Cervical intraepithelial neoplasia: Diagnostic excisional procedures

AUTHORS: Mitchel S Hoffman, MD, William J Mann, Jr, MD
SECTION EDITOR: Barbara Goff, MD
DEPUTY EDITOR: Alana Chakrabarti, MD

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INTRODUCTION

Cervical diagnostic excisional procedures (also known as conization or cone biopsy) refer to the excision of a cone-shaped portion of the cervix surrounding the endocervical canal and including the entire transformation zone. Excisional procedures can be performed using a scalpel, electrosurgery (ie, loop electrosurgical excision procedure [LEEP], also called large loop excision of the transformation zone [LLETZ]), or laser. While it is unclear if one technique is superior to another, LEEP has largely replaced laser because laser is expensive, technically difficult, and can cause harm to medical personnel. Laser is still occasionally utilized and, therefore, included in the following sections.

Since squamous lesions typically arise at the transformation zone, the procedure usually enables the pathologist to study an intraepithelial or superficially invasive lesion in its entirety. However, an excisional procedure does not always remove the entire transformation zone or lesion. Excision is less likely to be complete in certain situations, such as pregnancy, or when the transformation zone is large or high in the endocervical canal, or when the lesion extends onto the vaginal fornices or very deep into the cervical stroma.

Ablative procedures, which are usually done with cryosurgery or with the laser, are an alternative to an excisional procedure. However, no pathologic specimen is obtained since the cervical tissue is destroyed. These procedures are purely therapeutic and not of diagnostic value. They are appropriate for selected patients with previously well-characterized lesions histologically and colposcopically in whom invasive cancer has been

excluded. In the United States, excision, specifically with LEEP, has largely replaced the practice of cryotherapy or laser ablation.

The procedures for cervical excisional procedures are reviewed here. The management of cervical epithelial neoplasia (CIN), indications for ablation and excision, how to choose between the treatment options, and the procedures for ablation are discussed elsewhere.

- (See "Cervical intraepithelial neoplasia: Management".)
- (See "Cervical intraepithelial neoplasia: Choosing excision versus ablation, and prognosis and follow-up after treatment".)
- (See "Cervical intraepithelial neoplasia: Ablative therapies".)

COMPARISON OF METHODS

It is unclear if the three excisional methods (cold knife, loop electrosurgical excision procedure [LEEP], laser) yield similar outcomes. In a systematic review of 23 randomized trials of excisional procedures for CIN, rates of hemorrhage or CIN recurrence were similar among the three techniques [1]. Thermal artifact was greater with laser compared with LEEP (odds ratio [OR] 2.8, 95% CI 1.6-5.1). By contrast, in a 2022 network meta-analysis including over 19,000 patients with CIN from 71 randomized and observational studies, patients treated with cold knife cone or laser conization compared with large loop excision of the transformation zone (LLETZ; the most commonly used technique) had lower rates of treatment failure (OR 0.6, 95% CI 0.5-0.8 and OR 0.6, 95% CI 0.4-0.8, respectively) [2]. Other adverse events (eg, hemorrhage, thermal damage) were not reported.

There are procedural advantages and disadvantages of each type of excisional method. Familiarity with all of these procedures allows the gynecologic surgeon to use the method that best suits an individual situation (table 1). As an example, the laser allows greater flexibility in managing the ectocervical component of the disease because of its ability to combine the vaporization and excisional techniques, while LEEP is readily performed as an office procedure. In addition, cold knife or laser procedures usually remove a larger volume of tissue than LEEP [3]. A cold knife cone avoids thermal damage to the margins of the specimen.

HEALTH CARE WORKERS AT RISK FOR OCCUPATIONAL EXPOSURE

Smoke generated from excisional and ablative procedures for CIN can expose the operative team to human papillomavirus (HPV) infection [4]. In one study of 700 gynecologists, HPV infection rate was higher in the nasal epithelial cells of those who perform electrosurgery or

loop electrosurgical excision procedures compared with those who do not (9 to 10 percent versus 2 to 3 percent) [5]. In addition, HPV-positive rates were lower among those wearing an N-95 mask compared with a non-N-95 surgical mask (0 versus 14 to 16 percent).

This exposure may increase the risk of developing HPV-associated upper aerodigestive (nasal and oropharyngeal) disease. Although the magnitude of this risk is unknown, at least four case reports have described oropharyngeal cancer and laryngeal papillomatosis in health care workers with an occupational exposure to HPV [6-8].

The entire operative team, including physicians, nurses, and the operating room staff, should be aware of this risk. Health care workers should use personal protective equipment (eg, N-95 mask) in addition to a smoke evacuation system, and the American Society for Colposcopy and Cervical Pathology suggests that they receive the HPV vaccine, if not already vaccinated [9]. This is discussed in more detail separately. (See "Human papillomavirus vaccination", section on 'Health care workers at risk for occupational exposure'.)

OPERATIVE TECHNIQUE

Overview — The goal of cervical excisional procedures is to remove the entire transformation zone. Too small an excision can result in inadequate removal of the lesion, while an excision that is too large can lead to immediate and delayed complications. The size and shape of the excision should be tailored to the individual situation and based upon careful preoperative colposcopy and good surgical judgment. Colposcopy in the operating room just before the procedure is not always practical but may be helpful in many situations. Extending colposcopy to include evaluation of the upper vagina is worthwhile, especially in the presence of large, high-grade ectocervical lesions.

If the transformation zone and lesion are in the endocervical canal and the exocervix appears normal, the excisional procedure may be made narrower to preserve the normal ectocervical tissue, but should extend well upward along the endocervical canal (figure 1). By comparison, if the lesion and transformation zone are largely confined to the ectocervix and the endocervical canal appears to be free of disease, then the excision is taken wide enough to clear the transformation zone with minimal resection of the endocervical canal (figure 1).

The use of vasopressin and postprocedure packing decreases perioperative blood loss and menstrual symptoms. A systematic review of three randomized trials reported the following major results [10]:

- Cervical injection of vasopressin before biopsy reduced perioperative blood loss in cold knife and laser procedures.

- Packing of the biopsy site with a rolled gauze dipped in ferric subsulfate solution (Monsel solution) resulted in a twofold reduction in the incidence of secondary hemorrhage compared with lateral cervical sutures after cold knife conization.

- Packing of the biopsy site with a rolled gauze dipped in ferric subsulfate resulted in a decreased risk of amenorrhea or dysmenorrhea compared with lateral cervical sutures at four months after cold knife conization.

Cold knife conization — Cold knife conization is performed with a scalpel, almost always under general or regional anesthesia. The patient is placed in the dorsal lithotomy position. Many surgeons drain the bladder to protect against bladder injury. We, however, do not drain the bladder since we do not find this necessary for bladder protection, and catheterization may increase the risk of a postoperative urinary tract infection. A digital examination is not done and the vagina is gently prepared to avoid trauma to the cervix leading to possible difficulty with histologic interpretation of the specimen. A weighted speculum of appropriate length and narrow Deaver retractors are placed to allow visualization the cervix.

Colposcopic examination may be performed, and some surgeons use Lugol's iodine or 3 to 5 percent acetic acid solution to help demarcate the outer limits of the transformation zone. These procedures help the surgeon decide as to the size and configuration of the cone. Deeper cones (2 cm or more) are necessary in postmenopausal patients undergoing conization because the squamocolumnar junction tends to move cephalad into the endocervical canal; this anatomy makes the complete resection of abnormal cervical epithelium challenging and increases the risk of injury to surrounding structures.

The anterior lip of the cervix is grasped with a single tooth tenaculum well outside the transformation zone, so as not to interfere with the excision. If room allows, a tenaculum placed on the posterior cervical lip is also helpful. In patients with an abnormally shaped cervix (eg, "fish mouth" cervix), the specimen may need to be removed in pieces. The tenaculum is moved from one location to another to facilitate this. Although many surgeons recommend the placement of absorbable sutures at the three and nine o'clock positions just below the cervicovaginal junction (sutures placed too deeply may be cut during excision) (figure 2), this has not been shown to be the optimal technique.

A vasoconstrictor solution may be injected into the cervix at this time, if there are no medical contraindications (eg, hypertension). Use of the solution reduces intraoperative blood loss and thereby improves operative exposure, allowing the surgeon to do a more controlled and accurate cone biopsy. We use 20 to 30 mL of vasopressin (0.5 U/mL) or 1:200,000 epinephrine solution injected with a 1.5-inch, 21-gauge needle circumferentially deep into the dense cervical stroma, just lateral to the planned line of resection.

A long-handled scalpel with a #11 blade is used to make a circumferential incision just lateral to the outer limit of the transformation zone (figure 3). Starting posteriorly, the scalpel blade is inserted to the desired depth and direction (in general, slightly toward the endocervical canal). Using a very slight sawing motion (more like pushing) in an attempt to keep the scalpel at the same depth and angle, the desired circular incision is completed. A uterine sound may help guide the path of the incision when a significant portion of the endocervical canal must be removed; care should be taken not to traumatize the endocervical canal.

An Allis clamp or toothed forceps is used to gently grasp and manipulate the partially released specimen, being careful to avoid the mucosal surfaces (figure 4). Mayo scissors are used to complete and deepen the incision as necessary. The specimen is then removed by cutting across the remaining base with Jorgenson scissors (figure 5). The residual endocervical canal is then curetted.

Routine dilation and endometrial curettage is unnecessary, except in patients in the menopausal transition and postmenopausal patients, those with abnormal glandular cytology, and patients who otherwise have factors placing them at risk of endometrial pathology, such as abnormal bleeding [11,12]. In those patients in whom dilation and curettage is indicated, the conization is done first to preserve cervical architecture.

Optimal management of the cone bed is not well established. A variety of suture techniques have been described, such as a modification of Sturmdorf type sutures (figure 6) [13]. We use these sutures when there is significant bleeding from the cone bed or when a large cone biopsy has been taken. There is some concern, however, that sutures placed into the cone bed may interfere with healing. Another hemostatic measure is to firmly place in the cervix a tampon or rolled gauze soaked in ferric subsulfate solution; the pack can removed by the patient pulling the string in 12 to 24 hours.

Alternatively, an open cone bed technique can be performed [14-18]. This procedure is approached by obtaining spot hemostasis with electrocautery. A long, narrow piece of oxidized cellulose (eg, Surgicel) is then carefully packed into the cone bed and secured by tying lateral cervical sutures across the midline over the surgical pack (figure 7). Patients must be warned that they will pass this pack within one to two weeks. Ideally, the procedure is timed so that menstrual flow does not occur while the pack is in place. The vagina is generally not packed and the patient is sent home the same day or the next morning.

It is useful for the surgeon to measure the length (distance between the ectocervical and endocervical margin), anterior posterior dimension (distance between the anterior and posterior margin), and transverse dimension (distance between the left and right margin) of the cone specimen in the operating room and describe these measurements in the operative

note [19]. Measurements taken later, such as in the pathology laboratory, may be inaccurate due to shrinkage of the specimen.

If the cervix has a large defect, care must be taken in that area to not enter into the peritoneal cavity with the knife blade. Should this occur, laparoscopy to examine the pelvis may be indicated. Similarly, if the anterior cervix is absent and the blade is felt to have gone too deep, cystoscopy may be appropriate to examine the bladder.

Loop electrosurgical excision procedure — The loop electrosurgical excision procedure (LEEP), also called large loop excision of the transformation zone (LLETZ), utilizes a very thin wire in the shape of a loop and modern electrosurgical generators that allow accurate and selective blending of the current. The loops are available in a variety of sizes, allowing individualization and avoidance of excessive excision (figure 8). They are insulated along the shaft and crossbar to prevent injury to the patient and thermal damage to the ectocervical portion of the cone. A plastic or insulated speculum must also be used. A speculum that will connect to suction is helpful. The LEEP procedure can be performed in an office setting [20-24]. As with the laser cone, however, this requires a cooperative patient and a reasonable amount of room to work.

The cervix is assessed using the colposcope (see "Colposcopy"). The appropriate size loop is selected based upon the diameter of the lesion.

Analgesia is typically administered as a local anesthetic and vasoconstrictor solution (eg, 5 to 10 mL of 1 percent lidocaine with 1:100,000 epinephrine), injected submucosally into the surface of the cervix (ectocervix) at the 3, 6, 9, and 12 o'clock positions. Use of a local anesthetic with a vasoconstrictor is more effective at reducing pain than local anesthetic alone, based upon a meta-analysis that included two randomized trials [25]. In addition, the use of a vasoconstrictor reduces blood loss. Use of a topical anesthetic spray has been proposed to avoid the pain of injection. As an example, one randomized trial (n = 101) found no difference in pain during the excision for submucosal injection of lidocaine and epinephrine compared with topical lidocaine spray; however, blood loss was not measured [26].

The electrosurgical generator is set at 30 to 40 watts on blend 1. A blended current mixes cutting and coagulating currents. The higher the blend, the more the coagulating current and the greater the thermal damage.

The loop is carefully passed simultaneously around and under the transformation zone, thus excising it (figure 9). The loop should be allowed to glide through the cervix from one side to the other, allowing the cutting current to divide the tissue. If the surgeon attempts to pull quickly through the cervix, the loop will drag, bend, or adhere to the tissue, resulting in a shallower excision than was intended. If the loop moves too slowly, however, excess thermal

damage to the specimen will occur. Occasionally, it is necessary to make additional passes in order to ensure complete removal of endocervical disease.

If preoperative evaluation showed that the lesion extends into the endocervical canal beyond the reach of the loop (ie, 5 mm), additional tissue may be excised from this area with a smaller-diameter rectangular loop [21,22,27,28]. Additional local anesthesia should be administered to this area before proceeding. Colposcopic reassessment can be done to determine adequacy of excision.

An endocervical curettage is performed following completion of excision, and hemostasis is obtained with a Ball electrode or regular tip cautery. It is also advisable to apply ferric subsulfate paste to the cone bed.

Laser conization — The laser cone is a more demanding surgical procedure than cold knife conization and requires a certain amount of expertise, both with cone biopsy and with laser surgery of the lower genital tract. Most laser conizations are performed in the operating room under general or regional anesthesia. However, there are a few older reports of the procedure being done in an office setting [27,29-32]. This is only appropriate when a small or shallow cone is planned, the office staff is experienced, and the patient is cooperative and has some degree of pelvic organ prolapse. (See "Cervical intraepithelial neoplasia: Ablative therapies".)

Protective eyewear is mandatory for operating room personnel. In addition, there must be close communication between the surgeon and the person assisting in the operation of the laser machine. Wet towels are placed externally to protect the perineum and thighs from a misdirected laser beam. Paper drapes are avoided due to the risk of fire. Only the outer vagina is prepared. Speculums and tenaculums should be black to avoid reflection of the laser beam; both weighted and Graves speculums are available with a built-in hookup for suction. In the office, a Graves speculum may be used.

The cervix is infiltrated (as described above) with a vasoconstrictor solution. Under direct vision with the colposcope, a margin around the outer limit of the transformation zone is marked by making a series of dots with the carbon dioxide laser, which is set on intermittent power (figure 10). The diameter of the ectocervical portion of the cone should be kept fairly large because of shrinkage of the specimen, which does not occur with a cold knife cone. The recommended power density used for laser conization is generally in the range of 1000 to 1500 watts/cm^2.

A very large cone may be required if there is extensive ectocervical disease that is clearly intraepithelial. Alternatively, the surgeon may elect to ablate much of the ectocervical disease in concert with a small cervical cone biopsy [33,34]. The outer and inner margins of the planned ablation are marked with the laser and divided into quadrants. Starting

posteriorly, each quadrant is vaporized to a depth of 5 to 7 mm using a power density of 500 to 1000 watts/cm^2 (figure 11). The external incision for the planned cone biopsy is made with the laser. This is done with a smaller spot size (0.5 to 1.0 mm) and a higher power density (1000 to 1500 watts/cm^2).

A skin hook is placed on the freed stromal edges of the cone specimen and a tenaculum and/or lateral sutures are simultaneously used to manipulate the cervix and exert traction. The laser incision is deepened to the depth and in the direction desired until the specimen is only attached around the endocervical canal. It is desirable to cut across this area with Jorgenson scissors, rather than with the laser, to reduce thermal damage of the endocervical margin.

Endocervical curettage is then performed. The careful application of spot cautery or the application of ferric subsulfate paste is most effective for obtaining hemostasis. However, a "defocused" laser beam using a larger spot size (2 mm) and a lower power density (200 watts/cm^2) can be used to obtain hemostasis at the cut endocervical margin and within the cone bed. An oxidized cellulose (Surgicel) pack may be tied into the cone bed when bleeding is more substantial. (See 'Cold knife conization' above.)

POSTOPERATIVE INSTRUCTIONS

The patient is instructed to avoid intercourse, immersing in water, and place nothing in the vagina for two to four weeks. A follow-up visit is scheduled in the office at six weeks to be sure the cervix is healing and the endocervical canal is patent. The type of testing (human papillomavirus-based testing versus cytology only) and timing are discussed in detail elsewhere. It is important, however, that cytology, if performed, not be obtained before three months because the specimen may be contaminated with debris, metaplastic cells, and leukocytes, and thus difficult to interpret. (See "Cervical intraepithelial neoplasia: Choosing excision versus ablation, and prognosis and follow-up after treatment", section on 'Type and duration of testing'.)

COMPLICATIONS

Intraoperative bleeding — Major intraoperative complications are uncommon during cervical excisional procedures. Bleeding is rarely heavy and conservative measures (eg, sutures, cautery, ferric subsulfate paste [35]) are usually adequate for control of hemorrhage. The surgeon may resort to a cerclage-type stitch, internal iliac artery embolization or ligation, or hysterectomy if bleeding remains severe.

Uterine perforation — Perforation is uncommon but is more likely when the uterus is acutely anteflexed or atrophied (postmenopausal patients). Perforation laterally may result in laceration of the uterine artery and broad ligament hematoma [36]. Laceration of the bladder and rectum has also been reported [37]. Laparoscopy, or even laparotomy, may be needed to manage these problems. The likelihood of these complications probably does not vary greatly according to excisional method. (See "Uterine perforation during gynecologic procedures".)

Postoperative bleeding — Bleeding shortly after surgery may be due to inadequate intraoperative hemostasis or a result of vasodilation after the vasoconstrictor solution wears off. Delayed hemorrhage may occur one to two weeks after surgery, and is related to dissolving sutures or erosion of a blood vessel during the healing process. The incidence of postoperative bleeding following cold knife conization is 5 to 15 percent [13,14,38-43]. This rate may be reduced slightly in procedures using the laser (2 to 10 percent) [27,29,31,32,39,44-46] or loop electrosurgical excision procedure (LEEP; 0 to 8 percent) [20-23,41,47-50]. Few comparative studies are available and possible contributing factors, such as cone size, are difficult to assess from published information. Early or delayed hemorrhage will often resolve with conservative measures in the office, such as application of silver nitrate or ferric subsulfate, suturing, or packing. Occasionally, surgical hemostasis under anesthesia is required.

Infection — The incidence of infection following cold knife conization is 0.2 to 6.8 percent [13,39,40,42,47,51]. The infection may manifest in a variety of ways, including local cervical inflammation, endometritis, parametritis, salpingitis, or pelvic abscess. The value of prophylactic antibiotics before cone biopsy is not known. They should be used in selected high-risk patients (eg, history of gonorrhea, pelvic inflammatory disease). Infection following laser conization or the LEEP procedure appears slightly lower (0 to 2 percent) [20,21,23,27,29,30,32,34,41,46].

Late complications — Late complications of excision include cervical insufficiency and cervical stenosis.

Reported incidences of cervical stenosis following excisional procedures vary widely (0 to 27 percent) [52]. This variability is likely because studies have been small and there is no standard definition of cervical stenosis. In the largest studies, the rate of cervical stenosis for each excisional procedure was: cold knife (8 percent; n = 100), LEEP (4.3 to 7.7 percent; n = 274 and 277), and laser (7.1 percent; n = 1218) [52-55]. The most consistently reported risk factors for cervical stenosis in patients who had undergone excisional treatment were amount of tissue removed (eg, incision depth of ≥1 to 2 cm versus <1 cm was associated with cervical stenosis) and postmenopausal status [54-59]. In our experience, cervical stenosis

and obliteration of the canal occurs more commonly in postmenopausal compared with premenopausal patients.

Effects of an excisional procedure on fertility and pregnancy are discussed separately. (See "Reproductive effects of cervical excisional and ablative procedures", section on 'Adverse reproductive effects of procedures performed before pregnancy'.)

DISPOSITION

Excisional margins — An excisional procedure does not always remove the entire transformation zone. It is less likely to be complete in certain situations, such as pregnancy, large transformation zone, transformation zone high in the endocervical canal (especially in postmenopausal patients), or extension onto the vaginal fornices. A full discussion of follow-up of patients with CIN and positive margins after an excisional procedure can be found separately. (See "Cervical intraepithelial neoplasia: Choosing excision versus ablation, and prognosis and follow-up after treatment", section on 'Prognosis after excision or ablation'.)

Microinvasive disease or adenocarcinoma in situ — Management of the patient whose cone demonstrates microinvasive squamous cell carcinoma or adenocarcinoma in situ is discussed separately. (See "Management of early-stage cervical cancer" and "Cervical adenocarcinoma in situ".)

Planned hysterectomy — The inflammatory tissue reaction which follows cone biopsy impacts the timing of subsequent surgery. If a hysterectomy is indicated, it can be performed from immediately after an excisional procedure until the inflammation begins (usually one to two days postoperatively) [60-67]. During this brief window, decisions regarding hysterectomy will need to be made based on frozen section or expedited final pathologic evaluation. At institutions with pathologists experienced in interpretation of frozen cervical specimens, cervical excision with frozen section before planned hysterectomy is safe and accurate when the histopathology is intraepithelial squamous cell disease, and avoids the administration of a second anesthetic [64,68,69]. However, interpretation of frozen sections may be less accurate in patients who are pregnant or have adenocarcinoma or adenosquamous carcinoma [68]. Surgical therapy of these patients should be based upon results of permanent sections until data showing accuracy become available. If hysterectomy is felt to be indicated, but cannot be done within 48 hours, it is recommended that one wait approximately six weeks to allow parametrial inflammation to resolve. Should invasive cancer be found and radical hysterectomy planned, this can be done at any time interval, since the parametrium is to be removed.

The expedited approach is preferable if a radical hysterectomy is indicated following cone biopsy, depending upon the extent of disease [70]. Otherwise, there is a six to eight-week

waiting period until the inflammatory reaction subsides.

PREGNANT PATIENTS

An excisional procedure during pregnancy is rarely indicated and should be performed only when there is a strong suspicion of invasive cancer. A full discussion of cervical excisional procedures during pregnancy can be found separately. (See "Cervical cancer in pregnancy", section on 'Indications for and performance of conization'.)

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Cervical cancer screening, prevention, and management".)

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Beyond the Basics topic (see "Patient education: Management of a cervical biopsy with precancerous cells (Beyond the Basics)")

SUMMARY AND RECOMMENDATIONS

- **Clinical significance –** Cervical diagnostic excisional procedures (also known as conization or cone biopsy) refer to the excision of a cone-shaped portion of the cervix surrounding the endocervical canal and including the entire transformation zone in

patients with cervical intraepithelial neoplasia (CIN). Such procedures are diagnostic and potentially therapeutic. (See 'Introduction' above.)

- **Technique**
  - Excisional procedures can be performed using a scalpel, electrosurgical loop excision (ie, loop electrosurgical excision procedure [LEEP], also called large loop excision of the transformation zone [LLETZ]), or less commonly, laser. (See 'Introduction' above.)
  - It is unclear if the three excisional methods yield similar outcomes. Procedural advantages and disadvantages of each type of excisional method are detailed in the table (table 1). (See 'Comparison of methods' above.)
  - The technique used and the configuration of the excision should be individualized, depending on the specific lesion (figure 1). (See 'Operative technique' above.)
- **Complications**
  - Major intraoperative complications (eg, intraoperative bleeding, uterine perforation) are uncommon during cervical excisional procedures. (See 'Intraoperative bleeding' above and 'Uterine perforation' above.)
  - Postoperative bleeding occurs in up to 15 percent of patients and depends on the type of procedure performed. Bleeding shortly after surgery may be due to inadequate intraoperative hemostasis or a result of vasodilation after the vasoconstrictor solution wears off. Delayed hemorrhage can occur one to two weeks after surgery and is related to dissolving sutures or erosion of a blood vessel during the healing process. (See 'Postoperative bleeding' above.)
  - Late complications include cervical insufficiency and cervical stenosis. (See 'Late complications' above and "Reproductive effects of cervical excisional and ablative procedures", section on 'Adverse reproductive effects of procedures performed before pregnancy'.)
- **Health care workers –** Smoke generated from excisional and ablative procedures for CIN can expose the operative team to human papillomavirus (HPV) infection, increasing their risk of HPV-associated upper aerodigestive (nasal and oropharyngeal) disease. Health care workers should use personal protective equipment (eg, N-95 mask) in addition to a smoke evacuation system, and the American Society for Colposcopy and Cervical Pathology suggests that they receive the HPV vaccine, if not already vaccinated. (See 'Health care workers at risk for occupational exposure' above.)

- **Pregnant patients –** An excisional procedure during pregnancy is rarely indicated and should be performed only when there is a strong suspicion of invasive cancer. (See 'Pregnant patients' above.)

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Topic 3255 Version 28.0

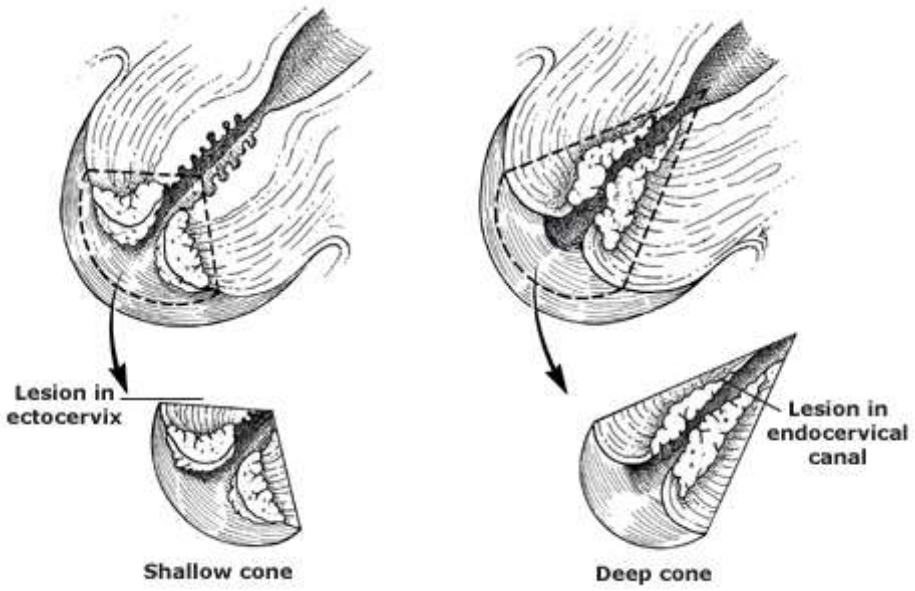
GRAPHICS

Comparison of different techniques for cervical (uterine cervix) conization

Advantages	Disadvantages
Cold knife conization	
▪ Technical simplicity ▪ Excellent specimen quality	▪ General or regional anesthetic required ▪ Distortion after healing ▪ Complication rate higher
Laser conization	
▪ Good specimen quality ▪ Good hemostasis ▪ Healing with minimal distortion ▪ Low complication rate ▪ Can be done in an office setting ▪ Flexible treatment of endocervix	▪ Technically difficult ▪ Expense and upkeep of equipment ▪ Some thermal damage ▪ A narrow deep cone is difficult
Large loop excision of the transformation zone	
▪ Easily done in the office setting ▪ Rapid performance ▪ Technically easy ▪ Equipment inexpensive ▪ Low complication rate ▪ Good specimen quality ▪ Healing with minimal distortion	▪ Some thermal damage ▪ A large or deep cone may be difficult to perform in the office and result in more thermal damage if a second loop excision is required

Graphic 61097 Version 3.0

Choosing the shape of cervical (uterine cervix) conization based upon configuration of the lesion



Courtesy of William J Mann, Jr, MD.

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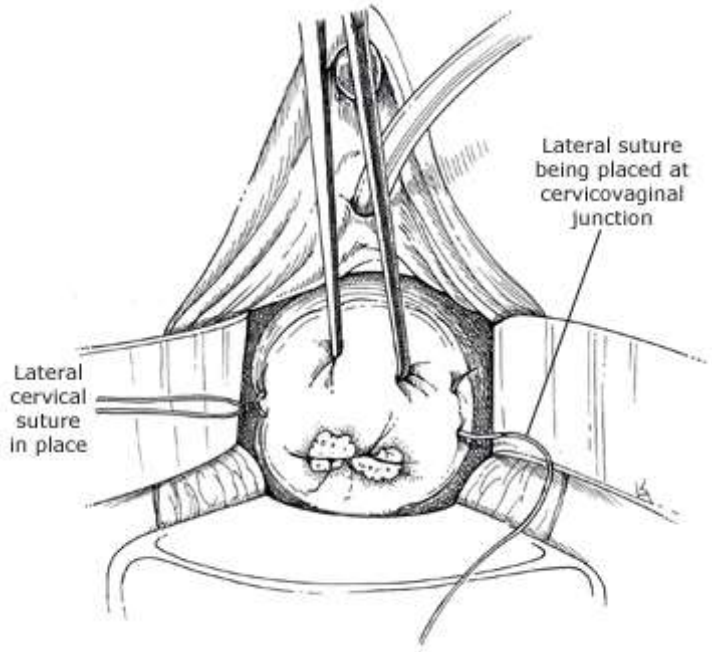
Placement of lateral sutures at cervicovaginal junction during cervical (uterine cervix) conization



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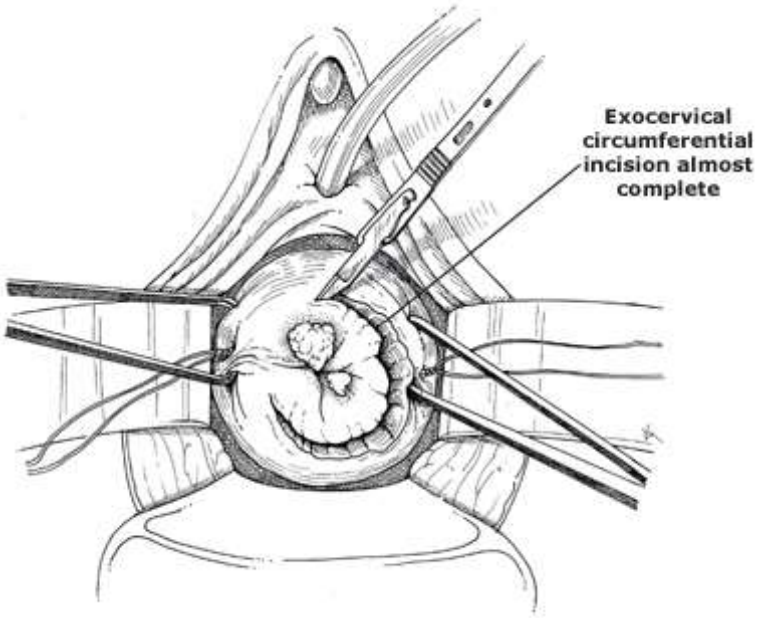
Start of cervical (uterine cervix) cone biopsy

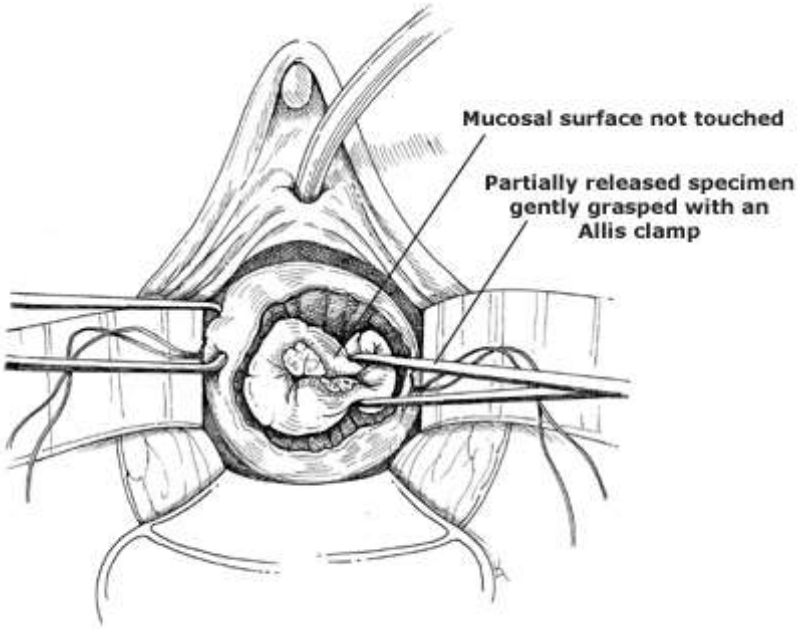


An exocervical circumferential incision is initiated.

Courtesy of William J Mann, Jr, MD.

Graphic 65918 Version 2.0

Removing the cervical (uterine cervix) cone specimen

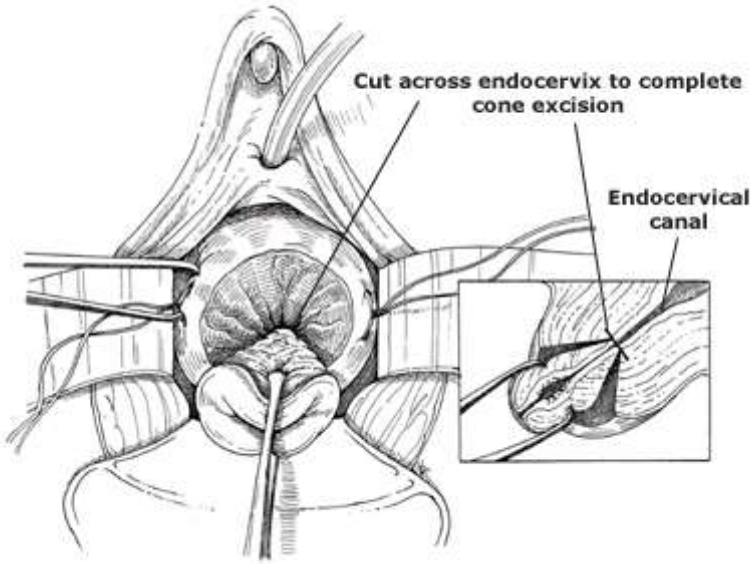


Partially released cone specimen is gently grasped with an Allis clamp, avoiding the mucosal surfaces.

Courtesy of William J Mann, Jr, MD.

Graphic 59404 Version 2.0

Completion of cervical (uterine cervix) cone biopsy

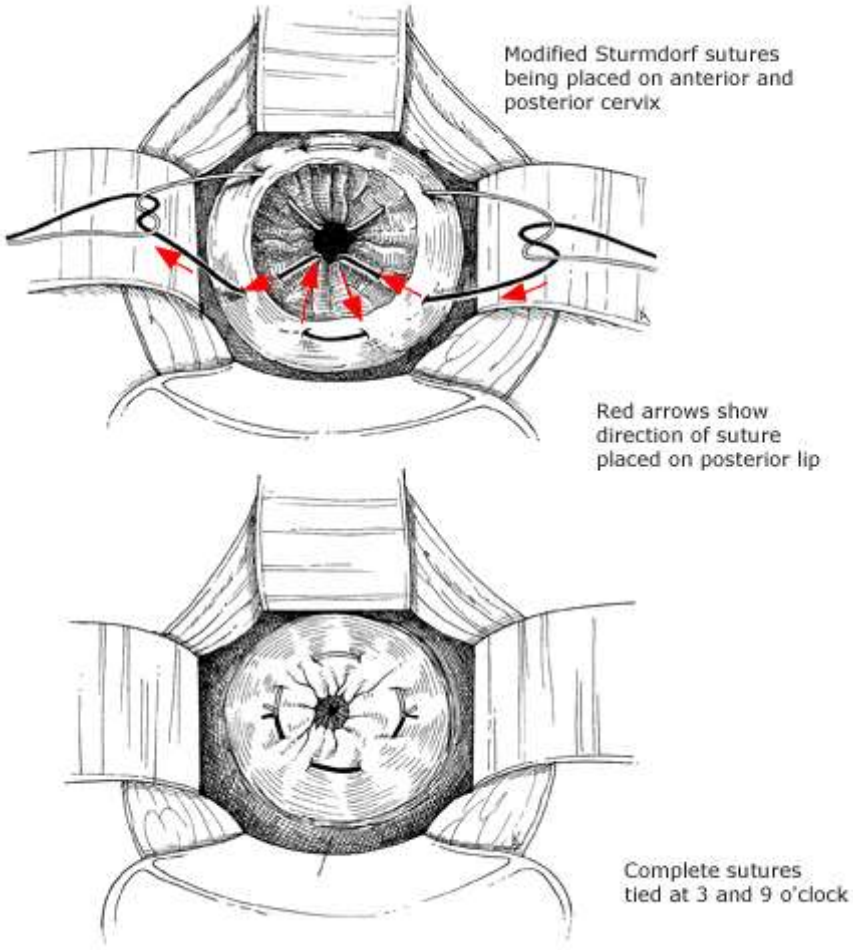


The specimen is excised by cutting across the endocervix.

Courtesy of William J Mann, Jr, MD.

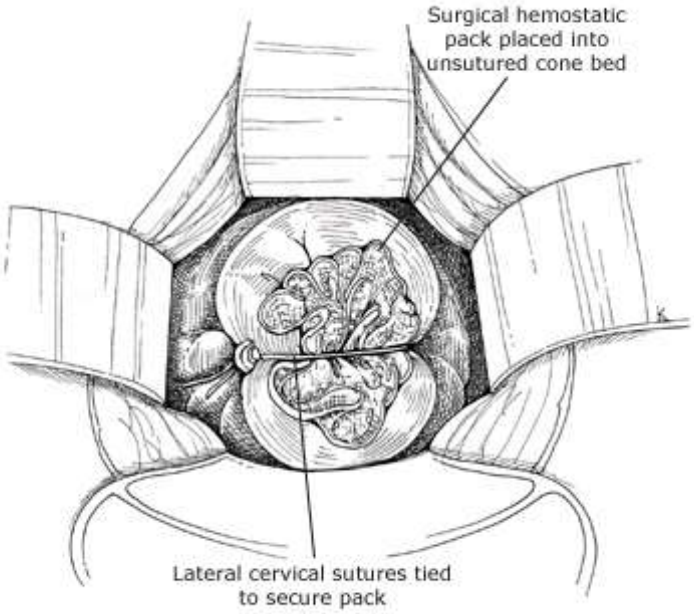
Graphic 54649 Version 2.0

Sturmdorf sutures for cervical (uterine cervix) conization



Graphic 52788 Version 2.0

Achieving hemostasis after cervical (uterine cervix) conization

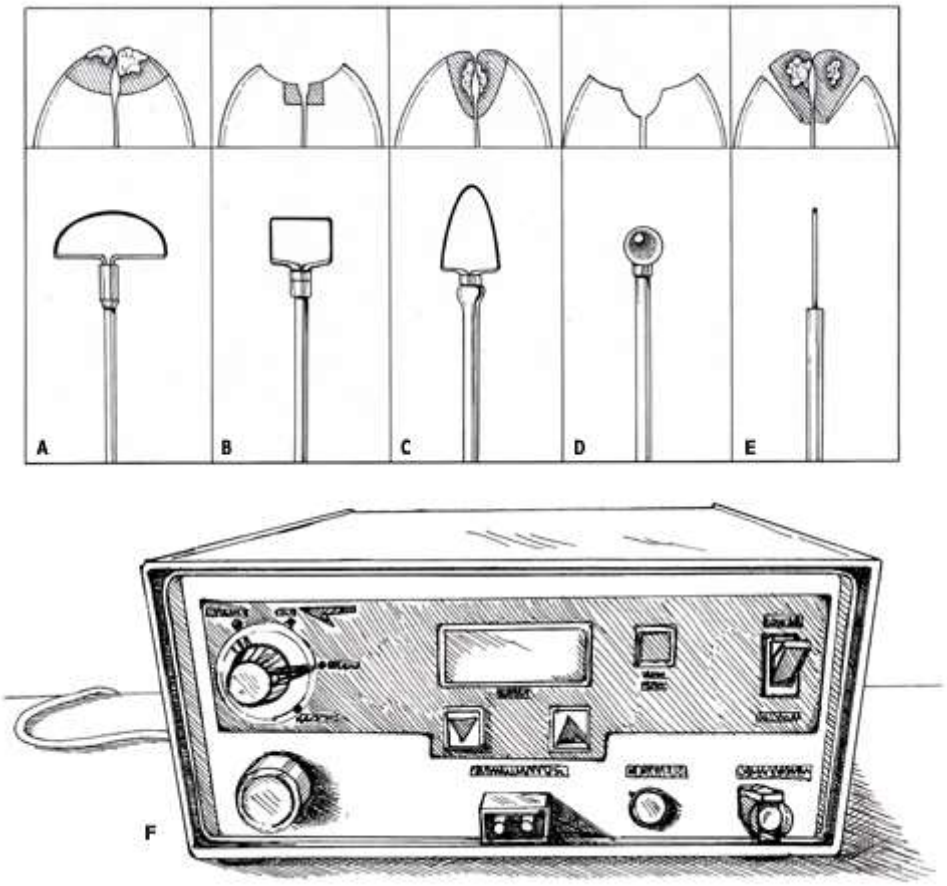


A surgical hemostatic pack (Surgicel) is placed into the unsutured cone bed and then secured in place by tying across with lateral cervical sutures.

Courtesy of William J Mann, Jr, MD.

Graphic 59131 Version 2.0

Equipment for loop electrosurgical excision procedure (LEEP) of uterine cervix



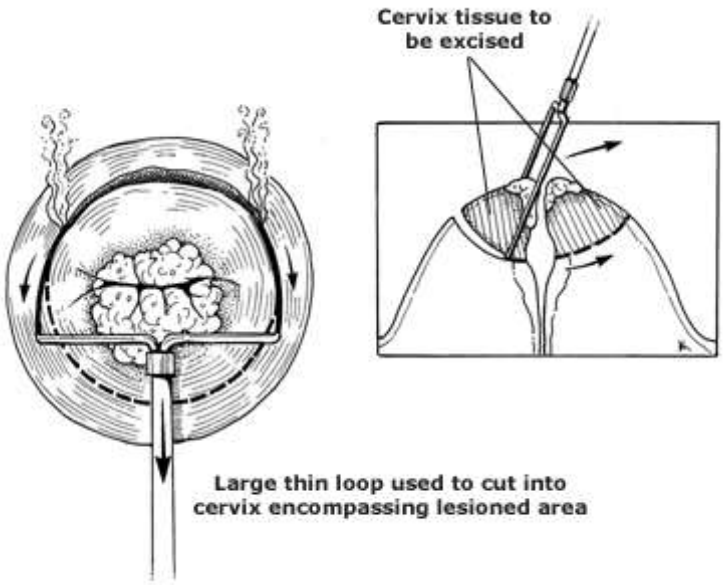
(A-E) Loops of various sizes.

(F) An electrosurgical generator.

Courtesy of William J Mann, Jr, MD.

Graphic 80021 Version 3.0

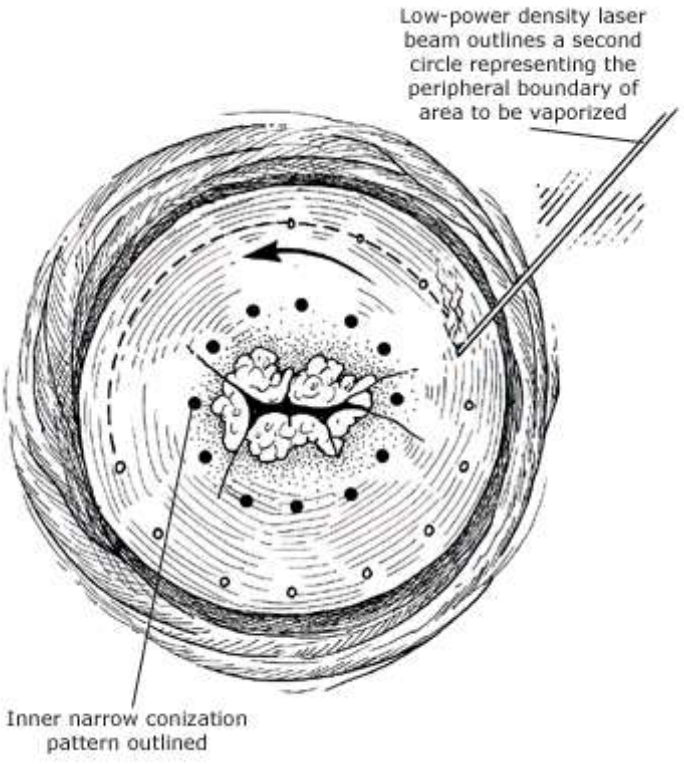
Large loop excision of the transformation zone of the uterine cervix



Courtesy of William J Mann, Jr, MD.

Graphic 81670 Version 2.0

Marking surgical boundaries for laser cervical (uterine cervix) conization

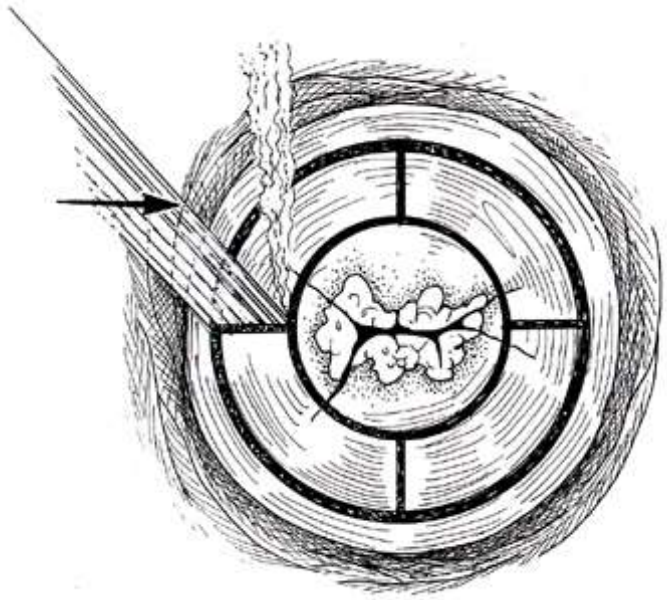


Exocervical margin of planned laser cone is marked with a circle of dots placed with the laser.

Courtesy of William J Mann, Jr, MD.

Graphic 68301 Version 2.0

Cervical (uterine cervix) conization-vaporization procedure



Areas planned for vaporization-conization are marked in quadrants. One quadrant is vaporized at a time.

Courtesy of William J Mann, Jr, MD.

Graphic 53376 Version 3.0

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Mitchel S Hoffman, MD No relevant financial relationship(s) with ineligible companies to disclose. **William J Mann, Jr, MD** No relevant financial relationship(s) with ineligible companies to disclose. **Barbara Goff, MD** No relevant financial relationship(s) with ineligible companies to disclose. **Alana Chakrabarti, MD** No relevant financial relationship(s) with ineligible companies to disclose.

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