Melanoma surgery and the impact of sentinel node biopsy

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Chapter 8

Cadaver study on the location of suboccipital lymph nodes: guidance for suboccipital node dissection

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ABSTRACT

Objectives: To provide anatomical guidance for the extent (technique) of suboccipital node dissection.

Methods: Five human cadaver necks (nine sides) were studied. Boundaries were the superior nuchal line and external occipital protuberance (cranial), the nuchal ligament (medial), an imaginary line through C7 (caudal) and the posterior wall of the auditory channel (anterior). The overlying skin and complete thickness of the cranial part of the trapezius muscle and fascia sheath was included (deep).

Results: An average number of 4 lymph nodes per suboccipital side were found. Diameters ranged from 1 to 6 mm. Twenty nodes (63%) were located in the subcutaneous tissue, twelve (37%) were found just underneath the superficial fascia of the trapezius muscle.

Conclusion: Suboccipital nodes are small and mainly located in the subcutaneous layer, with a minority just underneath the superficial fascia of the trapezius muscle. This anatomical knowledge was used to redesign the suboccipital dissection.
INTRODUCTION

Early detection of lymph node metastases offers the best chance of regional control and survival in patients with malignant scalp lesions. Sentinel node biopsy is a useful tool to detect these metastases and is also of prognostic value.[1-4] With the introduction of sentinel node biopsy, more insight in lymphatic drainage patterns of cutaneous head and neck malignancies has been gained.[5-8] The lymphatic drainage pathways were found to be unpredictable in this area. A melanoma in the head and neck region tends to drain to more than one lymph node level, to multiple sentinel nodes close together and to contralateral lymph node basins.[8-13]

In a recent analysis of 65 patients with a head and neck melanoma, 10% of the sentinel nodes were found in the suboccipital region, which is a remarkably high number.[14] The literature provides little information on the surgical anatomy of the (sub)occipital region and on the surgical procedures in this area. We could not retrieve information on the number and location of suboccipital lymph nodes in the literature. The aim of the study was to provide guidance for the extent (technique) of suboccipital node dissection based on the lymph node anatomy.

MATERIALS AND METHODS

Cadavers

This study was performed on nine halves of superficial neck tissue specimens from five cadavers. The embalmed cadavers had been fixated in formalin (4.0%) and frozen. The dissection was performed within five days after defrosting. The dissection specimens were photographed before and after excision.

Anatomic boundaries

The dissections were carried out by two experienced head and neck surgeons (WMCK and PJFML). The anatomic extent of the specimens was defined in advance to obtain uniform results. To encompass the complete suboccipital region the boundaries of the dissection were the superior nuchal line and external occipital protuberance (cranial border), the nuchal ligament (medial border), an imaginary line through C7 (caudal border), the posterior wall of the auditory channel (anterior border) and the complete thickness of the upper part of the trapezius muscle and fascia sheath (deep border).[15] The overlying skin was included in order to determine the distance between the epidermis and the subcutaneous lymph
nodes. The specimen was dissected from the periost of the mastoid and the insertion sites of
the sternocleidomastoid and origin of the trapezius muscle (Figure 1). Adhering to common
terminology, the term suboccipital is used to indicate the caudal part of the occipital region.

![Image](image_url)

**Figure 1.** The dissection specimens stained, cut in 3-4 mm slices and numbered.

**Pathology and analyses**
The dissection specimens were first macroscopically analysed for the presence of lymph
nodes. The specimens were then painted superficially for orientation, cut into 3 - 4 mm
slices and numbered (Figure 1). From these 3 - 4 mm slices, thinner slices of approximately
1 - 2 mm were obtained for microscopic evaluation and these were stained using a standard
haematoxylin and eosin solution. The head and neck pathologist (MLFvV) and head and neck
surgeon (WMCK) analysed the microscopy slides together. The exact location of each retrieved
lymph node was established and mapped.
RESULTS

Macroscopic analysis of the dissection specimens revealed only one lymph node in each cadaver side. The other lymph nodes were easily discovered in the microscopy slides (Figure 2). A total of 32 lymph nodes were found in the nine specimens, with a mean number of four lymph nodes per specimen (range: 2 - 7) (Figure 2). Twenty lymph nodes (63%) were located in the subcutaneous tissue. These nodes were located at the average distance of 7 mm (range: 4 mm - 14 mm) from the epidermis. The remaining twelve lymph nodes (37%) were found just underneath the superficial fascia of the trapezius muscle (Figure 3). The longest diameter of the 32 suboccipital lymph nodes ranged from 1 to 6 mm, with a mean of 3 mm. The average maximum size of the subcutaneous lymph nodes was 3 mm (range: 1 mm - 6 mm) and the average size of the lymph nodes underneath the fascia was 4 mm (range: 1 mm - 6 mm).

Figure 2. Anatomical location of all 32 lymph nodes (red dots) found in the suboccipital region in nine cadaver sides. All lymph nodes are projected to the left side.
Figure 3. Lymph node of 4 mm in diameter located just underneath the fascia of the trapezius muscle. The black arrows indicate the different histological layers.

DISCUSSION

This is the first study on suboccipital lymph node mapping using histology in order to provide knowledge on the anatomy of this region and refine the design of its dissection. A mean number of four lymph nodes per suboccipital side were found. Compared to other regions of the neck, the number of lymph nodes in the suboccipital region is small as they comprise around 12% of the total number harvested by (modified) radical neck dissection.\[13,14,16\] Most lymph nodes (63%) in the suboccipital region were located in the subcutaneous tissue. The majority of these suboccipital lymph nodes had a small diameter ranging from 1 to 6 mm in diameter, with a mean of 3 mm, which implies that these lymph nodes can be easily overlooked during an operation. Another interesting finding was that 37% of the lymph nodes were found just underneath the superficial fascia of the trapezius muscle, demonstrating that the cranial part of the trapezius muscle should be resected as well. Elsewhere in the neck, lymph nodes are not situated in the subcutaneous layer, with exception of the lymph nodes along the facial artery and the ones along the external jugular vein over the sternocleidomastoid muscle.
In a recent study, Pan et al radiologically visualized the suboccipital lymphatic anatomy in human cadavers by injecting head and neck lymphatic vessels with a radio-opaque lead oxide mixture.[17] Their results are in line with our findings and they visualized an average of six suboccipital collecting lymph vessels in each specimen draining to their first-tier lymph nodes in the subcutaneous tissue.

Studies describing the anatomic boundaries for suboccipital lymph node dissection in patients with a malignant scalp lesion are scarce. The posterolateral neck dissection, including a suboccipital dissection was first described in 1962 by Rochlin et al.[18] Apart from performing a classic radical neck dissection they also removed the cranial part of the trapezius muscle and underlying lymph node bearing tissue. They advocated this dissection for the management of metastatic disease from cutaneous malignancies of the scalp, the retro-auricular area, the suboccipital area and the neck that could metastasize to the posterior triangle. In 1993, Plukker et al further described this technique in a group of 21 patients with a head and neck malignancy of whom 19 had a melanoma.[19] Their suboccipital dissection begins with removal of the retro-auricular and suboccipital nodes along the occipital artery, which has to be sacrificed. The trapezius muscle is separated from the superior nuchal line to the level of C3-C4, and the cranial portion of the muscle is then horizontally transected cranial to the entry of the accessory nerve. By retracting the splenius capitis muscle anteriorly it is possible to remove the deep lymph node-bearing fibro-fatty tissue in the suboccipital region. In 1996, Diaz et al gave a detailed description of the posterolateral procedure with removal of the deeper located suboccipital lymph nodes.[20] However, Plukker nor Diaz removed the subcutaneous lymph nodes, which requires a careful dissection of a relatively thin suboccipital skin flap.

It is difficult to provide a clear description of the suboccipital dissection, because of the lack of precisely defined anatomical landmarks. Based on our anatomical findings, we refined the suboccipital dissection design as follows. The dissection can be performed in continuity with a (modified) radical neck dissection or a selective neck dissection, removing levels II–V. The use of a hockey-stick incision is preferred with extension to the retro-auricular region and from there into a horizontal direction towards the occiput (Figure 4). A thin suboccipital skin flap should be made, as all lymph nodes are located deeper than 3 mm in the underlying subcutaneous fat. The caudal boundary of the suboccipital dissection is where the lateral border of the splenius capitis muscle meets the lateral border of the trapezius muscle (Figure 5). At this point, the trapezius muscle is incised in a coronal plane towards the midline in the
ligamentum nuchae. The dissection is then continued in cranial direction until the occipital protuberans. From there, both the trapezius and sternocleidomastoid muscle are detached from the occipital bone from medial to lateral to the posterior wall of the external ear canal, starting two cm cranial of the occipital protuberans and thereby including the retro-auricular lymph nodes. During this phase of the dissection, the occipital artery should be identified and ligated. The trapezius muscle, including fascia sheath and surrounding fibro-fatty tissue should be dissected from the splenius capitis muscle and retracted laterally (Figure 6). The suboccipital tissues should stay in continuity with the (modified) radical or selective neck dissection specimen.

![Figure 6](image_url)  
*Figure 6. A hockey-stick incision with extension to the retro-auricular region and from there in a horizontal direction towards the occiput (dotted line). A: sternocleidomastoid muscle. B: trapezius muscle.*

In conclusion, the suboccipital area contains two to seven lymph nodes that are small and mainly located in the subcutaneous layer, with a minority just underneath the superficial fascia of the trapezius muscle. This surgical anatomical knowledge is of importance for a proper design of a suboccipital lymph node dissection in patients with malignant scalp lesions.
Figure 5.a. The caudal boundary of the suboccipital dissection is where the lateral border of the splenius capitis muscle meets the lateral border of the trapezius musculus (dotted line). A: trapezius muscle. B: splenius capitis muscle. C: sternocleidomastoid muscle. D: occipital artery.

Figure 5.b. The red horizontal line in the lower image represents a detailed overview of a pathology slice, which shows the location of a lymph node just underneath the trapezius muscle.
Figure 6. The trapezius musculus, including the fascia sheath and the surrounding fibro-fatty tissue is carefully dissected from the splenius capitis muscle and retracted laterally and is opened like a book. A: trapezius muscle. B: splenius capitis muscle. C: sternocleidomastoid muscle. D: occipital artery ligated.
REFERENCES

