the posterior edge of the sternocleidomastoid muscle to the lateral posterior edge of the anterior scalene muscle (ASc). Vertical lines have also been drawn from the medial edge of each common carotid artery. Nodes anterior to the oblique lines and lateral to the vertical lines are level IV nodes. The nodes posterior to the oblique lines are level V nodes. Level VI nodes are between the common carotid arteries (vertical lines). Note that the level IV nodes in this figure are the prescalene nodes described by Rouviere² and others.^{3,4} The clavicle (C) is identified for reference. The level V nodes in this figure should actually be classified as supraclavicular nodes, as they are at and caudal to the visualized portion of the clavicle.

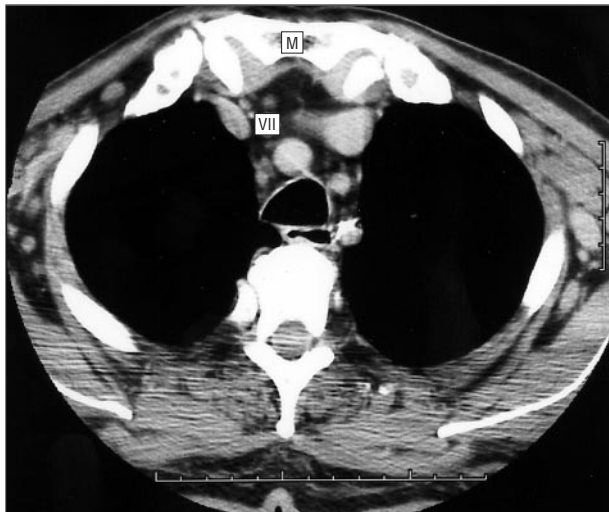


Figure 7. Axial postcontrast computed tomographic scan through the level of the top of the manubrium (M). Caudal to the top of the manubrium, the visceral nodes are classified as level VII. Cranial to this level, the visceral nodes are level VI nodes.

communicate the imaging findings to the clinicians in a mutually acceptable way. This new classification will provide added precision and reproducibility to nodal localization and will enhance the value of the data to be

accumulated in pending multi-institutional studies involving squamous cell carcinoma.²²

Accepted for publication October 13, 1998.

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