39 Inguinal Node Dissection

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Despite ongoing clinical experience, treatment of squamous cell carcinoma of the penis remains primarily surgical. Early meticulous surgical management with close follow-up typically provides the best opportunity for cure. The most important factor determining survival in patients with penile cancer is the extent of lymph node metastases (Johnson and Lo, 1984; Srinivas et al, 1987; Ravi, 1993; Horenblas and van Tinteren 1994). The management of the inguinal lymph nodes therefore is a major component of the overall treatment strategy, and appropriate decision making with regard to lymph node assessment and excision is critical.

ANATOMIC CONSIDERATIONS

Penile Lymphatics

Squamous cell carcinoma of the penis spreads initially to regional lymph nodes before the occurrence of distant metastatic disease. Lymphatic spread occurs in a systematic fashion along the normal route of penile lymphatic drainage. The superficial lymphatic system consists of vessels draining the prepuce and skin of the penile shaft that converge dorsally and then divide at the base of the penis to drain into the right and left superficial inguinal nodes. The deep lymphatic system consists of drainage from the glans penis toward the frenulum, where large trunks are formed and encircle the corona to unite with those from the other side on the dorsum. They traverse the penis to the base within the Buck fascia, draining through presymphyseal lymphatics into the superficial inguinal nodes and the deep inguinal nodes of the femoral triangle. It is not uncommon for penile cancer to metastasize to the contralateral inguinal nodes because of crossover in the symphyseal region, and this needs to be taken into account in developing a treatment strategy. Drainage subsequently proceeds from the inguinal nodes to the ipsilateral pelvic lymph nodes. It is generally accepted that penile lymphatics drain to the inguinal nodes before proceeding into the iliac nodes (Riveros et al, 1967), although some anecdotal observations have suggested that penile lymphatics may at times drain directly to the external iliac nodes (Lopes et al, 2000). This observation is most likely related to undersampling of the inguinal nodes at the time of lymphadenectomy or at the time of pathologic review. **Although penile carcinoma metastatic to the inguinal lymph nodes confers a poorer prognosis overall, aggressive lymphadenectomy is associated with improved long-term survival and potential cure** (McDougal et al, 1986; Horenblas and van Tinteren, 1994). In addition, immediate resection of clinically occult lymph node metastases is associated with improved survival when compared with delayed resection of involved nodes at the time of clinical detection (Kroon et al, 2005). If the tumor has spread to the pelvic nodes, long-term survival is less than 10%.

Urethral Lymphatics

Urethral lymphatic drainage runs parallel to the urethra and is located within the mucous membrane and submucosa (Spirin, 1963). **This network is most dense in the area of the fossa navicularis, and these branches join the lymphatics of the glans at the prepuce. The lymphatics of the penile urethra course laterally around the corpora cavernosa to join the vessels proceeding from the glans penis. Bulbar urethral drainage is more variable and may occur along the bulbar artery toward the medial retrofemoral node or may course under the pubis toward the anterior bladder wall, terminating in the retrofemoral and medial external iliac nodes** (Wood and Angermeier, 2010).

Inguinal Anatomy

The inguinal lymph nodes are divided into superficial and deep groups, which are anatomically separated by the fascia lata of the thigh. The superficial group is composed of 4 to 25 lymph nodes that are situated in the deep membranous layer of the superficial fascia of the thigh (Camper fascia). The superficial inguinal nodes have been divided into five anatomic groups (Daseler et al, 1948): (1) central nodes around the saphenofemoral junction, (2) superolateral nodes around the superficial circumflex vein, (3) inferolateral nodes around the lateral femoral cutaneous and superficial circumflex veins, (4) superomedial nodes around the superficial external pudendal and superficial epigastric veins, and (5) inferomedial nodes around the greater saphenous vein (Fig. 39-1). The deep inguinal nodes are fewer and lie primarily medial to the femoral vein in the femoral canal. The node of Cloquet is the most cephalad of this deep group and is situated between the femoral vein and the lacunar ligament (Fig. 39-2). The external iliac lymph nodes receive drainage from the deep inguinal, obturator, and hypogastric groups. In turn, drainage progresses to the common iliac and para-aortic nodes.

The blood supply to the skin of the inguinal region derives from branches of the common femoral artery—the superficial external pudendal, superficial circumflex iliac, and superficial epigastric arteries. Complete inguinal dissection necessitates ligation of these branches. Viability of the skin flaps raised during the dissection depends on anastomotic vessels in the superficial fatty layer of the Camper fascia that course lateral to medial along the natural skin lines. Because lymphatic drainage of the penis to the groin runs beneath the Camper fascia, this layer can be preserved and left attached to the overlying skin when the superior and inferior skin flaps are fashioned. On the basis of this anatomy, a transverse skin incision least compromises this blood supply. In this fashion, serious skin slough is prevented in the majority of patients. The femoral nerve lies deep to the iliacus fascia and supplies motor function to the pectineus, quadriceps femoris, and sartorius muscles. In addition, this nerve provides cutaneous sensation to the anterior thigh and should be preserved. Some of the sensory branches, however, are commonly sacrificed in the regional node dissection.

The femoral triangle is bounded by the inguinal ligament superiorly, the sartorius muscle laterally, and the adductor longus medially. The floor of the triangle is composed of the pectineus muscle medially and the iliopsoas laterally. The location of the saphenofemoral junction is estimated to be at a point two fingerbreadths lateral and two fingerbreadths inferior to the pubic tubercle.

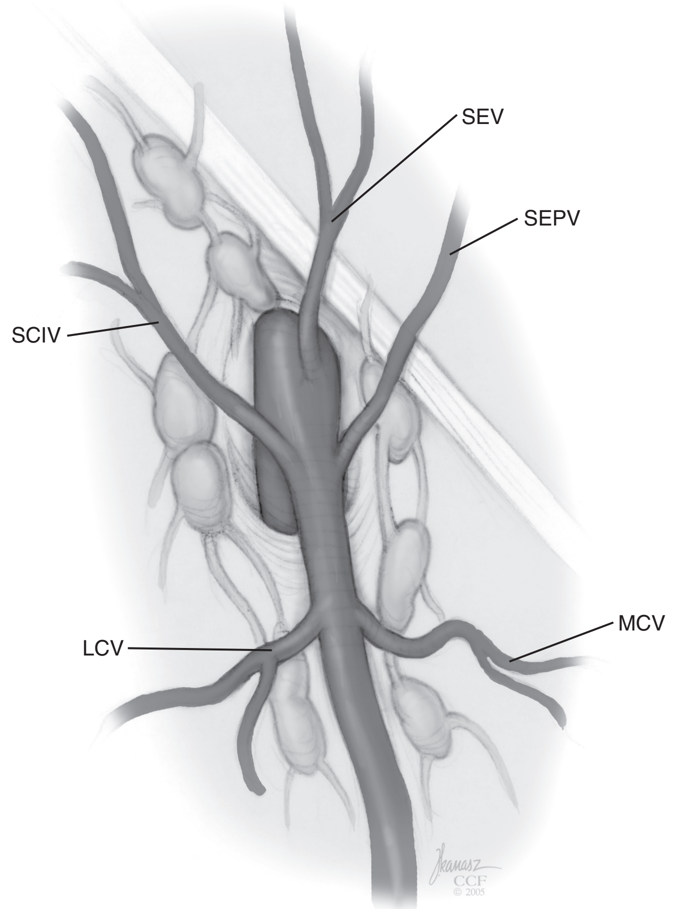

Figure 39-1. **Superficial inguinal lymph nodes and the branches of the saphenous vein. LCV, lateral cutaneous; MCV, medial cutaneous; SCIV, superficial circumflex iliac; SEPV, superficial external pudendal; SEV, superficial epigastric. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2003-2010. All rights reserved.)**

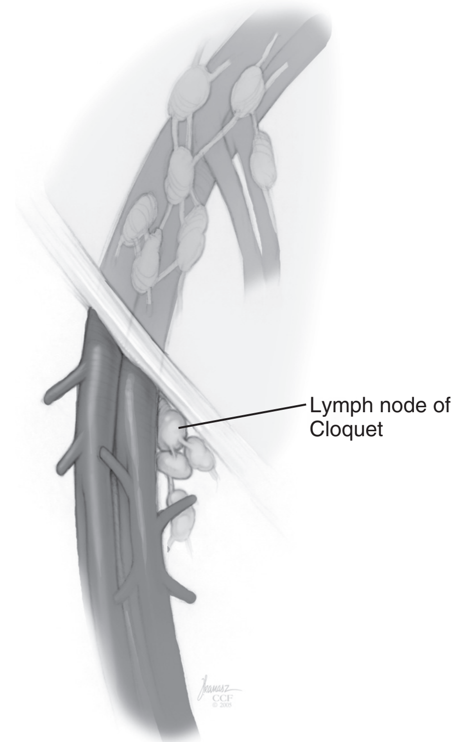

Figure 39-2. **Deep inguinal lymph nodes. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2003-2010. All rights reserved.)**

PENILE CANCER: SURGICAL MANAGEMENT OF REGIONAL LYMPH NODES

Clinically Negative Groins

Approximately 20% of patients with clinically nonpalpable inguinal nodes harbor occult metastases (Hegarty et al, 2006). Routine bilateral inguinofemoral lymph node dissection (IFLND) in these patients would overtreat 80% of them, subjecting them to potential increased morbidity. The optimal form of management would provide the ability to identify patients with metastatic penile cancer in this cohort who are potentially curable with surgical lymphadenectomy while at the same time avoiding unnecessary surgery in patients with pathologically negative inguinal nodes. Strategies to accomplish this include (1) improved prognostic algorithms and risk assessment based on the primary tumor's pathologic and clinical characteristics, (2) improved radiographic techniques, and (3) pathologic sampling of first-echelon nodes.

The indications for surgical assessment of inguinal lymph nodes when there is no palpable adenopathy are covered in Chapter 37. This section will focus on the techniques used for this purpose. The primary goal of these procedures is to accurately determine whether inguinal nodal metastases are present while minimizing patient morbidity.

Sentinel Node Biopsy

Sentinel lymph node biopsy is the technique to remove nodes that are first affected by the spread of metastatic disease. The theory is that certain cancers typically do not spread to other lymph nodes without the necessary and stepwise involvement of the sentinel node first. Based on anatomic studies, the concept of orderly lymphatic progression of metastatic cells from the primary tumor to the sentinel node does seem to be likely with regard to squamous cell carcinoma of the penis. This approach has gained acceptance as this concept has become more widely accepted, and has also proven effective for both breast cancer and melanoma.

The technique of sentinel node biopsy in patients with invasive squamous cell carcinoma of the penis and clinically negative inguinal regions was proposed by Cabanas (1977) after extensive study of lymphangiograms and anatomic dissections. A 5-cm incision is made parallel to the inguinal crease and centered two fingerbreadths lateral and inferior to the pubic tubercle. By insertion of the finger under the upper flap toward the pubic tubercle, the sentinel lymph node is encountered and excised (Fig. 39-3). Cabanas demonstrated that the sentinel node was always positive in patients with positive metastatic inguinal nodes at time of IFLND. In the absence of tumor in the sentinel node, no metastases were found in the other inguinal lymph nodes in 31 patients. In addition, he reported that this node (subsequently termed the *Cabanas node*) was positive in 4% of patients in whom the lymph nodes were not deemed clinically suspicious. It was concluded that routine excision of this sentinel node could identify patients with micrometastatic disease earlier than waiting for clinically palpable nodes, which was standard at the time.

Although Cabanas reported 90% survival in patients with normal findings on sentinel node biopsy, subsequent authors found the results to be less satisfactory, with false-negative rates of 18% to 25% (Perinetti et al, 1980; Wespes et al, 1986;

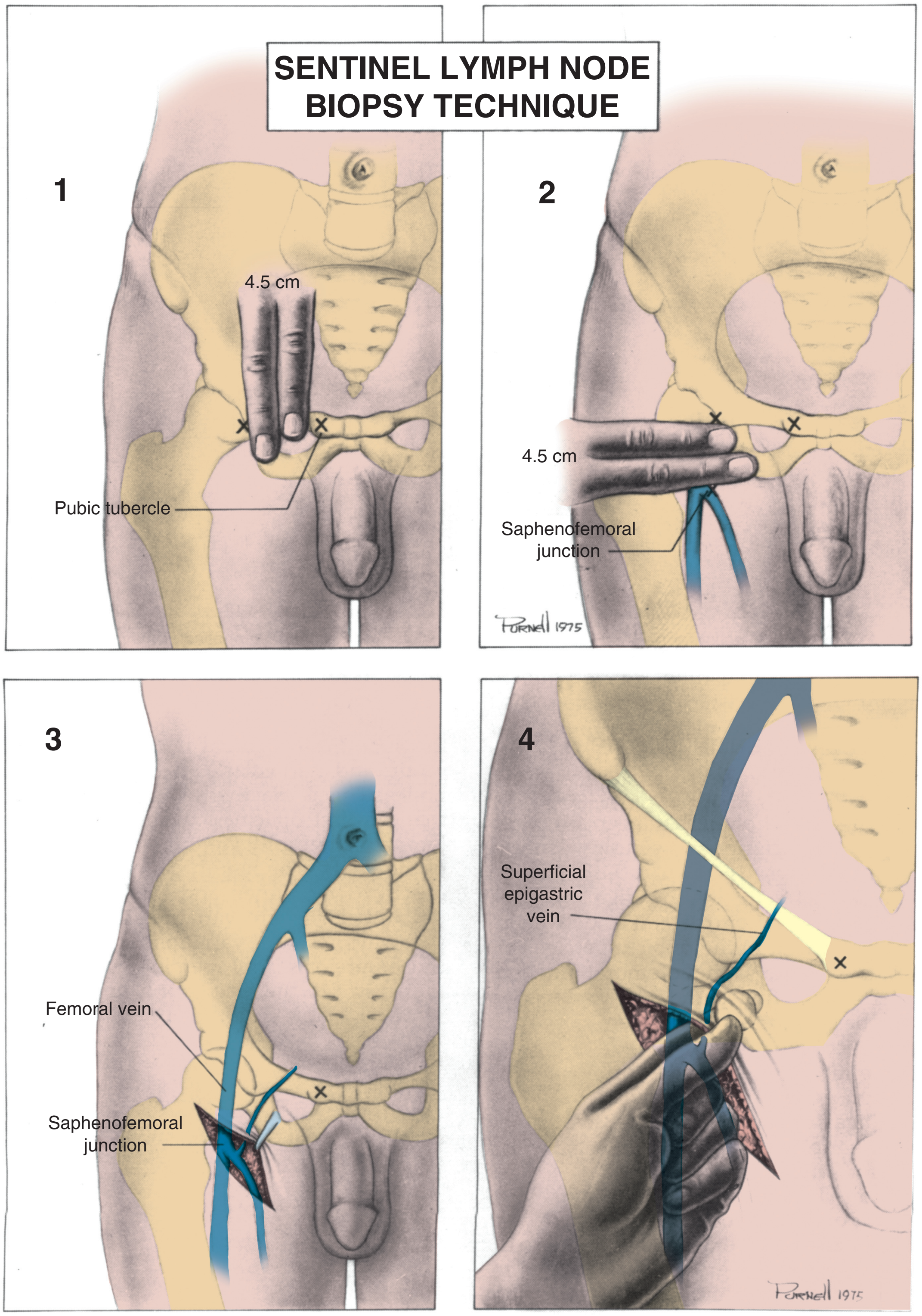

Figure 39-3. Sentinel lymph node biopsy technique as described by Cabanas in 1977. A 5-cm incision is made parallel to the inguinal crease and centered two fingerbreadths lateral and inferior to the pubic tubercle. By insertion of the finger under the upper flap toward the pubic tubercle, the sentinel lymph node is encountered and excised. (From Cabanas RM. An approach for the treatment of penile carcinoma. Cancer 1977;39:456–66.)

Srinivas et al, 1991). In large part, this is likely because this initial concept is based on a static location of the sentinel lymph node. As a result, this procedure is no longer recommended. In an attempt to improve sampling of the superficial nodal basin, Pettaway and colleagues (1995) evaluated extended sentinel node biopsy, during which all of the lymph nodes between the inguinal ligament and the superficial external pudendal vein were removed. This approach has also been abandoned because it resulted in a false-negative rate of 15% to 25% (Ravi, 1993; Pettaway et al, 1995).

Dynamic Sentinel Node Biopsy

Background

Renewed interest in sentinel lymph node biopsy for penile cancer returned as breast and melanoma treatments incorporated this approach successfully. Sentinel lymph node biopsy is now the preferred method of lymph node staging in breast cancer and melanoma (Warycha et al, 2009). The group at the Netherlands Cancer Institute (NKI) pioneered dynamic sentinel lymph node biopsy (DSNB) for staging in penile cancer beginning in 1994. **Since then, several groups have reported on the accuracy of DSNB in penile cancer as an alternative or adjunct to IFLND, and this procedure was included in the 2009 European Association of Urology (EAU) guidelines on penile cancer** (Pizzocaro et al, 2010). This method includes preoperative lymphoscintigraphy using technetium-99m nanocolloid, preoperative patent blue dye injection, and intraoperative guidance with a gamma ray detection probe to visualize the individual drainage pattern and accurately identify the sentinel node.

DSNB has undergone modifications to reduce false-negative rates. Initial reports out of the NKI revealed a relatively high false-negative rate of 22% (Tanis et al, 2002). Leijte and colleagues reported having found that patients staged by DSNB between 1994 and 2001 had an unsatisfactory false-negative rate of 19%. Further experience and refinement in their technique resulted in a reduction to a reported 5% in patients treated between 2001 and 2004 (Leijte et al, 2007). By combining the data from the NKI in Amsterdam (297 patients) and St. George's Hospital (SGH) in London (134 patients), a false-negative rate of 7% was subsequently achieved (Leijte et al, 2009). They reported a complication rate of 4.7% (28 of 592 explored groins), primarily infection, seroma or lymphocele, or delayed bleeding. A DSNB was classified as a false-negative procedure if a regional nodal recurrence was noted on follow-up after a negative DSNB. Of 323 patients in this study with 611 clinically negative groins, six such recurrences were noted, all within 15 months. The median follow-up for the paper was 17.9 months (range, 1 to 69 months) (Leijte et al, 2009). Subsequent data out of SGH reported on 500 inguinal basins in 264 consecutive men over a 6-year period (2004 to 2010). All patients had T1G2 or higher-stage disease of the primary tumor and nonpalpable nodes in one or both inguinal basins. Minimum follow-up was 21 months (median 57 months). Seventy-three positive inguinal basins (14.6%) in 59 patients (22.3%) were identified. The authors reported a false-negative DSNB rate of 5%. Twenty patients (7.6%) were identified with postoperative complications, half of which were lymphoceles.

Further outcomes of patients treated at NKI were reported based on time period of presentation. Of 1000 patients treated since 1956, 5-year cancer-specific survival increased for each cohort subsequently treated. In patients with cN0 disease, 5-year cancer-specific survival was 91% for patients treated between 1994 and 2012 versus 82% for patients treated between 1956 and 1993. Cancer-specific survival was better in patients treated during the DSNB era than those treated during the prophylactic bilateral IFLND era (Djajadiningrat et al, 2014).

Although the goal of treatment is to find all patients with potentially curable disease, false-negative rates of 5% to 10% are believed by many to be reasonably acceptable given the substantial reduction in morbidity. The ability of other centers to obtain results seen at NKI and SGH and generalize this method has been explored. A retrospective review of DSNB in a tertiary center in Sweden between 1999 and 2011 has been reported (Kirrander et al, 2012). Of 58 patients, 115 cN0 groins were analyzed with DSNB protocol. Two patients with a negative DSNB were noted to have a clinical recurrence, consistent with a false-negative rate of 15%. This study reported an evolving procedure at this institution; for instance, ultrasound was not used preoperatively in 45% of patients in the early time period. Nonetheless, the study confirms that this methodology and technique necessitate dedicated experience to gain optimal results. The false-negative rate of 15% is comparable with early reports from other series and is expected to fall with increased use and overall experience. In comparison, in the breast cancer literature, recommendations exist that DSNB should be performed by surgeons with at least 20 procedures per year, with the first 20 including assistance from an experienced surgeon. Before routine adoption of the procedure, a false-negative rate below 5% is suggested (Kuehn et al, 2005). The learning curve has not been well established in penile cancer, although in the study of pooled data from NKI and SGH, none of the six recurrences consistent with false negatives occurred in the initial 30 procedures (Leijte et al, 2009). Because of the rarity of penile cancer, these expectations are challenging and provide support for a referral network approach to specialized centers.

Based on the aforementioned information, DSNB should be performed with the goal of a false-negative rate at 5% or lower. Reasons postulated for the false-negative rates seen in penile cancer include (1) selection or identification of the wrong node, (2) poor pathologic sectioning or sampling such that small cancer foci are missed, and (3) tumor occupying and obstructing lymphatic channels that allows for new lymphatics or arborization to occur, leading to unorthodox drainage (Srinivas et al, 1991; Kroon et al, 2004).

Technique

Figure 39-4 outlines the technique and methodology for DSNB as espoused by groups at SGH in London and NKI in Amsterdam (Hadway, et al, 2007; Leijte et al, 2007; Lam et al, 2013). Variations in the initial technique have been used to reduce false-negative rates (Kroon et al, 2004). Currently, inguinal ultrasound and fine-needle aspiration (FNA) cytology of suspect lymph nodes has been added as a preliminary step before lymphoscintigraphy. Patients with abnormal nodes on ultrasound undergo FNA, and only patients with negative FNA findings proceed to scintigraphy and DSNB. Patients with positive FNA findings undergo IFLND. The abnormal ultrasound findings used by the group at SGH to direct patients to FNA are outlined in Box 39-1. Ultrasound-guided FNA was added to the DSNB procedure in an attempt to circumvent false-negative results caused by tumor blocking and rerouting of lymphatics. Combined use of a radiotracer and blue dye is then performed to improve the identification of the sentinel node (Fig. 39-5). A meta-analysis performed by Sadeghi and colleagues revealed a pooled detection rate of 88.3%, which was improved to 90.1% if both blue dye and radiotracer were used (Sadeghi et al, 2012). Another change made to the initial DSNB protocol is that an inguinal exploration is performed after removal of the sentinel node. The groin is carefully palpated for suspicious nodes that failed to pick up any radioactive or dye tracer. Finally, a more accurate pathologic analysis of the resected node has also proven essential. A single section through a center of a node may miss micrometastatic disease. All nodes are submitted whole and embedded in paraffin. They are then serially sectioned in 2-mm increments and are evaluated with immunohistochemistry in addition to standard staining to avoid pathologic false negatives.

DSNB can be performed at the time of initial definitive primary tumor resection (after a biopsy of the penile lesion only), or after the primary tumor has been treated (with glans-preserving resection, partial or total penectomy). The group from Amsterdam has reported that postresection DSNB can be done with the technetium-99m nanocolloid injected around the resection wound or scar instead of around the tumor. They found comparable rates of sentinel node visualization (93%), sentinel node identification (100%), and detection of occult metastases (12%) when done after referral following primary tumor resection as when performed synchronously with the penile surgery (Graafland et al, 2010).

Follow-up

Strict follow-up is necessary to identify recurrences that can be managed surgically and potentially salvaged. For patients with a negative ultrasound and negative DSNB, clinical evaluation of the inguinal nodes is recommended. Examination in the office every 3

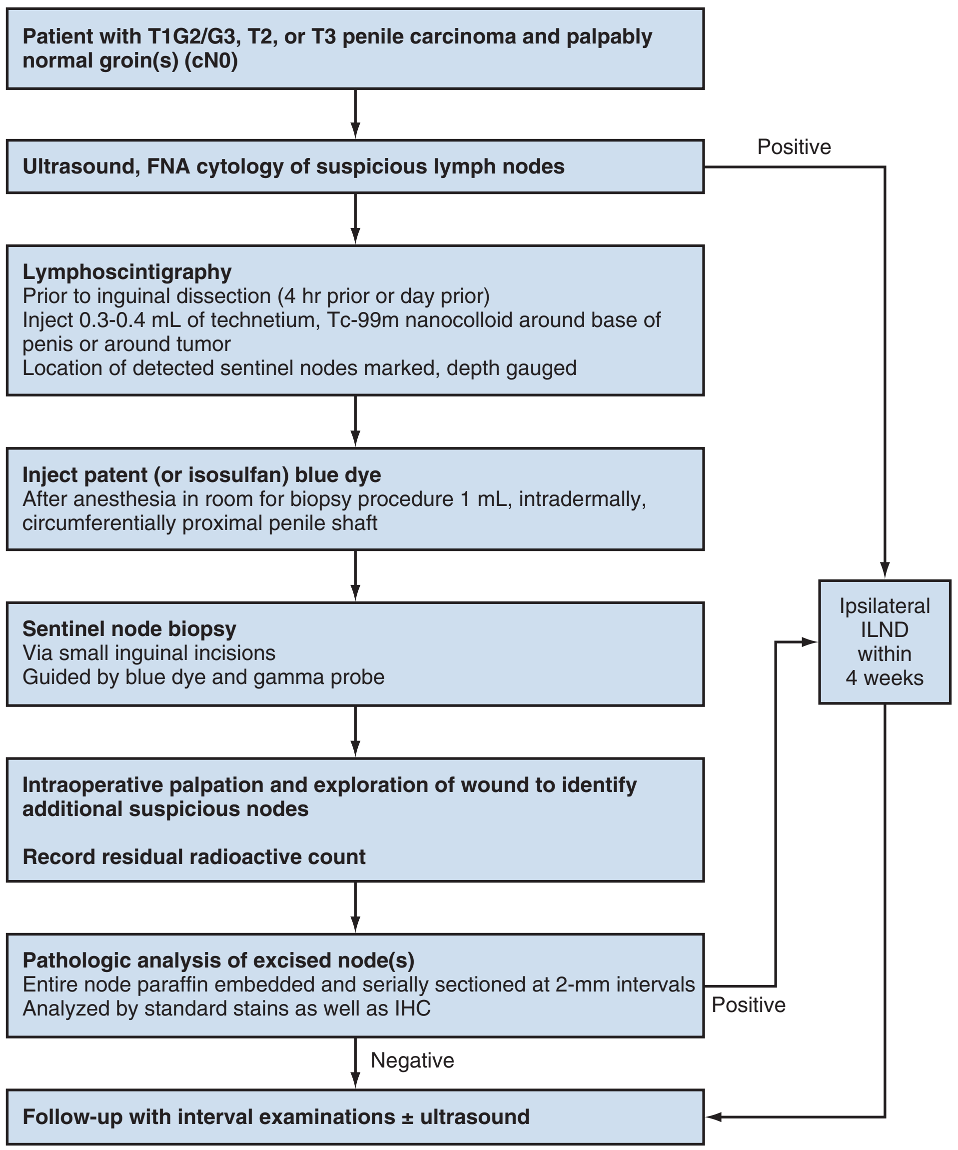

Figure 39-4. Flow diagram of technique and protocol for dynamic sentinel node biopsy. FNA, fine-needle aspiration; IHC, immunohistochemical markers; ILND, inguinal lymph node dissection. (Modified from Lam W, Alnajjar HM, La-Touche S, et al. Dynamic sentinel lymph node biopsy in patients with invasive squamous cell carcinoma of the penis: a prospective study of the long-term outcome of 500 inguinal basins assessed at a single institution. Eur Urol 2013; 63:657–63; and Leijte JA, Kroon BK, Olmos RA, et al. Reliability and safety of current dynamic sentinel node biopsy for penile carcinoma. Eur Urol 2007; 52:170–7.)

months for the first year, every 4 months for the second year, and every 6 months thereafter is recommended. Some patients may have a challenging inguinal nodal examination because of body habitus or lymphedema from prior procedures. In these patients ultrasound can be used. The role of computed tomography (CT), positron emission tomography (PET)-CT, or magnetic resonance imaging (MRI) is not well defined and sensitivity is suboptimal for low-volume metastatic disease. Finally, patients should be instructed on self-examination to be done at regular intervals (i.e., monthly) as an adjunct to their follow-up.

It is important to stress that DSNB remains a diagnostic procedure, allowing some men to avoid a therapeutic IFLND. Those with a positive DSNB should proceed to a full therapeutic lymphadenectomy. It is not appropriate for palpable lymphadenopathy and applies only to clinically negative nodes. **In patients with palpable lymphadenopathy, inguinal lymphadenectomy is still recommended, as approximately one half of these patients will harbor pathologically positive lymph node metastases.** Finally, those centers employing DSNB need the experience and dedication of a multidisciplinary team of surgeons, nuclear medicine physicians, radiologists, and pathologists. The occurrence of a false negative is very serious, and salvage is usually difficult. The EAU and the International Consultation on Penile Cancer agree that DSNB is an acceptable staging procedure in the hands of experienced centers. Selection of patients is also dependent on acceptance and commitment of patients for regular follow-ups, as well as self-examination because of the possibility of false-negative findings (Hegarty et al, 2010). Whether the outcomes achieved by experienced centers can be reproduced at other small- or large-volume centers remains to be seen.

Superficial Inguinal Node Dissection

Superficial inguinal node dissection has been proposed as another method to surgically stage penile cancer patients without palpable lymphadenopathy. The procedure consists of removal of the nodal

BOX 39-1 Criteria for Identifying Suspicious Inguinal Lymph Nodes on Ultrasound

Fine-needle aspiration for cytology is performed if one or more of the following are detected:

- Increased size
- Abnormal shape
  - Rounded, with a short-long axis ratio less than 2
  - Eccentric cortical hypertrophy
- Absence of an echogenic hilum
- Hypoechogenicity of the node compared with adjacent muscle
- Lymph node necrosis
- Abnormal vascularity on power Doppler

From Lam W, Alnajjar HM, La-Touche S, et al. Dynamic sentinel lymph node biopsy in patients with invasive squamous cell carcinoma of the penis: a prospective study of the long-term outcome of 500 inguinal basins assessed at a single institution. Eur Urol 2013; 63:657–63.

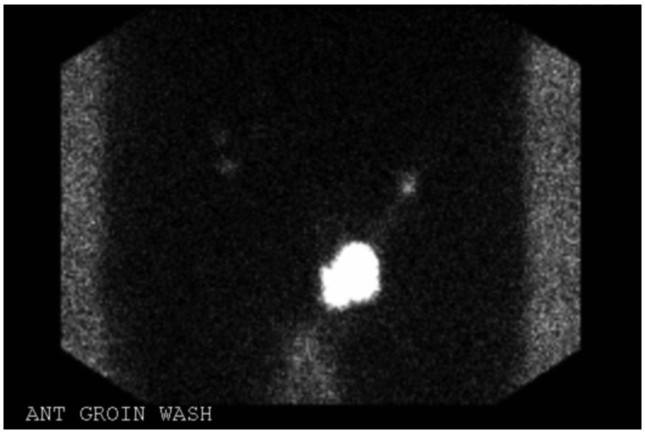

Figure 39-5. Lymphoscintigraphy: Dynamic images are obtained in multiple projections to provide location of the nodes with radiotracer uptake and their depth. Permanent marker is used to mark the location of each "hot" node. Here, there are two identified right sentinel inguinal lymph nodes and one left sentinel inguinal lymph node.

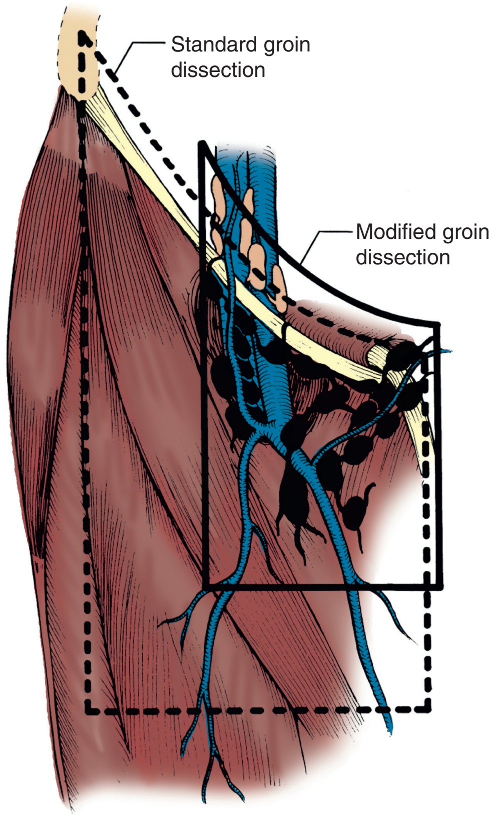

Figure 39-6. Limits of standard and modified groin dissection. (From Colberg JW, Andriole GL, Catalona WJ. Long-term follow-up of men undergoing modified inguinal lymphadenectomy for carcinoma of the penis. Br J Urol 1997;79:54–7.)

packet superficial to the fascia lata and centered about the fossa ovalis and saphenofemoral junction. The peripheral boundaries of the dissection are similar to those described later for modified complete inguinal node dissection; however, the fascia lata is not opened. Previous studies have demonstrated no positive nodes deep to the fascia lata unless superficial nodes were also positive (Pompeo et al, 1995; Puras-Baez et al, 1995), which supports the efficacy of this procedure in surgical staging. In addition, a previous study of DSNB included a cohort of patients who underwent complete superficial node dissection. If the superficial nodes were negative, there were no recurrences with follow-up longer than 3 years (Spiess et al, 2007).

Modified Complete Inguinal Lymphadenectomy

In 1988, Catalona proposed a technique of modified inguinofemoral lymphadenectomy designed to provide staging information and therapeutic benefit similar to standard extended lymphadenectomy with less morbidity (Catalona, 1988) (Fig. 39-6). **Key aspects of the procedure are (1) shorter skin incision, (2) limitation of the dissection by excluding the area lateral to the femoral artery and caudal to the fossa ovalis, (3) preservation of the saphenous vein, and (4) elimination of the need to transpose the sartorius muscle.**

All of the superficial lymph nodes within the described area are removed, as are the deep inguinal nodes that are located primarily medial to the femoral vein to the level of the inguinal ligament.

The procedure begins by placing the patient into a frog-leg position. A 10-cm skin incision is made approximately 1.5 to 2 cm below the inguinal crease. Skin flaps are developed in the plane just beneath the Scarpa fascia for a distance of 8 cm superiorly and 6 cm inferiorly. The superior dissection is carried to the level of the external oblique fascia with exposure of the spermatic cord. A funiculus of lymphofatty tissue, extending from the base of the penis to the superomedial portion of the lymph node packet, is ligated and divided. Dissection commences in a caudad direction with removal of the superficial and deep inguinal nodes, with the boundaries consisting of the adductor longus muscle medially and the femoral artery laterally. The saphenous vein is identified and preserved, although a number of branches draining into it will need to be sacrificed. The nodal packet is dissected caudad to the level of the skin flap dissection (Fig. 39-7), at which point the lymphatics are carefully ligated and the specimen is delivered from the operative field (Fig. 39-8). A closed-suction drain is placed, and the incision is closed in standard fashion.

The false-negative rate for this procedure, in terms of detecting inguinal metastatic disease, ranges from 0% to 5.5% in the majority of published reports (Parra, 1996; Colberg et al, 1997; Coblentz and Theodorescu, 2002; Bouchot et al, 2004; d'Ancona et al, 2004).

Morbidity after modified complete inguinal lymphadenectomy consists primarily of minor complications including seroma or lymphocele (0% to 26%), lymphorrhea (9% to 10%), and wound infection or skin necrosis (0% to 15%). These have been self-limited in the majority of patients (Parra, 1996; Coblentz and Theodorescu, 2002; Jacobellis, 2003; Bouchot et al, 2004; d'Ancona et al, 2004; Spiess et al, 2009). Lower extremity edema has been reported in 0%

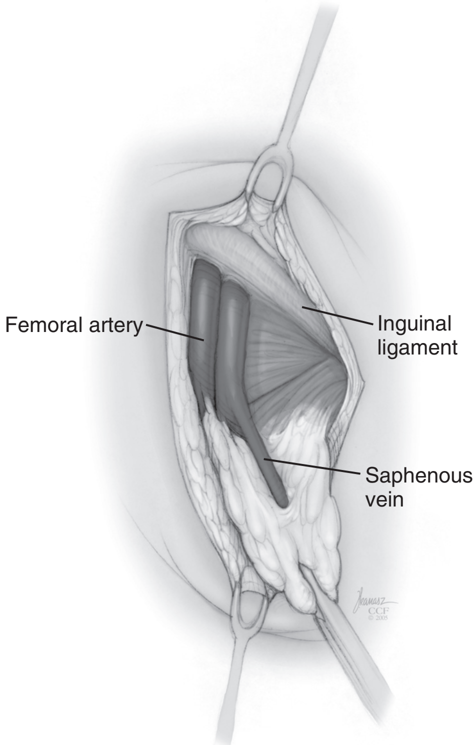

Figure 39-7. **Modified inguinal lymphadenectomy. Lymph node packet is medial to the femoral artery and includes superficial and deep inguinal nodes. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2003-2010. All rights reserved.)**

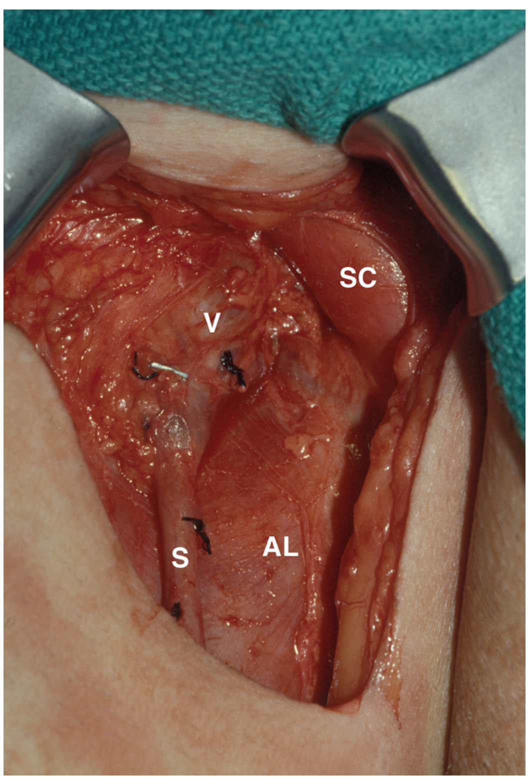

Figure 39-8. **Intraoperative photograph of right inguinal region after modified lymphadenectomy. AL, adductor longus; S, saphenous vein; SC, spermatic cord; V, femoral vein.**

to 36% of patients, and persistent clinically significant edema is uncommon.

The primary use of both superficial and modified complete inguinal lymphadenectomy currently is in patients with a primary tumor that places them at increased risk for inguinal metastasis and clinically negative groins on examination (stage T2 or greater, presence of vascular or lymphatic invasion, or high grade). These procedures allow for a more thorough assessment of the superficial inguinal nodal basin, do not require specialized equipment, and are associated with less morbidity than standard inguinal lymphadenectomy. If nodal metastasis is detected on frozen-section examination of the specimen, the procedure is converted to a standard radical IFLND.

Endoscopic and Robotic Inguinal Lymphadenectomy

Background

Endoscopic inguinal lymphadenectomy is a more recent technique with the potential for thorough excision of inguinal nodes with decreased morbidity. Bishoff and colleagues were first to report the use of endoscopic inguinal node dissection, in two cadavers and one patient with penile cancer (Bishoff et al, 2003). The patient required conversion to an open procedure because of inability to adequately mobilize the nodal mass superiorly. In 2006 Tobias-Machado and coworkers reported 10 patients who underwent bilateral lymphadenectomy for nonpalpable inguinal nodes. Standard open lymphadenectomy was performed on one side, and endoscopic on the other. Nodal counts were similar, with 20% complications on the endoscopic side, compared with 70% with open surgery (Tobias-Machado et al, 2006). Sotelo and colleagues reported the outcomes after 14 inguinal endoscopic lymphadenectomies in eight patients with clinical stage T2 squamous cell carcinoma of the penis, with a median operative time of 91 minutes and an average node yield of nine. No wound-related complications occurred (Sotelo et al, 2007). A detailed analysis of immediate and long-term complications using the Clavien classification system in 29 patients undergoing 41 endoscopic inguinal lymphadenectomy procedures revealed minor complications in 27%, and major complications in 14.6% (Master et al, 2012). There were no perioperative deaths. Similar experience has been reported in two recent smaller studies, demonstrating a yield of approximately 7 to 15 lymph nodes per groin and a 20% rate of seroma or lymphocele managed conservatively (Pahwa et al, 2013; Zhou et al, 2013).

In 2009, the first staged bilateral endoscopic operation performed robotically was reported (Josephson et al, 2009). Pathologic examination revealed no metastatic involvement in six superficial and four deep lymph nodes. The contralateral dissection occurred weeks later, and pathologic examination revealed five superficial and four deep negative nodes. There were no wound problems or lower extremity edema. Sotelo and colleagues reported performance of a bilateral procedure without repositioning the robot. Metastatic nodes were present bilaterally, with a yield of 19 lymph nodes on the right and 14 on the left (Sotelo et al, 2013). Matin and colleagues performed a thorough evaluation of the adequacy of a robotic inguinal lymph node dissection by subsequently opening the incision and having a second surgical oncologist look for unretrieved residual nodal tissue in 10 patients. The verifying surgeon's role was to inspect the surgical field to ensure that no additional superficial inguinal lymph nodes (e.g., above the fascia lata of the thigh) remained within the operative field. If additional tissue was removed at that time, it was sent for pathologic analysis to define whether it was nodal in origin and whether it contained metastasis. In one of these groins, two residual lymph nodes were recovered from below the Scarpa fascia along the superficial aspect of the inguinal field near the spermatic cord. No metastases were detected in these additional nodes. Among all patients undergoing robotic dissection, 18 of 19 fields (94.7%) were adequately dissected (Matin et al, 2013).

In summary, there is evidence to suggest that the morbidity of an endoscopic inguinal lymph node dissection is lower than

previously reported for open contemporary series with a similar number of nodes being harvested. The applicability of the robot is a more recent development and will need continued prospective evaluation in comparison with standard laparoscopic endoscopic procedures.

Surgical Technique

The patient is positioned on a split-leg table or in low lithotomy position to allow bilateral groin dissection without repositioning the robot. The assistant stands lateral to the right leg for a right-sided dissection and between the legs for the left side (Figs. 39-9 and 39-10). A Foley catheter is inserted in sterile fashion, after the inguinal and groin areas have been prepared and draped. Bony and soft tissue landmarks are marked on the skin surface, creating an inverted triangle in which the base is a line connecting the anterior superior iliac spine to the pubic tubercle, along the course of the inguinal ligament. The lateral boundary is the sartorius muscle angling toward the apex. The medial boundary is the adductor longus muscle, again extending toward the apex. These marks aid in correct trocar placement as well as in delineating the extent of dissection (Figs. 39-11 and 39-12).

A 2-cm incision is made 3 cm below the inferior aspect of the femoral triangle, approximately 25 cm below the inguinal ligament. A white subcutaneous layer is identified, which corresponds to the Scarpa fascia. Sweeping finger dissection is used to dissect the potential space beneath the Scarpa fascia to develop the skin flaps at the apex of the triangle out in both directions to two additional 8-mm ports (Fig. 39-13). These two primary robotic 8-mm ports are placed with finger-guided techniques laterally and medially. A subcutaneous workspace is extended with the endoscope by sweeping with the lens itself (Fig. 39-14). The aim of this step is to create a superficial subcutaneous flap under the Scarpa fascia (Fig. 39-15). Alternatively, after the initial finger dissection, a 12-mm Origin balloon port trocar may be used (Origin Medsystems, Menlo Park, CA), set at 25 mm Hg for 10 minutes to create the space (Master et al, 2009). The workspace is then expanded with CO_2 insufflation at a pressure of 15 mm Hg. A 0-degree 10-mm lens is inserted, and one additional intervening 10-mm assistant port is placed between the camera and primary 8-mm working port on the assistant side. The robotic docking is performed as shown in Figures 39-9 and 39-10. The robot is located at 45 degrees contralateral to the first procedure (right side) and lateral to the patient in the second procedure (left side).

Our instrument preference is bipolar Maryland, or PK forceps in the left robotic arm, and monopolar scissors in the right arm to dissect the membranous and lymphatic tissue just deep to the Camper fascia. Every effort is made to completely develop the anterior working space to the inguinal ligament. The inguinal ligament is usually identified at the end of this dissection as being a transverse structure with white fibers, marking the superior limit of the dissection (Fig. 39-16). The boundaries of the dissection extend from the inguinal ligament superiorly, the sartorius muscle laterally, and the adductor longus muscle medially. One will be able to spare the saphenous vein in most patients, and the small branches of the femoral artery and vein may be clipped and divided (see Fig. 39-16). Identification of the adductor longus and sartorius muscles is facilitated by identifying the fascia of the respective muscles and correlating this to the previously made skin markings. The medial spermatic cord is seen medially. Inadvertent dissection

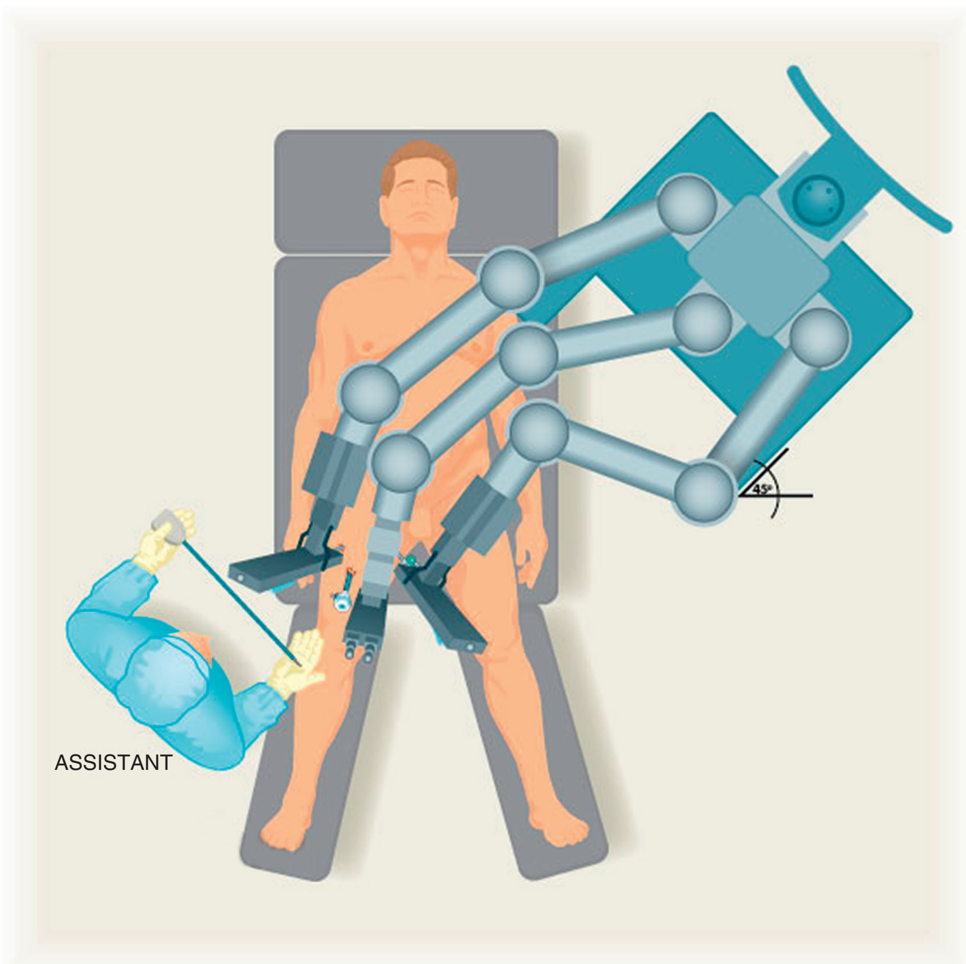

Figure 39-9. Assistant position and robotic docking for right inguinal node dissection.

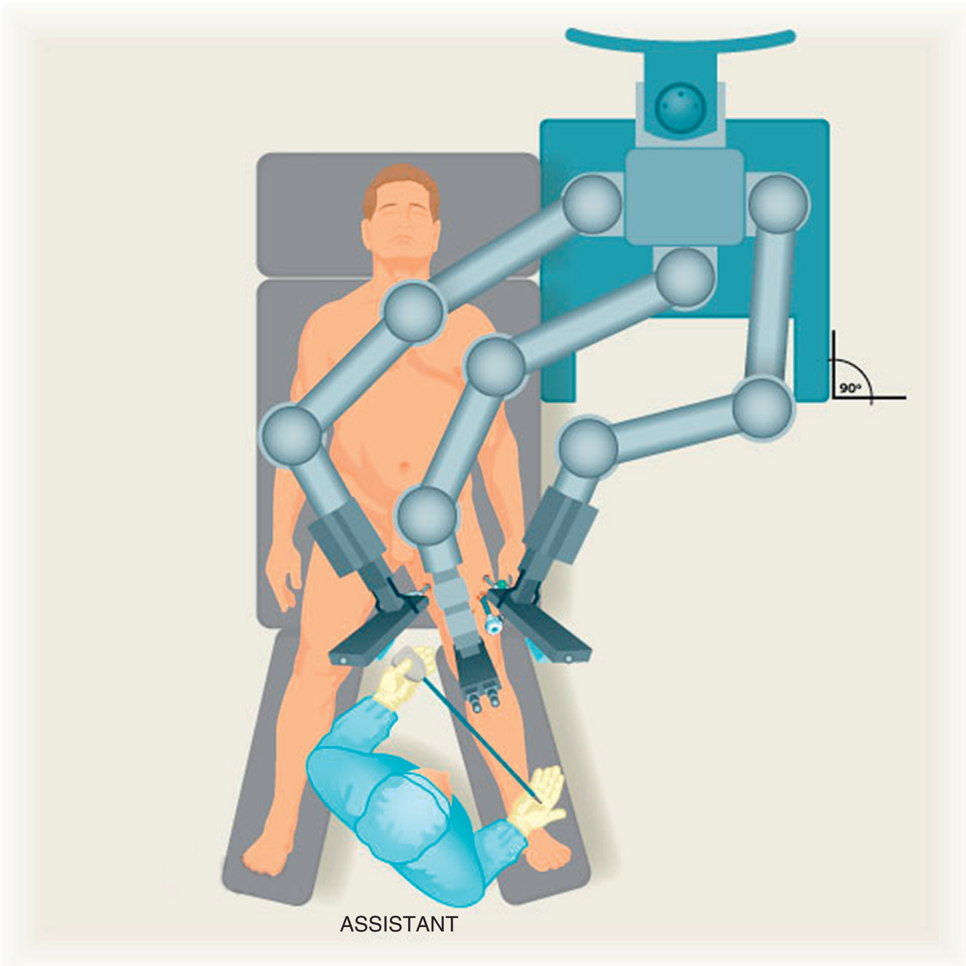

Figure 39-10. **Left inguinal node dissection.**

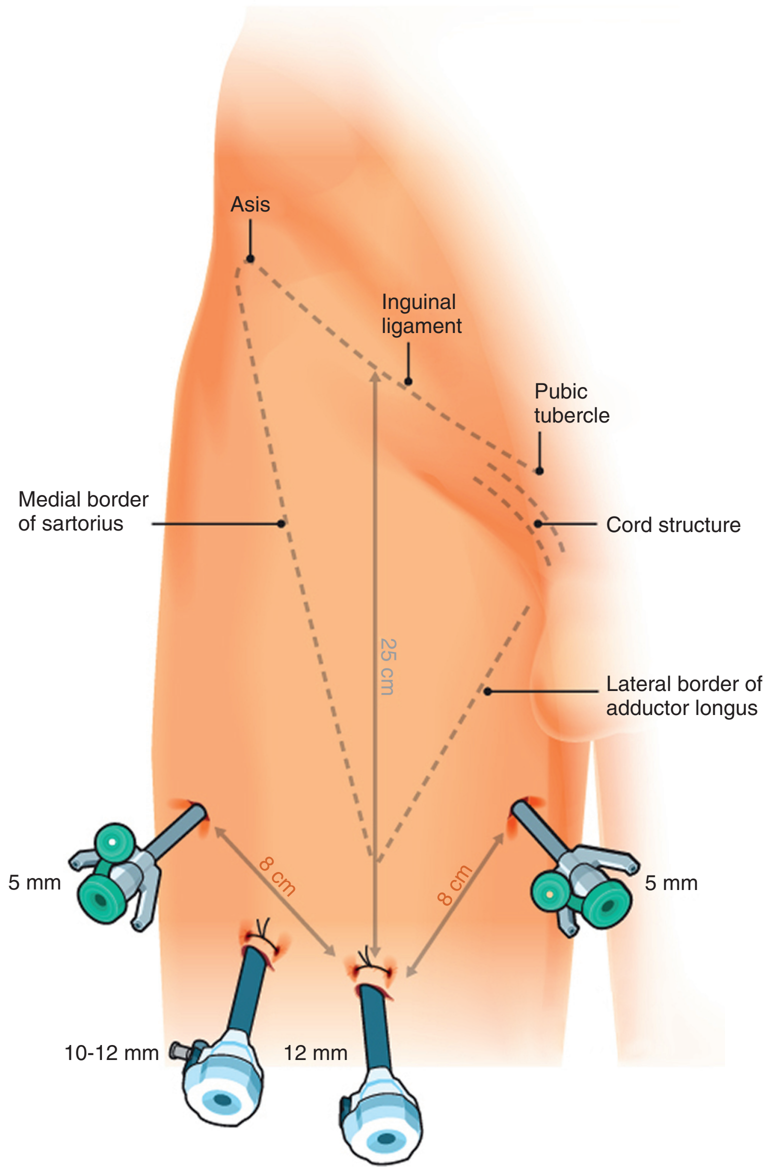

Figure 39-11. **Landmarks and trocar placement for right inguinal node dissection.**

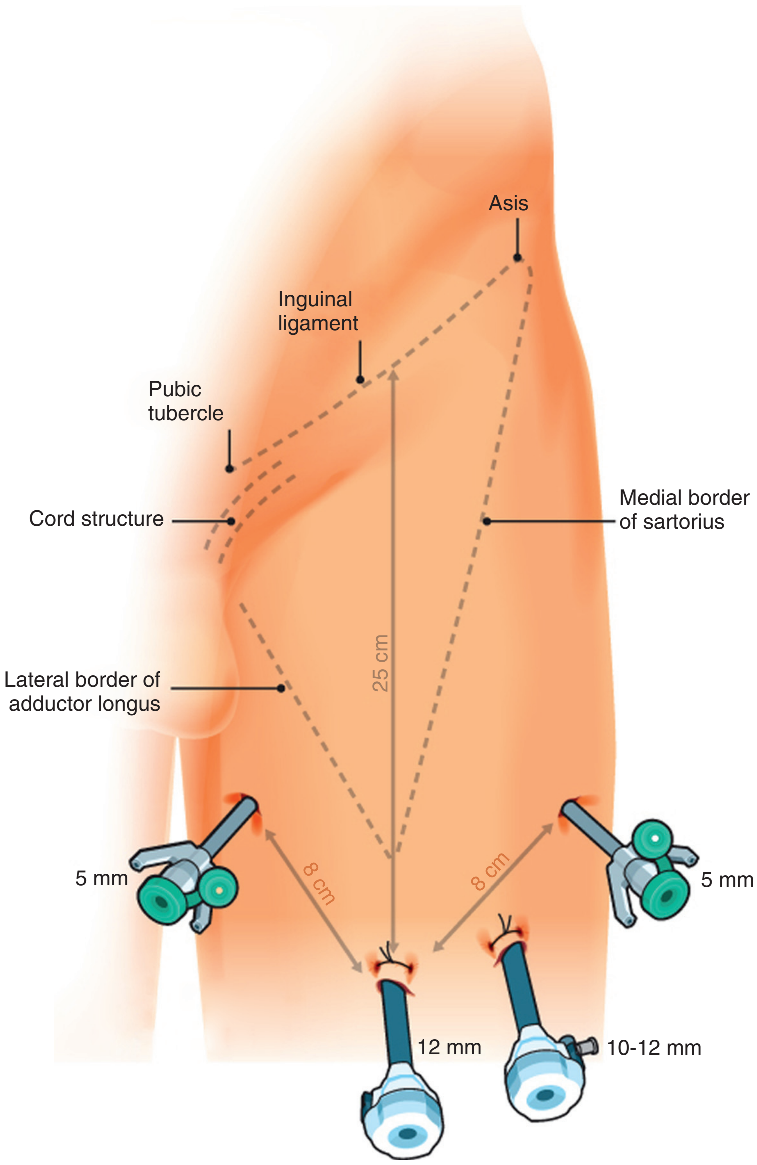

Figure 39-12. **Left inguinal node dissection.**

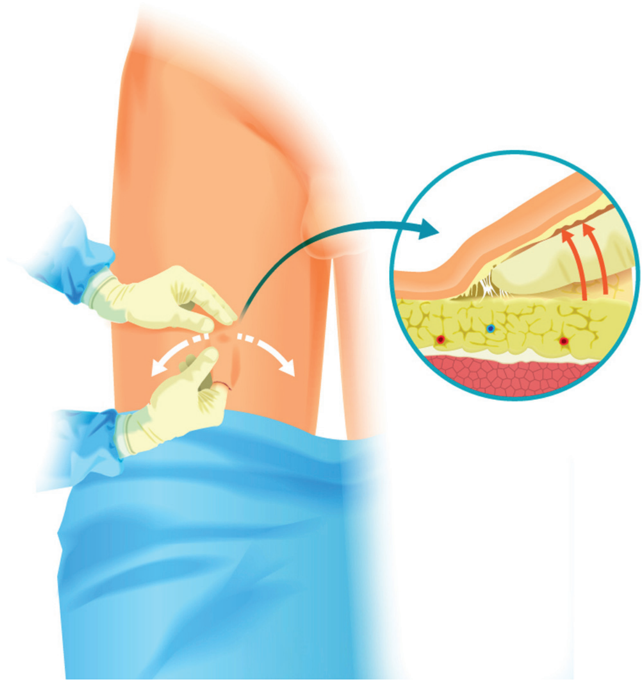

Figure 39-13. Sweeping finger dissection dissects the potential space beneath Scarpa fascia to develop the skin flaps at the apex of the triangle.

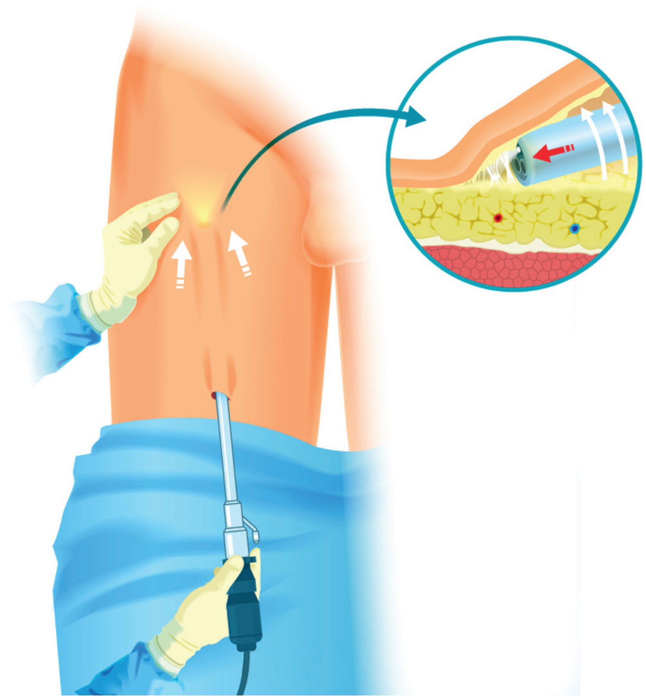

Figure 39-14. The subcutaneous workspace is extended with the endoscope by sweeping with the lens.

deep to the fascia lata is apparent when reddish muscular fibers are seen.

With blunt dissection, the nodal tissue can be rolled inward on both sides. This maneuver is continued inferiorly as much as possible from both sides to define the inferior apex of the nodal packet. The saphenous vein will be identified as it crosses the internal border of the dissection near the apex of the femoral triangle, and

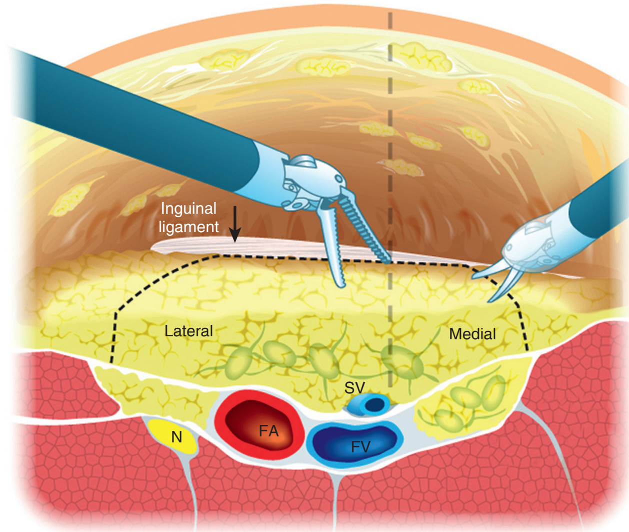

Figure 39-15. A superficial subcutaneous space is created under Scarpa fascia. FA, femoral artery; FV, femoral vein; N, femoral nerve; SV, saphenous vein.

following the vein leads the surgeon to the saphenous arch until its junction with the superficial femoral vein at the fossa ovalis. The dissection continues superiorly, where the packet is dissected off the fascia lata with a combination of sharp and blunt dissection. Typically the nondominant hand lifts the packet, and the monopolar scissors in the dominant hand advance the dissection. After the fossa ovalis is encountered, the packet is dissected away at its superolateral and superomedial limits, thereby narrowing the packet and pulling it away from the inguinal ligament. At this point the superficial and deep plane of dissection join and separate the package from the inguinal ligament (Fig. 39-17).

With the nodal packet circumferentially dissected except for its attachments to the saphenous arch, venous tributaries are clipped. Characteristic pulsations of the femoral artery serve as a nearby landmark. If possible, the packet will be released from the saphenous vein. If not, the vein can be ligated in the saphenous arch with Weck clips or an endovascular stapler. One must always attempt to preserve the saphenous vein whenever possible, however, to reduce the risk of postoperative lymphedema (Zhang et al, 2007).

The specimen is removed in an Endo Catch bag after extension of the camera trocar incision. Frozen section results determine whether a deep ipsilateral dissection will be required. We typically begin to create the working space in the other leg while waiting for results.

For the deep inguinal node dissection, the pneumoperitoneum is reestablished. The fascia lata medial to the saphenous arch is opened to expose the saphenofemoral junction. Inferomedial dissection around the femoral vein enables resection of the deep inguinal nodes (Master et al, 2009). This should be continued to the level of the femoral canal until the pectineus muscle is seen to ensure complete nodal retrieval (Fig. 39-18).

Insufflation pressure is then decreased to 5 mm Hg to confirm hemostasis. It is of great importance that meticulous control of lymphatics and excellent hemostasis be established to further reduce the risk of formation of lymphocele and/or hematoma, which could potentially become infected. A closed suction drain is positioned in the most dependent (caudal) portion of the lymphadenectomy field such that fluid tends to find the drain when the patient is upright. Trocar incisions are closed in standard fashion. The patient is allowed to ambulate the day of surgery and given a regular diet. Discharge is planned for the first postoperative day. A compressive elastic girdle, used for liposuction patients, is used to provide bilateral compression of the groins. In addition, elastic compression stockings are worn simultaneously and are used for 3

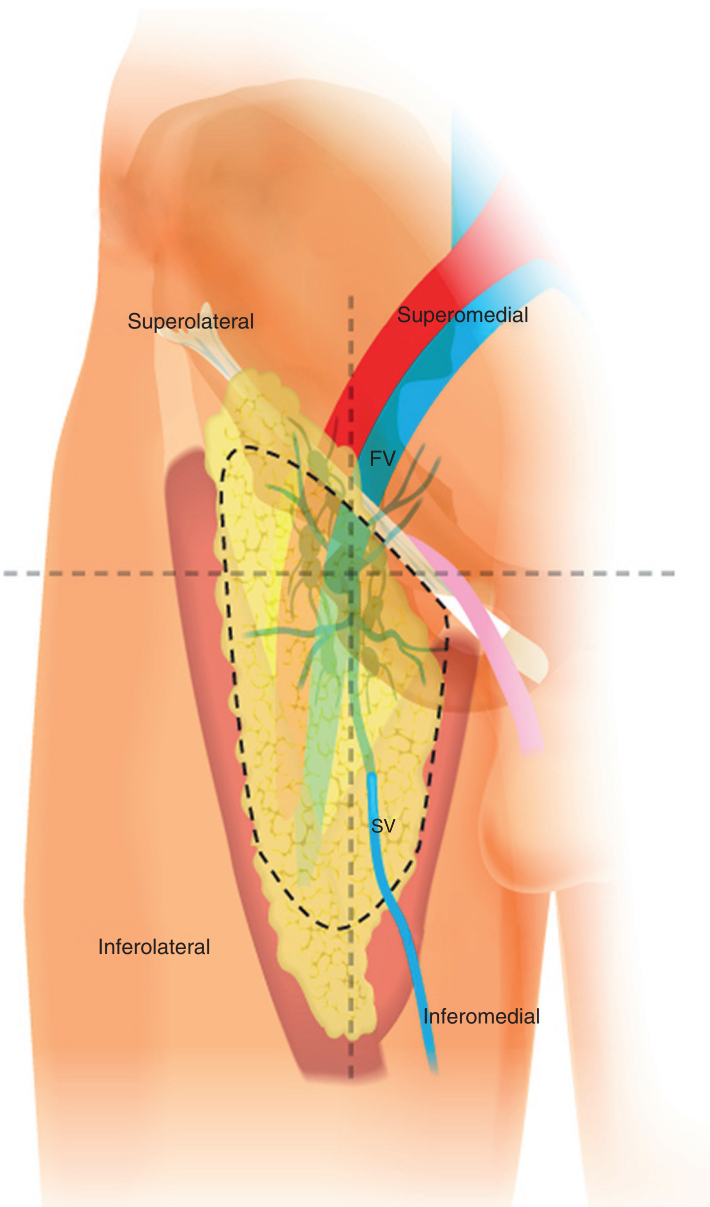

Figure 39-16. Boundaries of the inguinal node dissection. FV, femoral vein; SV, saphenous vein.

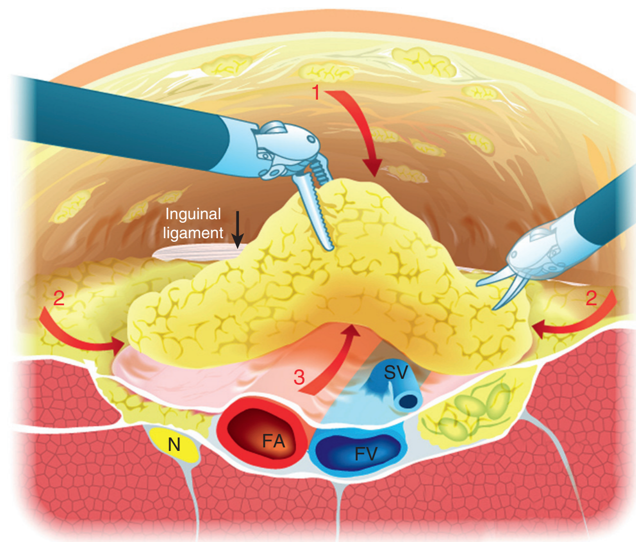

Figure 39-17. Steps in dissection of the nodal tissue; see corresponding text. FA, femoral artery; FV, femoral vein; N, femoral nerve; SV, saphenous vein.

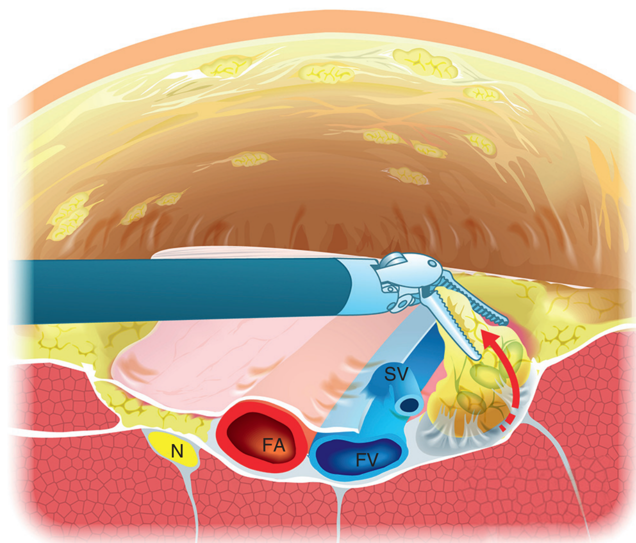

Figure 39-18. Resection of the deep inguinal nodes. FA, femoral artery; FV, femoral vein; N, femoral nerve; SV, saphenous vein.

months after surgery (Fig. 39-19). Broad-spectrum antibiotics are continued until after drains have been removed. Drains typically stay in place until the output is less than 50 mL per 24-hour period. All patients receive venous thromboembolism prophylaxis using fractionated or low-molecular-weight heparin.

Palpable Inguinal Adenopathy or Positive Inguinal Nodes

Radical Inguinofemoral Lymph Node Dissection

Radical IFLND is indicated in patients with resectable metastatic adenopathy and may be curative when the disease is limited to the inguinal nodes. We have also favored its use as a palliative procedure in patients with documented inguinal metastasis who are fit for surgery. If left unchecked, cancer-bearing inguinal nodes may lead to significant complications, such as infection or abscess with chronic foul-smelling drainage or life-threatening femoral hemorrhage (Fig. 39-20). Antibiotics are often administered preoperatively to reduce the inflammatory component of the regional adenopathy. The patient is positioned with the involved thigh slightly abducted and externally rotated with cushioned support under the flexed knee.

The inguinofemoral dissection is designed to cover an area outlined superiorly by a line drawn from the superior margin of the external ring to the anterior superior iliac spine, laterally by a line drawn from the anterior superior iliac spine extending 20 cm inferiorly, and medially by a line drawn from the pubic tubercle 15 cm down the medial thigh. In most situations the procedure is carried out through an oblique incision approximately 3 cm below and parallel to the inguinal ligament and extending from the lateral to the medial limit of the dissection (Fig. 39-21). If an area of the skin overlying the cancer-bearing nodes is invaded or adherent and requires excision, an elliptical incision is made around the involved skin and then extended medially and laterally. In this setting, the

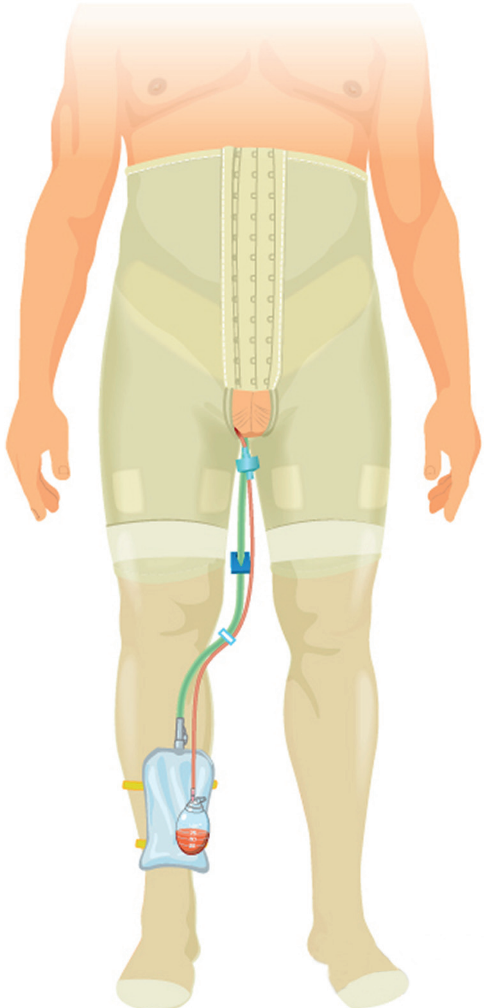

Figure 39-19. **A compressive elastic girdle and elastic compression stockings are placed postoperatively.**

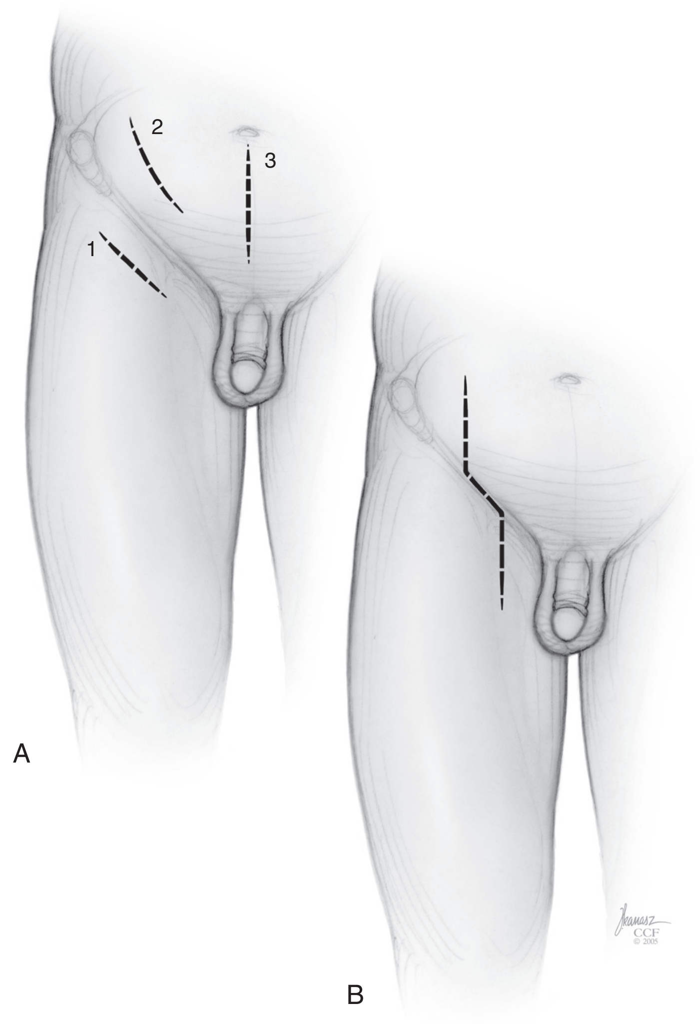

Figure 39-21. **Ilioinguinal lymph node dissection. A, Incisions for inguinofemoral lymph node dissection (1), unilateral pelvic lymph node dissection (2), and bilateral pelvic lymph node dissection (3). B, Single-incision approach for ilioinguinal lymph node dissection. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2003-2010. All rights reserved.)**

Figure 39-20. **Pelvic computed tomographic scan of patient with penile carcinoma demonstrating large left inguinal metastasis overlying the femoral vessels.**

incision may alternatively be extended superiorly from the lateral border of the ellipse and inferiorly from the medial border to make a single S-shaped incision for the iliac and inguinofemoral dissections (Fig. 39-22).

Superior and inferior skin flaps are developed in the plane just below the Scarpa fascia. The superior flap is elevated cephalad to a point 4 cm above the inguinal ligament, and the inferior flap to the limit of the dissection. The fat and areolar tissues are dissected from the external oblique aponeurosis and the spermatic cord to the inferior border of the inguinal ligament, forming the superior boundary of the lymph node packet (Fig. 39-23). The inferior angle of the inguinofemoral exposure is at the apex of the femoral triangle, where the long saphenous vein is identified and divided. In patients with minimal metastatic disease, it may be feasible and beneficial to spare the saphenous vein, and this should be considered (Fig. 39-24). Dissection is deepened through the fascia lata overlying the sartorius muscle laterally and the thinner fascia covering the adductor longus muscle medially. At the apex of the femoral triangle, the femoral artery and vein are identified, and dissection is continued superiorly along the femoral vessels. Superficial cutaneous perforating arteries are ligated as they are encountered on the

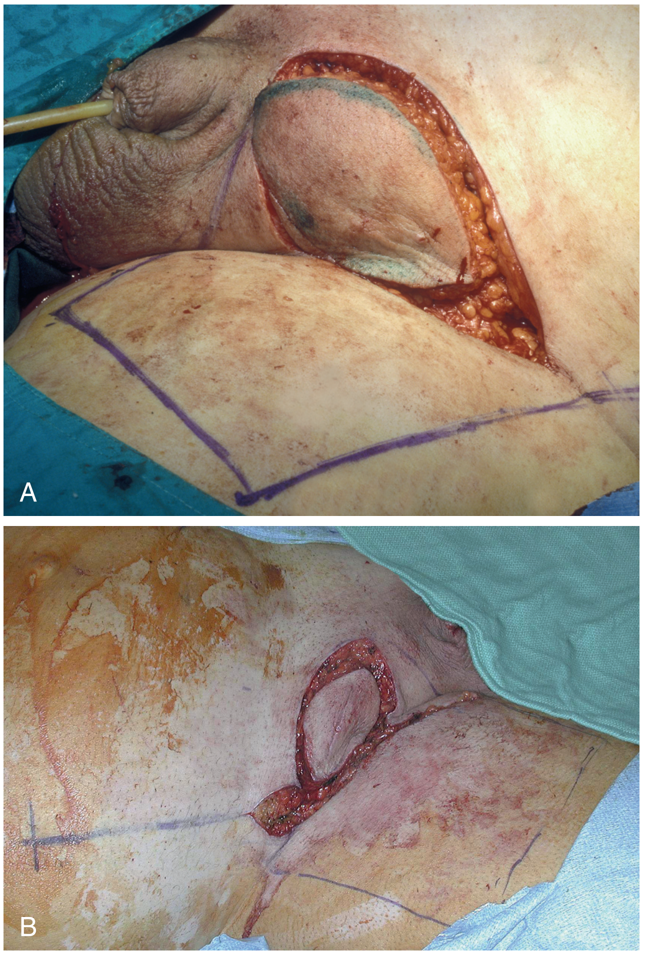

Figure 39-22. A, Incision and area of dissection for left inguinofemoral lymph node dissection with excision of adherent skin overlying nodal mass. B, Single-incision approach and area of dissection for right ilioinguinal lymph node dissection with excision of overlying skin.

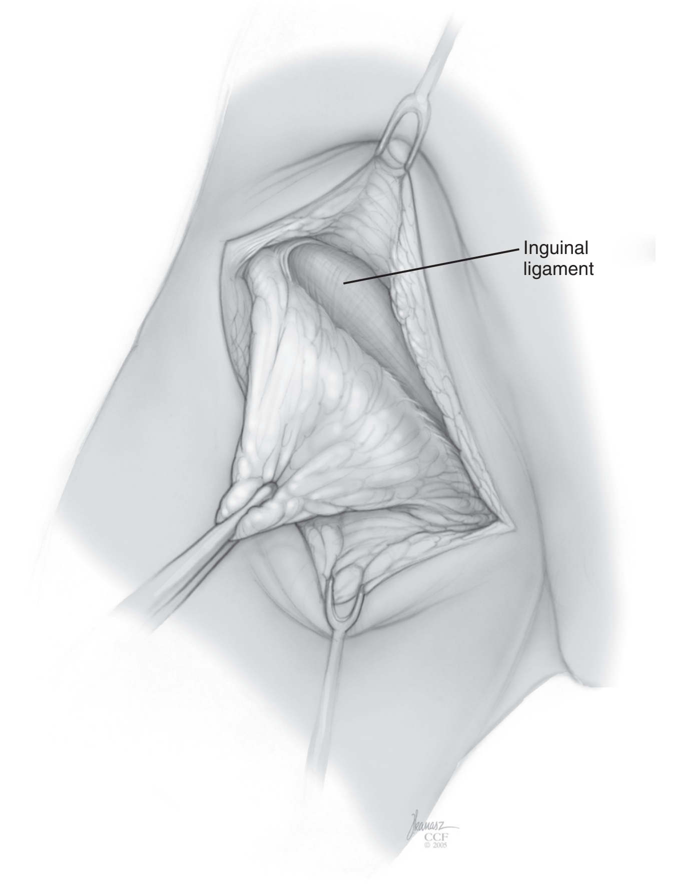

Figure 39-23. Initial dissection for radical inguinofemoral lymph node dissection with exposure of superior border defined by the external oblique fascia. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2003-2010. All rights reserved.)

surface of the femoral artery. The saphenous vein is divided at the saphenofemoral junction, and the dissection is continued superiorly to include the deep inguinal nodes medial and lateral to the femoral vein until continuity with the pelvic dissection is attained at the femoral canal (Fig. 39-25). The anterior aspects of the femoral vessels are dissected, but the femoral vessels are not skeletonized, and the lateral surface of the femoral artery is not exposed. This avoids injury to the femoral nerve and the profunda femoris artery, and the femoral nerve is usually not visible as it runs beneath the iliacus fascia.

After the femoral triangle is dissected (Fig. 39-26), the sartorius muscle is mobilized from its origin at the anterior superior iliac spine and either transposed or rolled 180 degrees medially to cover the femoral vessels. The muscle is sutured to the inguinal ligament superiorly, and its margins are sutured to the muscles of the thigh immediately adjacent to the femoral vessels (Fig. 39-27). The femoral canal is closed, if necessary, by suturing the shelving edge of the Poupart ligament to the Cooper ligament, being careful not to compromise the lumen of the external iliac vein or to injure the inferior epigastric vessels in the process. Primary closure of the inguinofemoral dissection is usually possible with minimal or no further mobilization of the excision margins. When circumstances demand a large area of inguinal soft tissue sacrifice, primary closure may be obtained by scrotal skin rotation flaps (Skinner, 1974), an abdominal wall advancement flap (Tabatabaei and McDougal, 2003), or a myocutaneous flap based on the rectus abdominis or tensor fasciae latae (Airhart et al, 1982) for more extensive defects.

Closed-suction drains are placed under the subcutaneous tissue and brought out inferiorly. During closure, the skin flaps are sutured to the surface of the exposed musculature to decrease dead space. The skin is closed with absorbable subcutaneous sutures and staples. The patient is maintained on bed rest for 2 or 3 days, and pneumatic compression stockings are used. The drains are removed after 5 to 7 days, when drainage is less than 30 to 40 mL/day. Compression stockings are recommended postoperatively. We maintain the patient on a suppressive dose of a cephalosporin for 1 to 2 months until healed to decrease the incidence of erythema and cellulitis, and this seems to improve overall wound healing.

In the past, complications related to radical ilioinguinal lymphadenectomy have been significant. In contemporary series, early minor complications have been reported in 40% to 56% of dissections (Bevan-Thomas et al, 2002; Bouchot et al, 2004; Nelson et al, 2004; Spiess et al, 2009). These consist primarily of lymphocele, wound infection or necrosis, and lymphedema. Major complications, such as debilitating lymphedema, flap necrosis, and lymphocele requiring intervention, occur in 5% to 21% of patients (Bevan-Thomas et al, 2002; Nelson et al, 2004). Deep venous thrombosis (DVT) or pulmonary embolism (PE) has been reported in 4% to 7% of patients (Johnson and Lo, 1984; Ravi, 1993; Spiess et al, 2009). Efforts to minimize lower extremity lymphedema include early use of compression stockings and saphenous vein preservation when feasible. With regard to DVT and PE, sequential

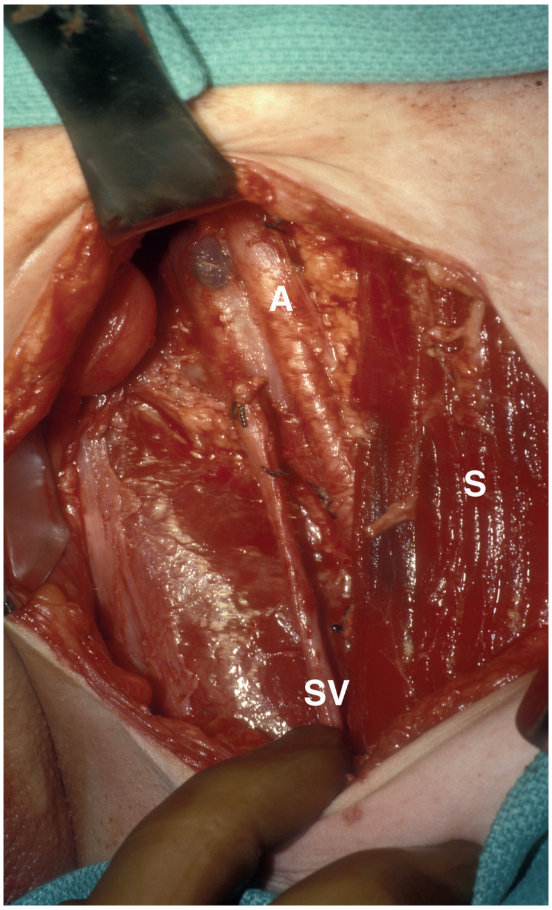

Figure 39-24. Intraoperative photograph after saphenous-sparing, radical, left inguinofemoral lymph node dissection. A, femoral artery; S, sartorius muscle; SV, saphenous vein.

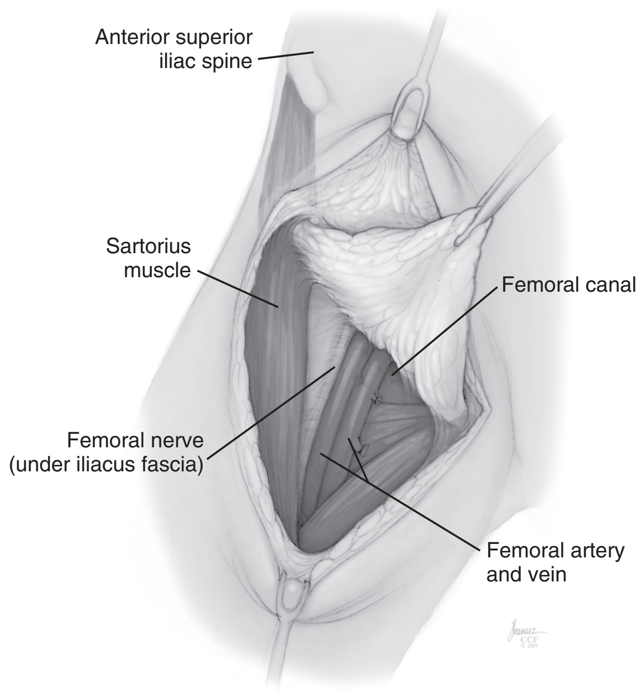

Figure 39-25. Inferior dissection during radical inguinofemoral lymph node dissection with removal of lymph node packet from the inferior border of the femoral triangle. After further lateral and medial dissection, the packet will remain in continuity with the pelvic dissection in the area of the femoral canal. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2003-2010. All rights reserved.)

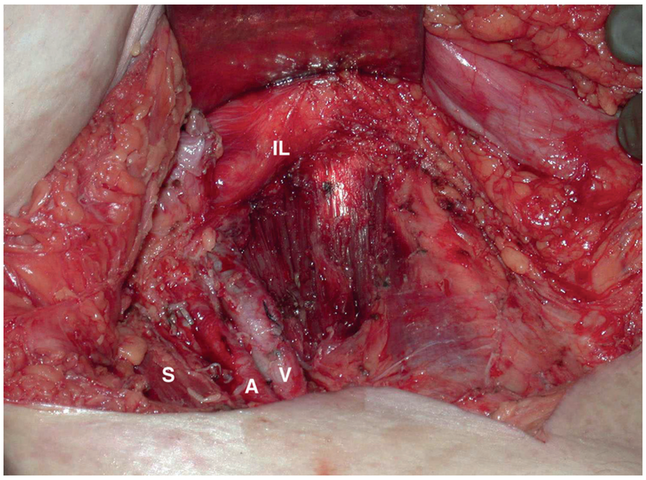

Figure 39-26. Intraoperative photograph after right radical inguinofemoral lymph node dissection in an obese patient. A, femoral artery; IL, inguinal ligament; S, sartorius muscle; V, femoral vein.

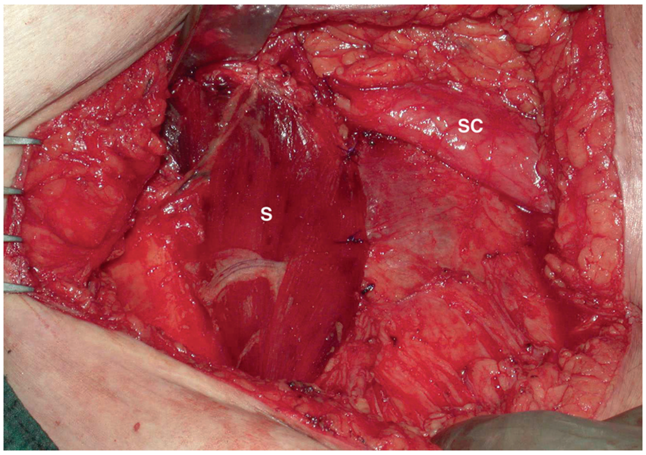

Figure 39-27. Sartorius muscle after detachment from the anterior superior iliac spine and 180-degree rotation medially, with suture fixation to the fascia of the inguinal ligament and the adductor longus. S, sartorius muscle; SC, spermatic cord.

lower extremity compression devices are placed before surgery. Use of prophylactic fractionated subcutaneous heparin or low-molecular-weight heparin is recommended while the patient is on bed rest, and the current trend is toward earlier ambulation when appropriate (Spiess et al, 2009).

KEY POINTS

- The most important factor determining survival in patients with penile cancer is the extent of lymph node metastases.
- Approximately 20% of patients with clinically nonpalpable inguinal nodes harbor occult metastases.
- Immediate resection of clinically occult lymph node metastases is associated with improved survival when compared with delayed resection of involved nodes at the time of clinical detection.
- In experienced hands, DSNB is an effective minimally invasive technique for assessment of clinically negative groins and should be performed with the goal of a false-negative rate of 5% or less.
- Superficial and modified complete inguinal lymph node dissections allow for a thorough assessment of the superficial inguinal nodal basin, do not require specialized equipment, and are associated with less morbidity than radical inguinal lymphadenectomy.
- There is early evidence to suggest that the morbidity of an endoscopic inguinal lymph node dissection may be lower than previously reported for open contemporary series with a similar number of nodes being harvested.
- Radical IFLND is indicated in patients with resectable metastatic adenopathy and may be curative when the disease is limited to the inguinal nodes.
- Penile cancer metastases to the pelvic lymph nodes do not occur in the setting of negative ipsilateral inguinal nodes.

REFERENCES

The complete reference list is available online at www.expertconsult.com.

SUGGESTED READINGS

Catalona WJ. Modified inguinal lymphadenectomy for carcinoma of the penis with preservation of saphenous veins: technique and preliminary results. J Urol 1988;140:306–10.

Djajadiningrat RS, Graafland NM, van Werkhoven E, et al. Contemporary management of regional nodes in penile cancer—improvement in survival? J Urol 2014;191:68–73.

Hagarty PK, Dinney CP, Pettaway CA. Controversies in ilioinguinal lymphadenectomy. Urol Clin North Am 2010;37:421–34.

Kroon BK, Horenblas S, Lont AP, et al. Patients with penile carcinoma benefit from immediate resection of clinically occult lymph node metastases. J Urol 2005;173:816–9.

Lam W, Alnajjar HM, La-Touche S, et al. Dynamic sentinel lymph node biopsy in patients with invasive squamous cell carcinoma of the penis: a prospective study of the long-term outcome of 500 inguinal basins assessed at a single institution. Eur Urol 2013;63:657–63.

Master VA, Jafri SM, Moses KA, et al. Minimally invasive inguinal lymphadenectomy via endoscopic groin dissection: comprehensive assessment of immediate and long-term complications. J Urol 2012;188:1176–80.

Matin SF, Cormier JN, Ward JF, et al. Phase 1 prospective evaluation of the oncological adequacy of robotic assisted video-endoscopic inguinal lymphadenectomy in patients with penile carcinoma. BJU Int 2013; 111:1068–74.

McDougal WS, Kirchner FK, Edwards RH, et al. Treatment of carcinoma of the penis: the case for primary lymphadenectomy. J Urol 1986;136: 38–41.

Pizzocaro G, Algaba F, Horenblas S, et al. EAU penile cancer guidelines 2009. Eur Urol 2010;57:1002–12.

Sadeghi R, Gholami H, Zakavi SR, et al. Accuracy of sentinel lymph node biopsy for inguinal lymph node staging of penile squamous cell carcinoma: systematic review and meta-analysis of the literature. J Urol 2012;187:23–31.

Spiess PE, Hernandez MS, Pettaway CA. Contemporary inguinal lymph node dissection: minimizing complications. World J Urol 2009;27:205–12.

Wood HM, Angermeier KW. Anatomic considerations of the penis, lymphatic drainage, and biopsy of the sentinel node. Urol Clin North Am 2010;37:327–34.