Neck Dissection and Parotidectomy for Melanoma

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Contents

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Abstract

Head and neck melanomas are a surgical and medical challenge. Facial anatomy and its lymphatic drainage are complex and often unpredictable. To balance oncologic clearance with morbidity, surgeons must be familiar with the anatomy of the head and neck region, possible patterns of nodal drainage, and regions of potential anatomic danger. Unless facial surgery is part of a surgeon's common practice, facial nerve injury and soft tissue embarrassment can result. Although head and neck melanomas are treated similarly to other body regions, they are often underrepresented in clinical trials, making extrapolation difficult. Thus, the surgeon must be aware of current clinical data and tailor care to each individual patient. The goal of this chapter is to review head and neck lymphatics, discuss relevant surgical techniques, and review clinical evidence relating to sentinel node biopsy and

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complete neck dissection in head and neck melanomas.

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Head and Neck Lymphatics and Their Impact on Melanoma Outcomes

Cephalization in animals is an ancient evolutionary adaptation in which the mouth, major sense organs, and the majority of neural tissue become concentrated at the front end of an animal, producing a distinct head. The concentration of these tissues in one anatomic location has made the head and neck region of Bilateria, an animal phylum that contains the majority of animal species including humans, the most complex in the body. This complexity is mirrored in the lymphatics of the head and neck, as approximately one third of all lymph nodes in the body are located in this region.

While lymph nodes and lymphatic vessels were described in ancient times by Hippocrates and Herophilos, later anatomists such as Gaspar Asellius and Antony Nuck rediscovered the lymphatic system in the seventeenth century (Subramanian et al. 2007). In 1787, Paolo Mascagni published the first detailed anatomic description of the lymphatic system, which was updated in 1909 by Poirer and then specifically described for the head and neck by H.A. Trotter in 1930.

The classification system accepted throughout the majority of the twentieth century for lymph nodes in the head and neck was established by Rouviere. This system classified cervical nodes into groups in distinct anatomic locations that are roughly oriented in horizontal (submental, facial, submandibular, parotid, mastoid, occipital, and superficial cervical) and vertical, deep planes (anterior and posterior cervical). The advantage of this system was that it established the relationship between the nodal levels in relation to adjacent anatomic structures.

A simplified system more congruent with the surgical technique for neck dissection, in which numerical levels are assigned for different nodal groups, was adopted by Shah et al. (1981). Rather than searching for and removing nodes in a discontinuous fashion from different zones of the neck, a neck dissection follows fascial planes in a systematic way to remove lymph node-bearing tissue. This technique minimizes the chance that a node in a given anatomic zone will be missed, allows for greater standardization, and minimizes the effect of variables such as the amount of fat in the tissue that can alter the efficiency of nodal removal.

This system was updated and expanded by classification systems from the American Academy of Otolaryngology and the American Joint Committee on Cancer dividing the lymph node-bearing basins into levels that are more easily described when standardizing surgery and the delivery of radiotherapy. A neck dissection classification update by the American Head and Neck Society and the American Academy of Otolaryngology-Head and Neck Surgery in 2002 delineates these nodal levels and can be compared to the anatomic correlates in the TNM atlas for lymph nodes of the neck (Robbins et al. 2002; Hermanek et al. 1988; Gregoire et al. 2014). Lymph nodes in areas not delineated by numbered levels are described anatomically and include superior mediastinal nodes, retropharyngeal nodes, periparotid nodes, buccinator nodes, postauricular nodes, and suboccipital nodes.

Any discussion on lymphatic drainage, clinically demonstrated with lymphoscintigraphy, would be remiss not to acknowledge the important work done by Dr. Roger Uren and Dr. Hayley Reynolds. Without their pioneering work, it would be impossible to preoperatively predict the location of sentinel nodes, especially in a region as complex as the head and neck (Uren 2004; Reynolds et al. 2009; de Wilt et al. 2004). In two studies investigating drainage patterns from head and neck melanoma, bilateral drainage was found to be rare – occurring approximately 10% of the time with drainage to sentinel lymph nodes following expected patterns of anatomy (Suton et al. 2012). On the contrary, Lin et al. found that the rate of discordance was high with sentinel lymph nodes identified by lymphoscintigraphy in areas that were not clinically predicted to be at risk as well as areas that are not typically dissected during standard neck dissections such as the postauricular region (Lin et al. 2006). The discordancy is highest in the head and neck for melanoma with at least 36% of cases showing at least one sentinel lymph node in an area that would not be clinically predicted compared to discordance rates of 25% for melanomas of the trunk and 13% for melanomas of the extremities (Leong et al. 1999). Another study found drainage to unexpected nodal regions in 13 of 51 patients with 18 of 51 patients having parotid metastases (Fincher et al. 2004). One study in patients undergoing parotidectomy and neck dissection for head and neck cutaneous melanoma demonstrated that parotid disease was associated with high likelihood of occult neck disease in greater than 40% of patients (Suton et al. 2012). These authors further recommended a posterior lymphadenectomy for melanomas in the scalp and posterior neck (see also chapter ► "Lymphoscintigraphy in Patients with Melanoma").

More recently, a 2013 update by Gregoire et al. divided the neck into 10 nodal groups creating levels for these areas that are at risk of regional metastasis from malignancies arising in the skin (Gregoire et al. 2014). This system is in many ways more useful for the treatment of nodal disease in melanoma. The original six levels of the neck were described and optimized to standardize neck dissections for metastatic disease from the upper aerodigestive tract. Therefore, nodal levels most likely to be involved with metastatic disease from these areas were included, and many levels such as the parotid and postauricular nodes which are often involved with melanoma were excluded in formal definition of levels with the prior neck dissection classification system. This comprehensive updated description is useful for melanoma since in addition to cutaneous sites, melanoma can very occasionally present in the orbit, nasal cavity, sinuses, and oral cavity as well. Figure 1 and Table 1 demonstrate these nodal levels as well as the areas they receive drainage from. Clearly, an understanding of the complex drainage

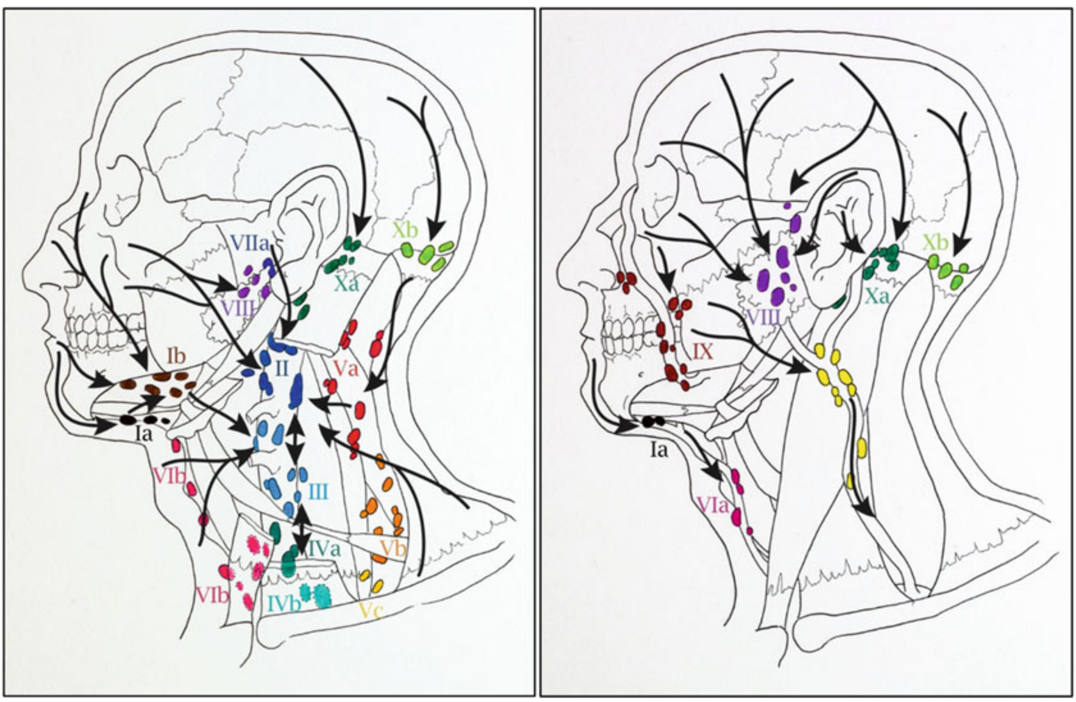

Fig. 1 Nodal levels of the head and neck. (Adapted from Gregoire modification of nodal levels from the American Head and Neck Society and the American Academy of Otolaryngology-Head and Neck Surgery * illustrations by Anna Tomkies)

Table 1 Nodal levels of the head and neck. Adapted from Gregoire modification of nodal levels from the American Head and Neck Society and the American Academy of Otolaryngology-Head and Neck Surgery

Level	Anatomic location	Receives drainage from
Ia	Submental group	Chin, lower lip, tip of tongue, anterior floor of mouth
Ib	Submandibular group	Midface, level Ia, inferior nasal cavity, palate, alveolar ridge, cheek, lips, anterior tongue
II	Upper jugular group	Face, parotid, levels Ia and Ib, retropharyngeal nodes, nasal cavity, pharynx, larynx, external auditory canal, middle ear, sublingual submandibular glands
III	Middle jugular group	Levels II and V, retropharyngeal and pre- and paratracheal nodes, pharynx, larynx, thyroid
IVa	Lower jugular group	Levels III and V, retropharyngeal and pre- and paratracheal nodes, pharynx, larynx, thyroid
IVb	Medial supraclavicular group	Levels Iva and Vc, pre- and paratracheal nodes, hypopharynx, esophagus, larynx, trachea, thyroid
V	Posterior triangle group	
Va	Upper posterior triangle nodes	Occipital and parietal scalp, skin of lateral and posterior neck and shoulder, occipital and retroauricular nodes, nasopharynx, pharynx, thyroid
Vb	Lower posterior triangle nodes	Occipital and parietal scalp, skin of lateral and posterior neck and shoulder, occipital and retroauricular nodes, nasopharynx, pharynx, thyroid
Vc	Lateral supraclavicular group	Levels Va and Vb
VI	Anterior compartment group	
VIa	Anterior jugular nodes	Lower face anterior neck skin
VIb	Prelaryngeal, pretracheal, and paratracheal nodes	Anterior floor of mouth, tip of tongue, lower lip, thyroid, larynx, pharynx, esophagus
VII	Prevertebral compartment group	
VIIa	Retropharyngeal nodes	Nasopharynx, soft palate
VIIb	Retro-styloid nodes	Nasopharynx
VIII	Parotid group	Forehead, temporal scalp, eyelid, orbit, auricle, ear canal, tympanic membrane, nasal cavity, nasopharynx
IX	Bucco-facial group	Nose, eyelids, cheek
X	Posterior skull group	
Xa	Retroauricular and subauricular nodes	Posterior auricle, ear canal, scalp posterior to ear canal
Xb	Occipital nodes	Posterior scalp

patterns from these sites in the head and neck is essential for sentinel lymph node biopsy and the prediction of metastases when treating melanoma (see also chapters ▶ "Biopsy of the Sentinel Lymph Node" and ▶ "Lymphoscintigraphy in Patients with Melanoma").

Neck Dissection and Parotidectomy for Melanoma

Regional lymph node metastasis represents the most significant prognostic factor in early stage melanoma (Morton et al. 1991; Gershenwald et al. 1999; Balch et al. 2001). Given the potential morbidity of elective nodal dissection, sentinel lymph node biopsy was developed and now represents the standard of care for identifying patients with clinically occult metastatic melanoma (Balch et al. 2000; Morton et al. 2006). In patients with primary melanoma located in the head and neck region, surgical management may entail either sentinel lymph node biopsy in the parotid gland and/or neck to identify clinically occult disease or therapeutic parotidectomy and/or neck dissection in patients with clinically apparent regional disease. In the evolving era of effective systemic therapies, considerations regarding type and extent of surgery represent topics of increasing debate among melanoma providers. This is particularly evident among

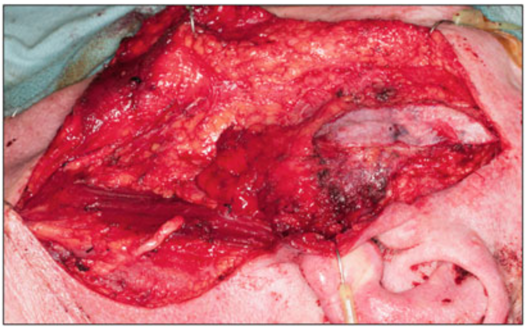

Fig. 2 Axial and coronal SPECT-CT images demonstrating utility of differentiating sentinel nodes in the superficial parotid versus deep parotid/upper level II. (Picture courtesy of Dr. Goepfert)

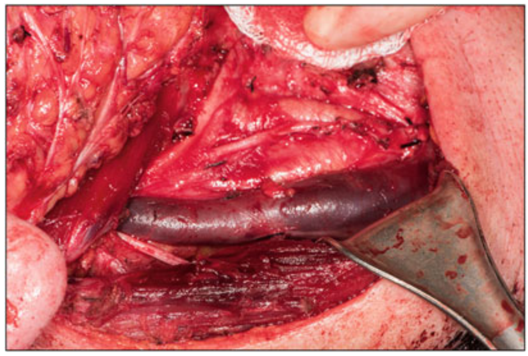

Fig. 3 Resection of incision of previously narrowly excised melanoma overlying parotid gland. (Picture courtesy of Dr. Goepfert)

head and neck surgeons who may be reluctant to risk compromising locoregional control by not performing completion parotidectomy and/or cervical lymphadenectomy (Faries et al. 2017).

Classically, primary cutaneous lesions anterior to a line bisecting the ear canal drain to lymphatic channels in the parotid gland and anterior neck levels I–IV. Routine use of single-photon emission computed tomography-computed tomography (SPECT-CT) has improved preoperative localization of sentinel lymph nodes in three dimensions (Van Der Ploeg et al. 2009; Zender et al. 2014; Chapman et al. 2016) (Fig. 2). The vast majority of lymph nodes in the parotid gland are located in the superficial lobe (superficial to the facial nerve), and it is very rare to have a cutaneous lesion drain to the deep lobe of parotid as a first echelon site on lymphoscintigraphy (McKean et al. 1985). Though the nerve cannot be seen as it courses through the parotid gland, use of the retromandibular vein can give an approximation of the delineation between superficial and deep lobes to aid in surgical planning (Divi et al. 2005). For sentinel nodes in the superficial lobe, gentle blunt dissection will locate the node without need for facial nerve identification (Ollila et al. 1999; Samra et al. 2012). Moreover, concomitant use of radiotracer and blue dye can further assist with rapid and accurate localization of the sentinel node within the parotid parenchyma. In cases where the sentinel node is unable to be located with blunt dissection, a complete superficial parotidectomy with formal dissection of the facial nerve may be considered for diagnostic purposes. Similarly, for patients with primary lesions draining to or through the parotid gland *and* clinically apparent adenopathy in the parotid gland and/or upper neck, a superficial parotidectomy should be performed. Moreover, for lesions overlying the parotid gland, a superficial parotidectomy is sometimes needed for diagnostic and/or therapeutic purposes (Fig. 3). Performance of a total parotidectomy may improve disease control in some patients, but this must be balanced with increased morbidity (Wertz et al. 2017). Every effort should be made to preserve the facial nerve, even for extensive adenopathy and the rare cases of macroscopic nodes deep to the facial nerve.

Completion lymphadenectomy was recently demonstrated to improve regional disease control but not melanoma-specific survival in patients with positive sentinel lymph node biopsies, but these findings have unclear application to melanoma of the head and neck region (Leiter et al. 2016; Faries et al. 2017). Conversely, therapeutic neck dissection for management of metastatic melanoma with clinically apparent neck metastases remains the standard of care though the extent and timing of surgery are a topic of great debate and are evolving along with the increasing use of more effective systemic therapies (Supriya et al. 2014; Faries 2018). The days of a uniform approach with modified radical neck dissection +/− parotidectomy for clinically apparent disease have passed (Shah et al. 1991). Similar to the decision-making for parotidectomy regarding lymphatic drainage anterior or posterior to a line bisecting the ear canal, the levels of neck dissection should vary. Primary lesions on the face or

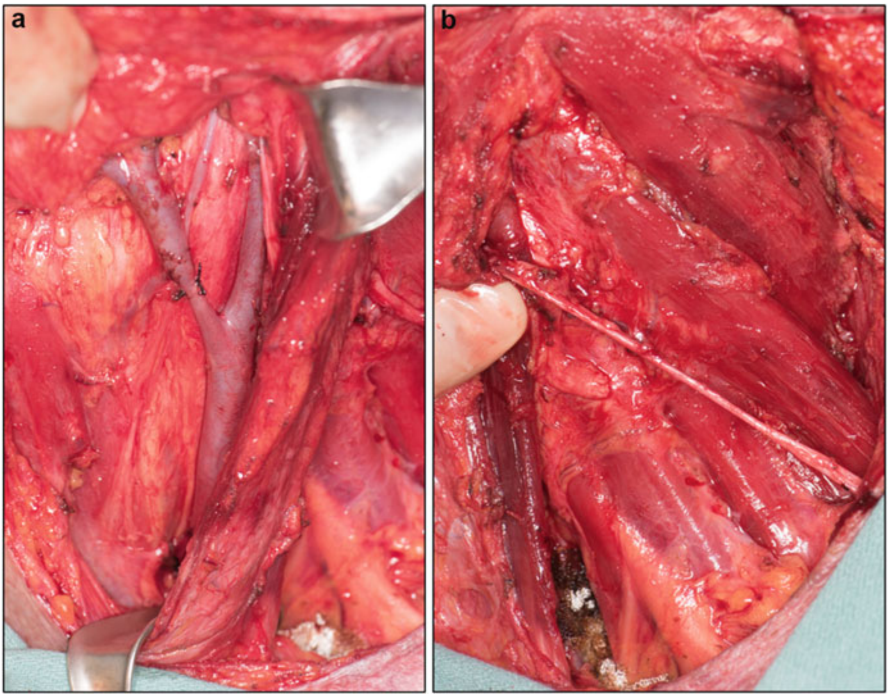

Fig. 4 Superficial parotidectomy with level I-III neck dissection for anterior face melanoma. (Picture courtesy of Dr. Goepfert)

scalp anterior to the ear with clinically apparent metastases in general should have dissection of the perifacial nodes and levels I-III/IV in addition to a superficial parotidectomy (Fig. 4). On the other hand, primary lesions on the upper neck or scalp posterior to the ear in general should have dissection of levels II–V, as well as suboccipital nodes for scalp lesions (Fig. 5). In all situations, the decision about whether to include level IIb is controversial, but our general approach is to dissect level IIb if we are performing a neck dissection, particularly for primary lesions of the scalp, ear, or periauricular regions, or if there is adjacent macroscopic disease (Creighton et al. 2016).

Surgical planning in melanoma has become increasingly multidisciplinary given the introduction of neoadjuvant and adjuvant therapeutic approaches. However, several principles regarding sentinel node biopsy, parotidectomy, and neck dissection remain useful. Sentinel node incisions should be planned along incision lines for parotidectomy and/or neck dissection should these procedures eventually be required. Parotidectomy incisions are most often made in

Fig. 5 Posterolateral levels II-IV (**a**) and level V (**b**) neck dissection for scalp melanoma. (Picture courtesy of Dr. Goepfert)

a preauricular crease and curve around the lobule toward the postauricular area into a natural neck skin crease (Fig. 6). The postauricular portion of the incision should not extend too far cephalad prior to curving into a skin crease; otherwise the blood supply may be compromised causing skin necrosis (Fig. 7). Skin flap elevation over the parotid gland should split the fat ("fat up, fat down") and avoid becoming too thin, exposing the sweat glands, and increasing the risk or severity of Frey's syndrome (gustatory sweating)

Fig. 6 Standard parotidectomy incision. (Picture courtesy of Dr. Goepfert)

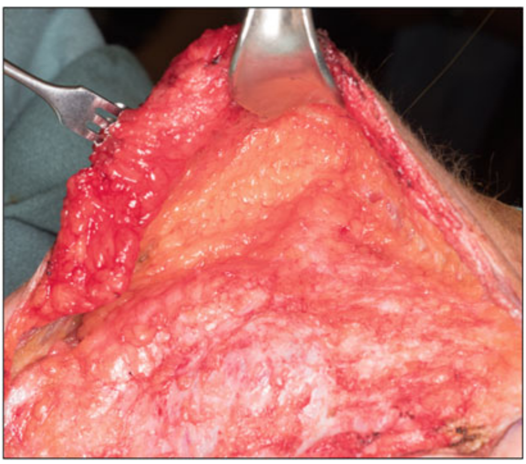

Fig. 7 Necrosis of superior skin tip. (Picture courtesy of Dr. Goepfert)

(Durgut et al. 2013) (Fig. 8). Facial nerve identification should be undertaken in every parotidectomy. Standard landmarks including the tragal pointer, posterior belly of digastric, and tympanomastoid suture line should be used to locate the facial nerve, while use of a facial nerve monitoring system is dependent on surgeon preference (Fig. 9). In our experience, use of a nerve monitor can be helpful in the setting of

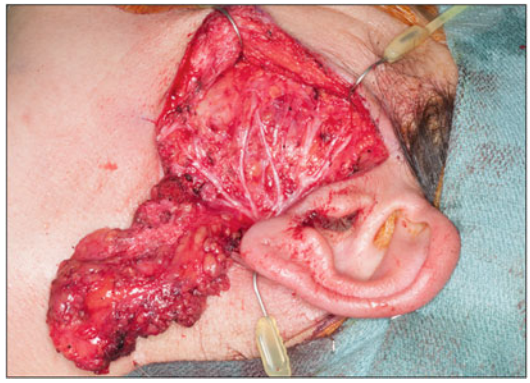

Fig. 8 Skin flap elevation should avoid being too thin to expose the sweat glands and lessen the risk of Frey syndrome. (Picture courtesy of Dr. Goepfert)

surgical training for feedback regarding the degree of nerve stimulation during dissection.

In the case of patients treated with neoadjuvant therapy with radiologic evidence to support response to treatment, our burgeoning experience is in favor of a more selective neck dissection with great effort to preserve nerves and blood vessels even despite intimate association with apparent gross nodal disease (Hodi et al. 2016; Raigani et al. 2017). In such patients, the intraoperative appearance of the nodal disease may be indistinguishable from patients who have never received neoadjuvant therapy, yet final pathology often demonstrates sheets or aggregates of pigmented macrophages without evidence of viable melanoma. In either case, decisions on the extent of surgical resection for patients with regional metastases must be made with multidisciplinary support and must carefully balance locoregional control and accurate staging with surgical morbidity (Faries 2018).

Technique for Neck Dissection and Parotidectomy

Surgical removal of clinically palpable nodes is termed a *therapeutic neck dissection*, whereas removal of clinically negative nodes is elective or *prophylactic neck dissection*. Comprehensive or modified radical neck dissection involves complete dissection of all five neck levels, whereas selective neck dissection involves dissection of

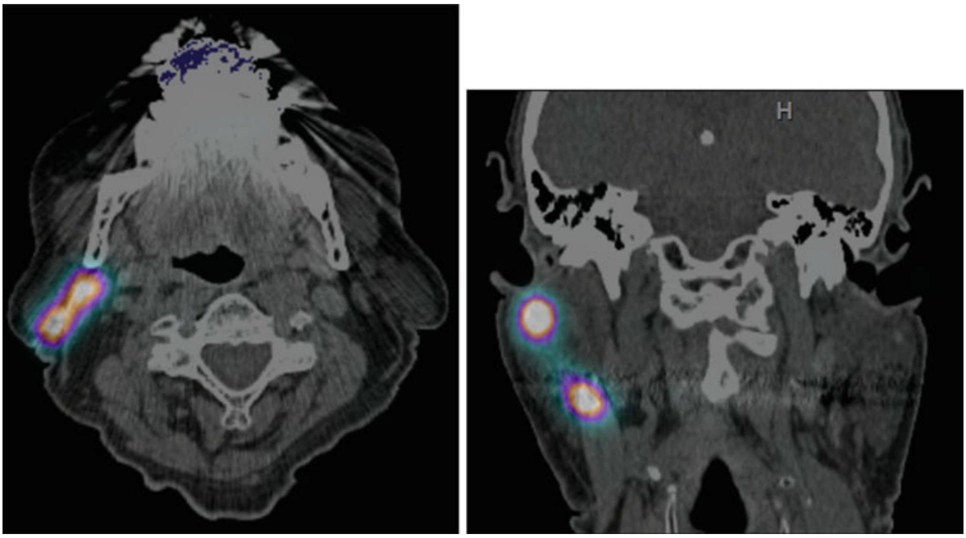

Fig. 9 Identification of all branches of the facial nerve. (Picture courtesy of Dr. Goepfert)

only certain node levels or groups. According to this terminology, the only dissection that requires no additional description is *radical neck dissection*. This dissection involves removal of the lymph nodes of all five levels, along with the internal jugular vein, the spinal accessory nerve, and the sternocleidomastoid muscle. For other comprehensive dissections, it must be specified which structures should be preserved (in modified radical neck dissection) or additionally removed (in extended radical neck dissection).

A number of descriptions of neck dissections can be found in standard surgical texts. Our preferred technique will be described in this section, but the final selection of an incision and overall conduct of the operation will depend on the surgeon's personal preference, experience, and training. The patient's presentation will also influence the selection of a technique. Previous incisions, skin grafts, and other surgical procedures must be taken into account when planning the operation.

In patients with clinical evidence of cervical nodal metastasis, a therapeutic neck dissection including levels I to V is indicated. Most often a therapeutic neck dissection is a modified radical neck dissection that spares the sternocleidomastoid muscle, the internal jugular vein, and the spinal accessory nerve.

The initial steps in planning the operation are the most important in avoiding poor outcomes. Planning the skin incision is the starting point for avoiding problems. Patients who have had previous operations will have preexisting scars that must be taken into account. Failure to carefully evaluate this will lead to parallel incision lines, which can result in poor healing and wound dehiscence.

The incision is marked with a skin marker. Once the incision lines are marked on the neck, it is useful to infiltrate the skin and subcutaneous tissue with a local anesthetic mixed with epinephrine, 1:100,000 or 1:200,000, to minimize bleeding when the skin is incised. Many options are available for acceptable incisions that provide adequate exposure. One such incision is the *lazy-S* incision, which is initiated with a transverse incision beginning at the mastoid process and running across the lateral neck approximately two fingerbreadths below the inferior border of the mandible. The exact position of the incision should be adjusted so that it will fall in a natural skin crease. The incision should be designed so that dehiscence would not lead to disastrous exposure of the underlying vessels. A vertical incision is carried from the transverse incision to the midpoint of the clavicle in a lazy-S configuration. The gentle curve of the incision will help to decrease the incidence of scar contracture that is often seen with straight-line incisions. The transverse incision is opened through the skin, subcutaneous tissue, and platysma muscle, and the vertical incision is incised. Care should be exercised to avoid injury to the external jugular vein; it will be resected at a later point in the operation. The skin flaps are elevated with the use of skin hooks to control the tissue and avoid the crushing or scarring that can occur with standard forceps.

Another option for incision design is the *hockeystick* or *J-incision*. The J-incision employs a vertical incision extending along the posterior aspect of the sternocleidomastoid muscle from the mastoid apex to 2 cm above the clavicle, which is then curved in the horizontal plane parallel to the bottom edge of the cricoid cartilage and extending medially to the point where the sternocleidomastoid muscle is attached to the clavicular head. A host of other incisions have been described in the literature and have been safely and successfully employed for exposure in neck dissection. These can be used at the discretion and comfort of the surgeon. However, the basic techniques of gentle tissue handling apply in all cases.

The operation begins in the posterior triangle (level V). There is no platysma posterior to the sternocleidomastoid muscle. This makes the plane of dissection a bit more technically sensitive as far as the thickness of the flaps is concerned. As the superior flap is raised, care is taken to stay on the sternocleidomastoid muscle to avoid injury to the parotid gland. The inferior flap is raised, and the great auricular nerve is identified. The spinal accessory nerve exits deep to the sternocleidomastoid muscle approximately 1 cm cephalad to the greater auricular nerve. The flap is now raised at the level of the superficial layer of the deep cervical fascia. Care must be taken to avoid injury to the spinal accessory nerve. The soft tissue flap is elevated in a cephalad direction to the mastoid process. A cautery is used to minimize bleeding, and the lateral edge of the trapezius muscle is identified. The muscle is quite superficial, and care must be taken to avoid "buttonholing" the flap. Once the edge of the muscle is identified, a curved clamp is placed along the edge of the muscle, and the tissue is divided by means of cautery. The spinal accessory nerve traverses the lateral neck to enter the trapezius at the junction of its middle and inferior third. This dissection should stay just dorsal to the edge of the muscle. As the junction of the middle and inferior thirds is approached, careful spreading of the fat will reveal the accessory nerve. Now that this is identified, the remainder of the flap can be elevated to the clavicle. The nerve is freed of its investing fascia using a nerve hook and sharp tissue scissors. Bipolar cautery is preferred to standard unipolar cautery for this portion of the dissection because it is more controlled and less likely to result in nerve injury caused by current transmission and heat conduction. The nerve is freed to the point where it exits from the posterior border of the sternocleidomastoid muscle. All of the fibrofatty node-bearing tissue is dissected from the posterior triangle of the neck starting high, at the mastoid process. The fascia overlying the muscles, starting with the splenius capitis, is elevated with the cautery. This dissection proceeds in a caudal direction. The accessory nerve is retracted off of the tissue, and the specimen is passed deep to it. The soft tissue in the lower portion of level V is elevated from lateral to medial. Numerous veins and small vessels will be found in this supraclavicular fat pad. The transverse cervical artery and vein are identified, ligated, and divided. The posterior belly of the omohyoid muscle is identified. The muscle is freed of its investing fascia so it can be retracted. This muscle is an important landmark in the lower neck. It lies superficial to the brachial plexus and the phrenic nerve as it crosses the anterior scalene muscle.

On the left side of the neck, in the area where the internal jugular vein passes deep to the omohyoid muscle, the thoracic duct enters in the vicinity of its junction with the subclavian vein. The fat contains numerous lymphatic channels and nodes. There is significant potential for lymphatic leakage. The soft tissue in this area is best managed by division between clamps and then ligation to avoid lymphatic leakage. Now that level V has been dissected, the specimen is elevated to the posterior aspect of the internal jugular vein in the lower neck. Numerous spinal roots will be encountered as they pass between the paraspinous muscles into the fat of the posterior triangle. An attempt should be made to preserve the motor roots. The sensory roots will be divided as they exit the neck to provide sensation to the upper chest and shoulder area. These areas of cutaneous numbness will improve over time, with significant return of feeling.

The operation is now directed to the upper portion of the sternocleidomastoid muscle at its insertion into the mastoid process. The investing fascia is elevated from the muscle using the cautery. In the upper neck, the muscle is retracted posteriorly, and spreading the soft tissue in the area of the angle of the mandible, superficial to the internal jugular vein, will reveal the posterior belly of the digastric muscle, an important landmark in the upper neck. The internal jugular vein passes just deep to the digastric muscle, and the eleventh cranial nerve is usually found lying on or immediately posterior to the vein. The nerve is freed of its investing tissue and elevated with a nerve hook. The bipolar cautery is used to mobilize the tissue of level IIb and pass it under the spinal accessory nerve. Now, with the use of a curved clamp, the fibrofatty, node-bearing tissue is elevated and divided with the cautery. The sternocleidomastoid muscle is completely freed from its fascia so that it can be retracted away from the surgical bed. The dissection moves from cephalad to caudad. The roots of the cervical plexus are identified, and an attempt is made to preserve as many of the motor roots as possible. Many of the sensory roots will need to be divided. The sternocleidomastoid muscle is completely freed of investing fascia and elevated. The specimen from the posterior neck is passed deep to the muscle. The omohyoid muscle is retracted so that level IV can be accessed. The entire specimen is now gradually elevated off of the internal jugular vein. *As* the dissection comes anterior to the internal jugular vein, the common facial vein is ligated and divided. The descendens hypoglossi is identified just anterior to the vein and preserved in an effort to maintain motor function to the strap muscles. The omohyoid muscle is followed up to the hyoid bone with cautery. The submental triangle is entered, and the nodal tissue is elevated off of the mylohyoid muscle. The anterior belly of the digastric muscle is identified. The superior soft tissue flap is elevated staying close to the deep surface of the platysma muscle. As the caudal edge of the submandibular salivary gland is approached, the operation slows, and careful spreading in the soft tissue will reveal the marginal mandibular branch of the facial nerve directly on the capsule of the salivary gland. The nerve is dissected with sharp scissors and/or bipolar cautery and retracted upward with the upper skin flap. Another technique would be to identify the posterior facial vein, ligate and divide it, and reflect the stump up with the skin flap, and the nerve will be safely found between the stump of the vein and the platysma muscle. Once the nerve is out of the way, the soft tissue at the inferior border of the mandible is divided. The facial artery and vein are ligated and divided. The dissection now proceeds from anterior to posterior. The anterior belly of the digastric muscle is retracted, and cautery is used to elevate the tissue off of the mylohyoid muscle until the posterior edge is identified. A number of veins will be encountered, and they should be ligated. A small retractor is used to retract the mylohyoid anteriorly. This will allow access to the submandibular triangle. The gland is freed and carefully retracted inferiorly. The lingual nerve is identified deep to the gland. The secretory motor fibers are identified, ligated, and divided. The gland can now be further retracted exposing Wharton's duct and the hypoglossal nerve. The duct should be clamped and divided only after the hypoglossal nerve is identified as it crosses deep to the digastric tendon. This will avoid inadvertent injury to the nerve. Once the duct is divided, the gland can be elevated with the use of a curved clamp and cautery. The proximal facial artery is divided and suture ligated. The entire specimen can be elevated and delivered in one piece. The soft tissue is carefully labeled for the pathologist. Levels I to V should be indicated with sutures or other markers. A Valsalva maneuver is used to check for hemostasis. The flaps are closed in multiple layers over a closed suction drain, taking care to reapproximate the platysma muscle.

Elective dissections of levels I to III or I to IV are essentially equivalent and should be combined with a superficial parotidectomy for melanomas of the anterior scalp, face, and anterior upper neck. Level IV should be included when the dissection is being carried out for clinical disease in level I. This procedure can be carried out through a single, large cervicofacial incision. Elevation of the skin flap should be carried out with care in the submandibular region because the marginal mandibular nerve may be injured at this site.

The neck dissection involves preservation of the sternocleidomastoid muscle, internal jugular vein, and spinal accessory nerve and begins with division of the investing layer of fascia along the posterior half of the sternocleidomastoid muscle. This fascia is elevated, releasing the sternocleidomastoid muscle, which is retracted posteriorly, allowing dissection onto the deep surface of the muscle. The external jugular vein and great auricular nerve are usually divided. Dissection on the deep surface of the sternocleidomastoid muscle continues until the posterior border of the muscle is reached. The branches of the cervical plexus form the deep plane of the dissection as they pass laterally behind the posterior border of the sternocleidomastoid muscle.

Level III is dissected first, and the jugulo-omohyoid node should be identified and removed. Dissection proceeds cephalad, and at level II, the upper end of the sternocleidomastoid muscle is retracted posteriorly, allowing careful dissection of the tissue around the spinal accessory nerve and the upper end of the internal jugular vein. When a parotidectomy is to be included, the facial nerve should then be identified and the parotidectomy carried out next. The lymph nodes of the submandibular triangle, which lie in relation to the facial vessels as they cross the jaw, should then be removed, but this may be left as the last step to minimize the risk of injury to the marginal mandibular branch of the facial nerve.

The other common selective procedure involves dissection of levels II to V for posteriorly situated melanomas. This may be a therapeutic procedure when involved nodes are present in the posterior triangle and the primary lesion is located on the posterior scalp. The procedure should include removal of the occipital nodes because these may be a site of subsequent recurrence. Selective dissections of levels III to V may be carried out through a single incision across the lower neck, but, as is the case for all dissections for melanoma, the nodes in the investing fascia at the upper third of the sternocleidomastoid muscle should be included.

The supraclavicular area is rich in lymph nodes that may be involved with metastatic disease from a primary melanoma of the anterior or posterior thorax, upper extremity, or head and neck. Patients with extensive nodal disease in the axilla may also exhibit disease extending into the neck. The operation will address nodes at risk in levels III, IV, and V. The area is approached with a collar incision, and usually no other incision is needed. The spinal accessory nerve will need to be identified as soon as the skin flaps are elevated. The nerve is freed of its investing fascia and elevated so that the specimen can be safely passed under it. The dissection then proceeds to the clavicle. The lower portion of level IV, where the internal jugular vein joins the subclavian vein, is an area that requires careful attention. This area should be cleared of all nodes in an effort to avoid recurrence in a difficult location. As mentioned earlier, the confluence of the internal jugular vein and subclavian vein on the left side is the location of the thoracic duct. The tissue in this area will need to be clamped, divided, and ligated.

Frequently the standard preauricular incision that is carried into the neck will need to be incorporated into a neck dissection incision to allow for an adequate cervical lymphadenectomy. This is especially true when clinical disease is present because parotidectomy should be accompanied by a neck dissection, allowing removal of all at-risk nodes. The incision should be carefully marked in a preauricular skin crease and then carried into the neck by curving it around the tail of the parotid gland. The incision line is injected with local anesthetic with epinephrine I:100,000. It is then best to wait a few minutes until the skin begins to blanch. This will greatly improve hemostasis at the skin edge.

The skin flap is elevated directly on the parotid fascia, a thick white layer of tissue that is readily identified. If fat is present on the deep plane, dissection is not deep enough. If parotid tissue is seen, the fascia has been violated, and the dissection plane is too deep. The tail of the parotid gland should now be elevated from the sternocleidomastoid muscle, and that muscle should be retracted posteriorly. Further dissection deep to the parotid gland will allow identification of the posterior belly of the digastric muscle. This is a useful landmark because it has its origin on the deep surface of the mastoid process, which in turn assists with identification of the facial nerve.

The parotid gland is separated from the cartilaginous auditory canal. This is easily done with a clamp and cautery. This proceeds until the junction of the bony and cartilaginous canal is reached. The parotid tail is elevated from the posterior belly of the digastric muscle. Gentle anterior traction is placed on the gland. A fine curved clamp is used to spread the gland at the point of the digastric origin on the mastoid process. The glandular tissue is separated and carefully divided with bipolar electrocautery. The main trunk will be found approximately 1 cm into the gland.

Once the main trunk of the facial nerve has been identified, the dissection is slowly carried out to identify the bifurcation of the upper and lower divisions. There is great variability in the anatomy of the extracranial facial nerve. Care must be taken to confirm that the main trunk of the facial nerve has truly been identified. The dissection is carried out in a plane just superficial to the nerve. A very fine curved clamp is used to gently spread the tissue, and bipolar cautery is used to divide the tissue in an absolutely bloodless field. Dissection proceeds toward the periphery, keeping the nerve in constant view between the tines of the clamp. The superficial temporal artery and vein may need to be ligated and divided. As the cephalad portion of the dissection is completed, the gland is reflected caudad, and the buccal branches are carefully identified. These branches often run parallel to Stensen's duct. Once the duct is identified, it should be ligated and divided. The dissection of the lower division of the nerve proceeds in a similar manner until the gland is totally freed and delivered.

Removal of the deep lobe, which is rarely required, begins just as the superficial parotidectomy is begun. Once the superficial lobe is removed, the main trunk of the facial nerve is carefully dissected from investing tissue and is mobilized. The deep lobe is mobilized using blunt dissection and bipolar cautery to eventually be passed under the nerve. A closed suction drain is placed, and the flaps are carefully reapproximated. The wound is closed in multiple interrupted layers, and a subcuticular suture is used to close the skin. No dressings are needed, but a thin film of antibiotic ointment can be placed on the incision line.

Completion Lymph Node Dissection Utility in Head and Neck Melanoma

The role of a sentinel lymph node biopsy (SLNB) and the merit of performing a completion lymph node dissection (CLND) in melanoma were investigated in the multicenter selective lymphadenectomy trials (MSLT-I and II) and the German DeCOG-SLT trial. However, head and neck melanomas, despite representing 18% of all primary melanomas, were underrepresented or not included in these studies (Lachiewicz et al. 2008). (See also chapter ▶ "Biopsy of the Sentinel Lymph Node.")

The first Multicenter Selective Lymphadenectomy Trial (MSLT-I), published in 2014, randomized patients with a primary melanoma to observation or SLNB of their nodal basin. In the observation arm, nodal dissection was only performed if and when lymph node metastases became clinically evident. In the SLNB group, SLNB was performed at the time of wide-local excision with immediate lymph node dissection if positive. Importantly, the proportion of head and neck melanomas in this study was not indicated. At 5 years, the hazard ratio (HR) for recurrence in head and neck melanoma patients assigned to SLNB was 1.08, and the HR for death from melanoma in this group was 1.18, neither of which was statistically significant (Morton et al. 2006). At 10 years, these HRs were both 1.2, still not reaching statistical significance. The 10-year analysis importantly demonstrated in subset analysis that in patients with intermediate-thickness melanoma (1.2–3.5 mm), early CLND after positive SLNB improved 10-year distant disease-free and melanoma-specific survival (Morton et al. 2014).

The second Multicenter Selective Lymphadenectomy Trial (MSLT-II), published in 2017, randomized patients with a positive SLNB to undergo either CLND or observation with frequent nodal ultrasound examination. This was an international, randomized, phase three trial conducted at 63 centers and involving 1939 patients with a median follow-up of 43 months. Both dissection and observation groups consisted of 13.7% head and neck melanomas, lower than the incidence rate of 18% of new melanomas. This study demonstrated that while immediate CLND impacted staging and regional disease control by reducing the rate of regional nodal recurrence by 69% (HR 0.31; 95% CI 0.24–0.41, $p < 0.001$) compared to delayed CLND, it did not provide a survival benefit. When compared to the arm/leg subsites, the HR in the head and neck subgroup for melanoma-related deaths was 0.81 (not significant) in the dissection group and 1.6 ($p = 0.07$) in the observation group. However, due to the small sample size, this may have reached significance with an increased number of patients (Faries et al. 2017).

Another important clinical trial, published in 2016, a German phase three multicenter randomized control trial (RCT) (DeCOG-SLT), while underpowered, also showed no difference in survival in SLNB-positive patients treated with CLND compared with observation only (Leiter et al. 2016). However, the head and neck melanoma subsite was an exclusion criterion for this study.

The fact that head and neck melanomas are often underrepresented in or excluded from clinical trials investigating the utility of CLND has led some to believe that head and neck melanoma patients may be more likely to benefit from CLND. If the determination of performing a CLND is to be based on SLNB status, the head and neck region makes this difficult, as the accuracy of the SLNB may be less reliable. There are over 300 lymph nodes in the head and neck (Hyde and Prvulovich 2002), and lymphatic drainage is unpredictable and discordant and can be bilateral to multiple nodal levels (Even-Sapir et al. 2003; Uren 2004; Wells et al. 1994; Chao et al. 2003; Morton et al. 1993; Shah et al. 1991; Garbe et al. 1995; Albertini et al. 1996; O'brien et al. 1995; Leong et al. 1999; Eberbach et al. 1987; Lin et al. 2006; Klop et al. 2011; Macneill et al. 2005; Teltzrow et al. 2007). With the complex anatomy of the head and neck, surgical inexperience can result in an inability to identify the correct node(s) (Scoggins et al. 2010). From an imaging standpoint, the close proximity of the primary lesion to the nodes can mask the radioactive signal, and the parotid uptake of free technetium can lead to a high background signal (Carlson et al. 2000; Eicher et al. 2002; Jansen et al. 2000). A recent publication calculated the false-negative rate (FNR) in the literature for head and neck melanoma SLNB using the formula FN/TP + FN. FNR ranged from 0 to 50%, with an average of 22.4% (Knackstedt et al. 2018). Thus, it is difficult to base the decision on whether or not to perform a CLND based on the status of the SLNB if the reliability of the biopsy is questionable. (See also chapter ► "Lymphoscintigraphy in Patients with Melanoma.")

Conclusion

Head and neck melanomas are a surgical challenge due to the complex anatomy of the facial region and its unpredictable nodal drainage. When managing these patients, surgeons must be thoroughly familiar with the anatomy of the head and neck region, possible patterns of nodal drainage, and regions of potential danger to anatomical structures. Head and neck melanomas are treated with the same guiding principles as melanomas of other regions; however, they are often underrepresented in clinical trials. Treatment of head and neck melanoma must balance the need for oncologic control with the risk of surgical morbidity. As clinical trials continue to guide treatment paradigms for melanoma, it will be crucial to ensure that head and neck melanomas are appropriately represented in order to determine the best strategies for patient care.

References

Albertini JJ, Cruse CW, Rapaport D, Wells K, Ross M, Deconti R, Berman CG, Jared K, Messina J, Lyman G, Glass F, Fenske N, Reintgen DS (1996) Intraoperative radio-lympho-scintigraphy improves sentinel lymph node identification for patients with melanoma. Ann Surg 223:217–224

Balch CM, Soong S, Ross MI, Urist MM, Karakousis CP, Temple WJ, Mihm MC, Barnhill RL, Jewell WR, Wanebo HJ, Harrison R (2000) Long-term results of a multi-institutional randomized trial comparing prognostic factors and surgical results for intermediate thickness melanomas (1.0 to 4.0 mm). Intergroup Melanoma Surgical Trial. Ann Surg Oncol 7:87–97

Balch CM, Soong SJ, Gershenwald JE, Thompson JF, Reintgen DS, Cascinelli N, Urist M, McMasters KM, Ross MI, Kirkwood JM, Atkins MB, Thompson JA, Coit DG, Byrd D, Desmond R, Zhang Y, Liu PY, Lyman GH, Morabito A (2001) Prognostic factors analysis of 17,600 melanoma patients: validation of the American Joint Committee on Cancer melanoma staging system. J Clin Oncol 19:3622–3634

Carlson GW, Murray DR, Greenlee R, Alazraki N, Fry-Spray C, Poole R, Blais M, Hestley A, Vansant J (2000) Management of malignant melanoma of the head and neck using dynamic lymphoscintigraphy and gamma probe-guided sentinel lymph node biopsy. Arch Otolaryngol Head Neck Surg 126:433–437

Chao C, Wong SL, Edwards MJ, Ross MI, Reintgen DS, Noyes RD, Stadelmann WK, Lentsch E, McMasters KM, Sunbelt Melanoma Trial G (2003) Sentinel lymph node biopsy for head and neck melanomas. Ann Surg Oncol 10:21–26

Chapman BC, Gleisner A, Kwak JJ, Hosokawa P, Paniccia A, Merkow JS, Koo PJ, Gajdos C, Pearlman NW, McCarter MD, Kounalakis N (2016) SPECT/CT improves detection of metastatic sentinel lymph nodes in patients with head and neck melanoma. Ann Surg Oncol 23:2652–2657

Creighton F, Bergmark R, Emerick K (2016) Drainage patterns to nontraditional nodal regions and level IIB in cutaneous head and neck malignancy. Otolaryngol Head Neck Surg (United States) 155:1005–1011

de Wilt JH, Thompson JF, Uren RF, Ka VS, Scolyer RA, McCarthy WH, O'Brien CJ, Quinn MJ, Shannon KF (2004) Correlation between preoperative lymphoscintigraphy and metastatic nodal disease sites in 362 patients with cutaneous melanomas of the head and neck. Ann Surg 239(4):544–52

Divi V, Fatt MA, Teknos TN, Mukherji SK (2005) Use of cross-sectional imaging in predicting surgical location of parotid neoplasms. J Comput Assist Tomogr 29:315–319

Durgut O, Basut O, Demir UL, Ozmen OA, Kasapoglu F, Coskun H (2013) Association between skin flap thickness and Frey's syndrome in parotid surgery. Head Neck 35:1781–1786

Eberbach MA, Wahl RL, Argenta LC, Froelich J, Niederhuber JE (1987) Utility of lymphoscintigraphy in directing surgical therapy for melanomas of the head, neck, and upper thorax. Surgery 102:433–442

Eicher SA, Clayman GL, Myers JN, Gillenwater AM (2002) A prospective study of intraoperative lymphatic mapping for head and neck cutaneous melanoma. Arch Otolaryngol Head Neck Surg 128:241–246

Even-Sapir E, Lerman H, Lievshitz G, Khafif A, Fliss DM, Schwartz A, Gur E, Skornick Y, Schneebaum S (2003) Lymphoscintigraphy for sentinel node mapping using a hybrid SPECT/CT system. J Nucl Med 44:1413–1420

Faries MB (2018) Completing the dissection in melanoma: increasing decision precision. Ann Surg Oncol 25:585–587

Faries MB, Thompson JF, Cochran AJ, Andtbacka RH, Mozzillo N, Zager JS, Jahkola T, Bowles TL, Testori A, Beitsch PD, Hoekstra HJ, Moncrieff M, Ingvar C, Wouters M, Sabel MS, Levine EA, Agnese D, Henderson M, Dummer R, Rossi CR, Neves RI, Trocha SD, Wright F, Byrd DR, Matter M, Hsueh E, Mackenzie-Ross A, Johnson DB, Terheyden P, Berger AC, Huston TL, Wayne JD, Smithers BM, Neuman HB, Schneebaum S, Gershenwald JE, Ariyan CE, Desai DC, Jacobs L, McMasters KM, Gesierich A, Hersey P, Bines SD, Kane JM, Barth RJ, McKinnon G, Farma JM, Schultz E, Vidal-Sicart S, Hoefer RA, Lewis JM, Scheri R, Kelley MC, Nieweg OE, Noyes RD, Hoon DSB, Wang HJ, Elashoff DA, Elashoff RM (2017) Completion dissection or observation for sentinel-node metastasis in melanoma. N Engl J Med 376:2211–2222

Fincher TR, O'brien JC, McCarty TM, Fisher TL, Preskitt JT, Lieberman ZH, Stephens JF, Kuhn JA (2004) Patterns of drainage and recurrence following sentinel lymph node biopsy for cutaneous melanoma of the head and neck. Arch Otolaryngol Head Neck Surg 130:844–848

Garbe C, Buttner P, Bertz J, Burg G, D'hoedt B, Drepper H, Guggenmoos-holzmann I, Lechner W, Lippold A, Orfanos CE et al (1995) Primary cutaneous melanoma. Prognostic classification of anatomic location. Cancer 75:2492–2498

Gershenwald JE, Thompson W, Mansfield PF, Lee JE, Colome MI, Tseng CH, Lee JJ, Balch CM, Reintgen DS, Ross MI (1999) Multi-institutional melanoma lymphatic mapping experience: the prognostic value of sentinel lymph node status in 612 stage I or II melanoma patients. J Clin Oncol 17:976–983

Gregoire V, Ang K, Budach W, Grau C, Hamoir M, Langendijk JA, Lee A, Le QT, Maingon P, Nutting C, O'sullivan B, Porceddu SV, Lengele B (2014) Delineation of the neck node levels for head and neck tumors: a 2013 update. DAHANCA, EORTC, HKNPCSG, NCIC CTG, NCRI, RTOG, TROG consensus guidelines. Radiother Oncol 110:172–181

Hermanek P, Scheibe O, Spiessl B, Wagner G (1988) The TNM classification of malignant tumors: the new 1987 edition. Hautarzt 39:120

Hodi FS, Hwu W-J, Kefford R, Weber JS, Daud A, Hamid O, Patnaik A, Ribas A, Robert C, Gangadhar TC, Joshua AM, Hersey P, Dronca R, Joseph R, Hille D, Xue D, Li XN, Kang SP, Ebbinghaus S, Perrone A, Wolchok JD (2016) Evaluation of immune-related response criteria and RECIST v1.1 in patients with advanced melanoma treated with pembrolizumab. J Clin Oncol 34:1510–1517

Hyde N, Prvulovich E (2002) Is there a role for lymphoscintigraphy and sentinel node biopsy in the management of the regional lymphatics in mucosal squamous cell carcinoma of the head and neck? Eur J Nucl Med Mol Imaging 29:579–584

Jansen L, Nieweg OE, Kapteijn AE, Valdes Olmos RA, Muller SH, Hoefnagel CA, Kroon BB (2000) Reliability of lymphoscintigraphy in indicating the number of sentinel nodes in melanoma patients. Ann Surg Oncol 7:624–630

Klop WM, Veenstra HJ, Vermeeren L, Nieweg OE, Balm AJ, Lohuis PJ (2011) Assessment of lymphatic drainage patterns and implications for the extent of neck dissection in head and neck melanoma patients. J Surg Oncol 103:756–760

Knackstedt RW, Couto RA, Gastman B (2018) Indocyanine green fluorescence imaging with lymphoscintigraphy for sentinel node biopsy in head and neck melanoma. J Surg Res 228:77–83

Lachiewicz AM, Berwick M, Wiggins CL, Thomas NE (2008) Survival differences between patients with scalp or neck melanoma and those with melanoma of other sites in the Surveillance, Epidemiology, and End Results (SEER) program. Arch Dermatol 144:515–521

Leiter U, Stadler R, Mauch C, Hohenberger W, Brockmeyer N, Berking C, Sunderkotter C, Kaatz M, Schulte KW, Lehmann P, Vogt T, Ulrich J, Herbst R, Gehring W, Simon JC, Keim U, Martus P, Garbe C (2016) Complete lymph node dissection versus no dissection in patients with sentinel lymph node biopsy positive melanoma (DeCOG-SLT): a multicentre, randomised, phase 3 trial. Lancet Oncol 17:757–767

Leong SP, Achtem TA, Habib FA, Steinmetz I, Morita E, Allen RE, Kashani-Sabet M, Sagebiel R (1999) Discordancy between clinical predictions vs lymphoscintigraphic and intraoperative mapping of sentinel lymph node drainage of primary melanoma. Arch Dermatol 135:1472–1476

Lin D, Franc BL, Kashani-Sabet M, Singer MI (2006) Lymphatic drainage patterns of head and neck cutaneous melanoma observed on lymphoscintigraphy and sentinel lymph node biopsy. Head Neck 28:249–255

Macneill KN, Ghazarian D, McCready D, Rotstein L (2005) Sentinel lymph node biopsy for cutaneous melanoma of the head and neck. Ann Surg Oncol 12:726–732

McKean ME, Lee K, McGregor IA (1985) The distribution of lymph nodes in and around the parotid gland: an anatomical study. Br J Plas Surg 38:1–5

Morton DL, Wanek L, Nizze JA, Elashoff RM, Wong JH (1991) Improved long-term survival after lymphadenectomy of melanoma metastatic to regional nodes. Analysis of prognostic factors in 1134 patients from the John Wayne Cancer Clinic. Ann Surg 214:491–499; discussion 499–501

Morton DL, Wen DR, Foshag LJ, Essner R, Cochran A (1993) Intraoperative lymphatic mapping and selective cervical lymphadenectomy for early-stage melanomas of the head and neck. J Clin Oncol 11:1751–1756

Morton DL, Thompson JF, Cochran AJ, Mozzillo N, Elashoff R, Essner R, Nieweg OE, Roses DF, Hoekstra HJ, Karakousis CP, Reintgen DS, Coventry BJ, Glass EC, Wang HJ, Group M (2006) Sentinel-node biopsy or nodal observation in melanoma. N Engl J Med 355:1307–1317

Morton DL, Thompson JF, Cochran AJ, Mozzillo N, Nieweg OE, Roses DF, Hoekstra HJ, Karakousis CP, Puleo CA, Coventry BJ, Kashani-sabet M, Smithers BM, Paul E, Kraybill WG, Mckinnon JG, Wang HJ, Elashoff R, Faries MB, GROUP M (2014) Final trial report of sentinel-node biopsy versus nodal observation in melanoma. N Engl J Med 370: 599–609

O'brien CJ, Uren RF, Thompson JF, Howman-Giles RB, Petersen-Schaefer K, Shaw HM, Quinn MJ, McCarthy WH (1995) Prediction of potential metastatic sites in cutaneous head and neck melanoma using lymphoscintigraphy. Am J Surg 170:461–466

Ollila DW, Foshag LJ, Essner R, Stern SL, Morton DL (1999) Parotid region lymphatic mapping and sentinel lymphadenectomy for cutaneous melanoma. Ann Surg Oncol 6:150–154

Raigani S, Cohen S, Boland GM (2017) The role of surgery for melanoma in an era of effective systemic therapy. Curr Oncol Rep 19:17

Reynolds HM, Smith NP, Uren RF, Thompson JF, Dunbar PR (2009) Three-dimensional visualization of skin lymphatic drainage patterns of the head and neck. Head Neck 31(10):1316–25

Robbins KT, Clayman G, Levine PA, Medina J, Sessions R, Shaha A, Som P, Wolf GT, American Head and Neck Society and the American Academy of Otolaryngology-Head and Neck Surgery (2002) Neck dissection classification update: revisions proposed by the American Head and Neck Society and the American Academy of Otolaryngology-Head and Neck Surgery. Arch Otolaryngol Head Neck Surg 128:751–758

Samra S, Sawh-Martinez R, Tom L, Colebunders B, Salameh B, Truini C, Ariyan S, Narayan D (2012) A targeted approach to sentinel lymph node biopsies in the parotid region for head and neck melanomas. Ann Plast Surg 69:415–417

Scoggins CR, Martin RC, Ross MI, Edwards MJ, Reintgen DS, Urist MM, Gershenwald JE, Sussman JJ, Dirk Noyes R, Goydos JS, Beitsch PD, Ariyan S, Stromberg AJ, Hagendoorn LJ, McMasters KM (2010) Factors associated with false-negative sentinel lymph node biopsy in melanoma patients. Ann Surg Oncol 17:709–717

Shah JP, Strong E, Spiro RH, Vikram B (1981) Surgical grand rounds Neck dissection: current status and future possibilities. Clin Bull 11:25–33

Shah JP, Kraus DH, Dubner S, Sarkar S (1991) Patterns of regional lymph node metastases from cutaneous melanomas of the head and neck. Am J Surg 162:320–323

Subramanian S, Chiesa F, Lyubaev V, Aidarbekova A, Brzhezovskiy V (2007) The evolution of surgery in the management of neck metastases. Acta Otorhinolaryngol Ital 27:309–316

Supriya M, Narasimhan V, Henderson MA, Sizeland A (2014) Managing regional metastasis in patients with cutaneous head and neck melanoma – is selective neck dissection appropriate? Am J Otolaryngol Head Neck Med Surg 35:610–616

Suton P, Luksic I, Muller D, Virag M (2012) Lymphatic drainage patterns of head and neck cutaneous melanoma: does primary melanoma site correlate with anatomic distribution of pathologically involved lymph nodes? Int J Oral Maxillofac Surg 41:413–420

Teltzrow T, Osinga J, Schwipper V (2007) Reliability of sentinel lymph-node extirpation as a diagnostic method for malignant melanoma of the head and neck region. Int J Oral Maxillofac Surg 36:481–487

Uren RF (2004) Lymphatic drainage of the skin. Ann Surg Oncol 11:179S–185S

Van Der Ploeg IMC, Valdés Olmos RA, Kroon BBR, Wouters MWJM, Van den brekel MWM, Vogel WV, Hoefnagel CA, Nieweg OE (2009) The yield of SPECT/CT for anatomical lymphatic mapping in patients with melanoma. Ann Surg Oncol 16:1537–1542

Wells KE, Cruse CW, Daniels S, Berman C, Norman J, Reintgen DS (1994) The use of lymphoscintigraphy in melanoma of the head and neck. Plast Reconstr Surg 93:757–761

Wertz AP, Durham AB, Malloy KM, Johnson TM, Bradford CR, Mclean SA (2017) Total versus superficial parotidectomy for stage III melanoma. Head Neck 39:1665–1670

Zender C, Guo T, Weng C, Faulhaber P, Rezaee R (2014) Utility of SPECT/CT for periparotid sentinel lymph node mapping in the surgical management of head and neck melanoma. Am J Otolaryngol Head Neck Med Surg 35:12–18