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Perioperative Nursing Care and Clinical Outcomes in Cold Knife Conization of the Cervix: Pre-Procedure Assessment, Intraoperative Support, and Postoperative Surveillance

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Abstract

Background: Cervical dysplasia is a precursor to invasive cervical cancer, and accurate diagnosis is essential for effective management. Cold knife conization (CKC) is a surgical excisional technique that provides both diagnostic and therapeutic benefits by removing the transformation zone and abnormal epithelium for histopathologic evaluation.

Aim: This study aims to review perioperative nursing care and clinical outcomes associated with CKC, emphasizing indications, contraindications, procedural steps, complications, and interprofessional roles.

Methods: A comprehensive literature review was conducted, synthesizing evidence-based guidelines and clinical practices related to CKC. Key domains analyzed include anatomy, indications, contraindications, equipment, personnel, preparation, operative technique, complications, and nursing interventions.

Results: CKC offers superior specimen integrity and margin interpretability compared to electrosurgical techniques, reducing recurrence risk to approximately 1.4%. However, it carries notable risks, including intraoperative and delayed hemorrhage, infection, cervical stenosis, and obstetric complications such as preterm birth. Effective perioperative nursing care—spanning patient education, positioning, hemostasis monitoring, and discharge counseling—significantly mitigates these risks. Interprofessional collaboration among gynecologists, anesthesiologists, nurses, and pathologists is critical for optimizing outcomes.

Conclusion: CKC remains a gold-standard excisional procedure for high-grade cervical lesions when precise histopathologic assessment is required. Nursing interventions and team-based care are pivotal in ensuring safety, reducing complications, and supporting long-term surveillance.

Keywords: Cold knife conization, cervical dysplasia, perioperative nursing, margin status, complications, interprofessional care

Introduction

Cervical conization is an excisional surgical technique performed to obtain a diagnostic specimen from the cervix in patients with suspected or confirmed cervical dysplasia, and it may simultaneously provide definitive treatment in appropriately selected cases. The procedure—often termed a cone biopsy—entails removal of a cone-shaped segment of cervical tissue that includes the transformation zone, where most premalignant cervical lesions arise, together with the visibly abnormal epithelium or the area of greatest concern identified through cytology, colposcopy, and biopsy. The excised specimen is then submitted for histopathologic analysis to establish lesion grade, evaluate margin status, and—critically—exclude occult invasive carcinoma. When all dysplastic epithelium is fully contained within the cone specimen and margins are free of disease, cervical conization can be both diagnostic and therapeutic, offering a tissue-based approach that clarifies disease extent while achieving excision of the premalignant lesion [1]. Multiple modalities are available for performing cervical conization, and contemporary practice commonly includes cold knife conization (CKC), laser conization, the loop electrosurgical excision procedure (LEEP), and loop excision of the transformation zone (LLETZ) [1]. Although these approaches share the same overarching objective—excision of the transformation zone and the lesion of interest—they differ in operative technique, anesthesia requirements, specimen characteristics, and the extent of thermal artifact. These differences have direct implications for diagnostic accuracy and postoperative outcomes. In general, excisional procedures are indicated when histologic confirmation is required beyond what can be achieved through directed biopsy alone, particularly in situations where cytology and biopsy results are discordant, when high-grade cervical intraepithelial neoplasia is suspected or established, or when colposcopy is unsatisfactory due to incomplete

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visualization of the transformation zone. In such contexts, the ability to assess the endocervical canal and obtain intact tissue margins becomes essential for excluding invasive disease and ensuring appropriate staging and management planning.

Among available excisional techniques, LEEP and CKC remain the most commonly employed and are broadly effective for both diagnosis and treatment. However, method selection must be individualized, taking into account the patient's clinical risk profile, reproductive plans, lesion characteristics, colposcopic adequacy, and the need for precise histopathologic interpretation. CKC is performed using a scalpel rather than an electrosurgical loop and is typically undertaken under general or regional anesthesia. A frequently cited advantage of CKC is the acquisition of a larger, more anatomically intact specimen with reduced thermal injury at specimen edges compared with electrosurgical approaches. This characteristic can be particularly valuable when margin assessment is pivotal, such as in suspected glandular disease, when microinvasion is a concern, or when prior biopsies have not adequately explained high-risk cytologic findings. By minimizing thermal destruction at the margins, CKC may improve the pathologist's ability to evaluate completeness of excision and accurately determine whether dysplasia extends to resection borders [2][3]. Nevertheless, the choice between CKC and other modalities is not purely technical; it is a patient-centered decision that weighs diagnostic yield, procedural risk, and the implications of cervical excision for future fertility and pregnancy outcomes [1][2][3].

For nursing and interprofessional practice, CKC represents more than an operative event; it is a perioperative care pathway that begins with patient education and risk stratification and extends through intraoperative support, postoperative surveillance, and longitudinal follow-up for cervical intraepithelial neoplasia. Healthcare professionals involved in this pathway must be able to recognize appropriate indications and contraindications, understand expected benefits and foreseeable complications, and support procedural safety through evidence-aligned preparation and monitoring.

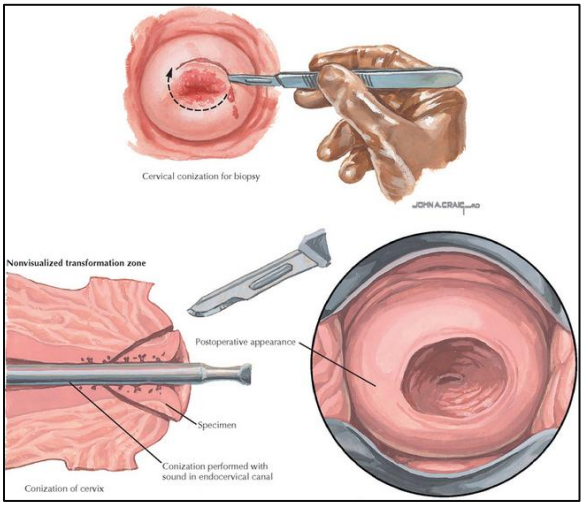

Fig. 1: Cold knife conization of the cervix.

This learning activity is designed to strengthen clinical competence in identifying when CKC is indicated, anticipating procedural risks, and understanding the operative principles that guide tissue excision and hemostasis. It also emphasizes the collaborative role of the interprofessional team—gynecologic clinicians, anesthesiology, nursing, pathology, and follow-up services—in delivering coordinated care that promotes accurate diagnosis, reduces complications, and improves patient outcomes for individuals undergoing cold knife conization for cervical dysplasia [1][2][3].

Anatomy and Physiology

The cervix is a compact, cylindrical structure forming the inferior portion of the uterus and serving as the anatomical and functional conduit between the uterine cavity and the upper vagina. Situated within the lower uterine segment, it provides a regulated passageway that supports several key reproductive functions, including maintenance of pregnancy, protection against ascending infection, and facilitation of menstrual outflow and childbirth. Anatomically, the cervix is commonly described in relation to two principal regions: the ectocervix and the endocervical canal. The ectocervix is the portion that projects into the vaginal vault and is visible on speculum examination. Its surface is lined by nonkeratinized stratified squamous epithelium, reflecting adaptation to the external vaginal environment. The opening through which the vaginal canal communicates with the cervix is the external cervical os, which marks the entry to the endocervical canal. The endocervical canal traverses the length of the cervix and provides continuity between the uterine endometrial cavity and the vagina. In contrast to the ectocervix, the endocervical canal is lined predominantly by columnar glandular epithelium, which is specialized for mucus production and plays a central role in cervical barrier function. The mucus produced within the canal varies in viscosity across the menstrual cycle under hormonal influence,

contributing to fertility regulation by either facilitating sperm transport during ovulation or limiting microbial ascent and sperm passage during other phases. The interface between the squamous epithelium of the ectocervix and the columnar epithelium of the endocervical canal is known as the squamocolumnar junction (SCJ), and the adjacent area of ongoing epithelial remodeling is referred to as the transformation zone [4]. This zone is of particular clinical significance because it is the predominant site for the development of cervical intraepithelial neoplasia and the location where screening and diagnostic sampling is most diagnostically informative [4].

The transformation zone is biologically dynamic and is shaped by the cervix's exposure to the vaginal environment. Because the vagina is characteristically acidic and the ectocervix is directly exposed to this milieu, everted columnar epithelium—when present on the ectocervical surface—undergoes physiologic replacement by squamous epithelium through a process of squamous metaplasia. This metaplastic transformation occurs at or near the SCJ and is generally a normal adaptive phenomenon. However, the same process creates a vulnerable microenvironment in which dysplastic and malignant transformation can occur, particularly when oncogenic strains of human papillomavirus (HPV) infect the basal epithelial cells. The SCJ and transformation zone are considered the cervical regions most susceptible to HPV attachment and infection, and persistent HPV infection in this area is a key driver of cervical dysplasia and potential progression to invasive carcinoma [4]. Importantly, the anatomical position of the SCJ is not fixed. In some individuals, it is readily visible on the ectocervix, facilitating colposcopic assessment and sampling. In others—particularly with age or postpartum cervical remodeling—the SCJ may migrate proximally into the endocervical canal, complicating visualization and increasing the clinical value of excisional procedures when high-grade disease is suspected but not fully accessible to directed biopsy [4]. Understanding cervical vascular and neural anatomy is essential for procedural planning and perioperative care, including cold knife conization. The primary arterial supply to the cervix arises from cervical branches of the uterine vessels, which typically enter the cervix laterally near the 3 o'clock and 9 o'clock positions. This laterally dominant blood supply has practical relevance for surgical hemostasis and for anticipating bleeding patterns during excisional procedures. From an innervation standpoint, the uterus and cervix receive sympathetic input via the hypogastric plexus and parasympathetic innervation from the sacral roots S2 to S4. Clinically, the cervix is relatively insensitive to cutting and burning, which explains why cauterization and limited excision can sometimes be performed with minimal anesthesia during certain therapeutic procedures. In contrast, the cervix and uterus are sensitive to stretch, such as occurs with dilation or distension, making adequate analgesia and careful technique important when cervical manipulation is required [4]. These anatomical and physiological features collectively underpin both the pathogenesis of cervical dysplasia in the transformation zone and the rationale for conization techniques that aim to excise this high-risk region while preserving cervical integrity whenever feasible [4].

Indications

Cold knife conization (CKC) is primarily a diagnostic excisional procedure performed to obtain an intact cervical specimen for definitive histopathologic evaluation when less invasive sampling is inadequate to clarify disease severity, extent, or invasive potential. While conization can be therapeutic when dysplastic epithelium is fully excised with negative margins, the central indication for CKC remains the need for a high-quality specimen that reliably includes the transformation zone and allows accurate assessment of lesion grade, glandular involvement, and margin status [5]. In contemporary practice, the decision to proceed with an excisional procedure reflects a risk-based appraisal: when the probability of high-grade disease or occult invasion is clinically meaningful, and when colposcopic-directed biopsy cannot exclude these possibilities, excision becomes the most appropriate next diagnostic step [5]. A foundational indication for conization in patients of any age is inability to adequately visualize the squamocolumnar junction (SCJ) during colposcopy. When the SCJ is not fully seen, the clinician cannot confidently evaluate the entire transformation zone—the site where most premalignant lesions arise—nor can they ensure that directed biopsies sample the most abnormal region. In such cases, excision is indicated to obtain tissue from the endocervical canal and transformation zone for definitive assessment. Similarly, CKC is indicated when cytologic findings suggest high-grade disease, including cervical intraepithelial neoplasia grade 2 or higher (CIN 2+), CIN 3+, or adenocarcinoma in situ (AIS). These cytologic abnormalities carry a higher pretest probability of clinically significant pathology and potential invasive disease, making histologic confirmation and margin evaluation crucial. Another common indication is discordance between cytology and biopsy histology, such as when screening cytology indicates high-grade squamous intraepithelial lesion but colposcopic biopsies demonstrate only low-grade changes or benign findings. Discordance raises concern for sampling error, incomplete lesion visualization, or endocervical extension and supports excisional sampling to reconcile conflicting data and exclude underdiagnosis [5][6].

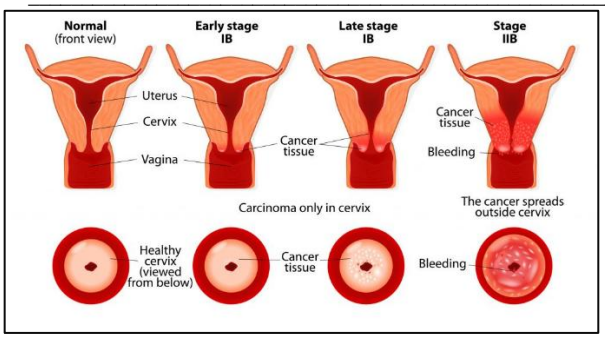

Fig. 2: Cervical conization.

Colposcopic anatomy and lesion distribution also guide indications. When colposcopy identifies a dysplastic lesion that extends into the endocervical canal and cannot be completely visualized, directed biopsies may not capture the full lesion or its most severe component. In this scenario, an excisional procedure is recommended because it permits evaluation of the endocervical component and enables pathologic mapping of the lesion's upper limit [1]. In addition to these universal indications, excisional management may be considered acceptable for certain persistent cytologic abnormalities in patients older than 25 years, reflecting a balance between diagnostic yield, recurrence risk, and the burden of repeated surveillance. Such situations include persistent atypical squamous cells in which a high-grade lesion cannot be excluded (ASC-H) or persistent CIN 1 on cytology for approximately two years, persistent high-grade squamous intraepithelial lesion (HSIL) for one to two years, positive margins for CIN 2+ following a prior diagnostic excisional procedure, and endocervical curettage demonstrating CIN 2+ [1]. These patterns signal either ongoing high-risk disease or inadequate clearance, and they often warrant excision to obtain definitive histology and reduce progression risk [1][2]. Within the category of excisional procedures, CKC may be preferred when specimen integrity and margin interpretability are particularly important. CKC generally produces an anatomically intact specimen with minimal thermal artifact, facilitating clearer histopathologic assessment of margins compared with electrosurgical techniques. Avoidance of specimen fragmentation is emphasized because fragmented excisions are associated with higher rates of indeterminate margins, complicating clinical decisions regarding adequacy of treatment and follow-up intensity [6]. Margin status is clinically meaningful: positive margins indicate dysplastic or neoplastic cells extending to the specimen edge, implying incomplete excision. Emerging data suggest that positive endocervical margins are associated with increased recurrence risk, supporting structured follow-up with cytology, HPV testing, and colposcopy when margins are positive or indeterminate [7][8].

Finally, CKC has a specialized role in fertility-preserving management for select early-stage malignancies. In carefully chosen patients who wish to retain reproductive potential, cervical conization may be used therapeutically for stage IA1 squamous cell carcinoma, typically in conjunction with appropriate lymph node assessment to ensure oncologic safety [9][10]. In these circumstances, CKC serves both diagnostic and treatment objectives: it enables accurate microinvasion assessment and margin evaluation while offering a conservative surgical option that may preserve cervical and reproductive function when oncologically appropriate. [7][8][9][10]

Contraindications

Cold knife conization (CKC) is an excisional cervical procedure that can provide definitive histopathologic assessment of dysplasia and, in selected cases, therapeutic excision. Nevertheless, because it involves cervical incision, tissue removal, and hemostatic manipulation—often under regional or general anesthesia—its use must be restricted in clinical contexts where procedural risk outweighs diagnostic benefit or where safer alternatives can achieve the same objective. Absolute and relative contraindications are therefore centered on infection control, bleeding risk, pregnancy-related considerations, and technical feasibility. Active or severe cervicitis is a key contraindication to CKC. Performing an excisional procedure through inflamed, infected cervical tissue increases the risk of perioperative bleeding, impaired wound healing, ascending infection, and postoperative complications such as endometritis. In addition, tissue inflammation can compromise specimen quality and margin interpretability, potentially limiting diagnostic value. Similarly, pelvic inflammatory disease represents a contraindication because instrumentation and excision may exacerbate an established upper genital tract infection, increase systemic spread risk, and worsen pelvic pain or inflammatory sequelae. In these situations, infection should be treated first, with reassessment for conization once the acute inflammatory process has resolved and the cervix is clinically stable [10][11].

Uncorrected anticoagulation constitutes another major contraindication because CKC can produce substantial cervical bleeding, and effective hemostasis may be difficult to achieve when coagulation is impaired. When anticoagulant therapy cannot be safely withheld or reversed, the risk of hemorrhage may be unacceptable, especially in patients with additional bleeding diatheses or limited physiologic reserve. In such cases, clinicians should pursue multidisciplinary evaluation—often involving hematology, anesthesia, and the treating specialist managing anticoagulation—to determine whether anticoagulation can be adjusted and, if so, how to time the procedure safely. Pregnancy is generally

considered a relative contraindication to CKC. Excision of cervical tissue during pregnancy carries heightened risks, including significant blood loss, cervical insufficiency, preterm labor, and pregnancy loss. For this reason, conization during pregnancy is typically reserved for circumstances in which invasive cancer is strongly suspected and the diagnostic information is essential for immediate oncologic decision-making. Even in this narrow context, the procedure should be performed only by an experienced clinician, with careful planning to minimize bleeding and obstetric complications, and with clear counseling regarding maternal–fetal risks. Technical feasibility also limits candidacy. If there is insufficient cervical tissue to excise—whether due to prior excisional procedures, congenital anatomy, extensive scarring, or other structural constraints—a CKC may be impractical or unsafe. Attempting to excise an adequate cone in such settings may increase the likelihood of poor hemostasis, cervical trauma, or inability to obtain diagnostically useful margins. When CKC is contraindicated because the patient is a poor surgical candidate or anesthesia risk is high, an office-based excisional procedure that avoids general anesthesia may be a more appropriate alternative, provided it can yield an adequate specimen and aligns with clinical risk assessment [11].

Equipment

Cold knife conization (CKC) is typically conducted in an operating room environment because the procedure requires precise exposure of the cervix, reliable hemostasis, and anesthesia support to ensure patient comfort and procedural control. Most cases are performed under general or regional anesthesia, allowing adequate relaxation, pain control, and immobility during cervical manipulation and excision. The equipment set-up should therefore be organized to facilitate optimal visualization of the transformation zone and endocervical canal, enable atraumatic tissue handling, support rapid bleeding control, and ensure safe specimen retrieval and preservation for histopathologic assessment. Patient positioning equipment is foundational. Candy cane or Allen stirrups are commonly used to support lithotomy positioning, providing stable lower-extremity alignment while allowing the surgical team unobstructed access to the perineum. Because prolonged lithotomy positioning can increase the risk of nerve compression, careful padding and alignment are essential, and nursing staff play a key role in ensuring safe positioning prior to incision. Bladder decompression is typically achieved with a straight catheter to minimize bladder distension, reduce injury risk, and improve operative exposure, especially when the cervix is elevated or traction is applied. Visualization tools are central to procedural accuracy. A weighted speculum and a right-angle retractor are commonly employed to expose the cervix and maintain a stable operative field. Many teams also use a colposcope in the operating room, particularly when lesion localization or margin planning benefits from magnified visualization. Application of 5% acetic acid or Lugol's iodine solution can enhance visualization of abnormal epithelium and help demarcate the transformation zone, supporting targeted excision while minimizing unnecessary tissue removal. Cervical stabilization instruments include a single-tooth tenaculum, which provides traction and improves control during incision and specimen delivery. Long-handled or Allis forceps are used for grasping and manipulating the cone specimen, while minimizing crush artifact that could compromise margin interpretation [11][12].

Hemostasis equipment and adjuncts are crucial because CKC can involve significant bleeding from the richly vascular cervical stroma. A vasoconstrictive agent such as vasopressin may be prepared for intracervical injection in patients without contraindications; however, careful screening is required because vasopressin may pose risks in patients with certain cardiovascular conditions. Electrosurgical capability, commonly via a Bovie cautery tool, should be available for coagulation of bleeding vessels and for refining hemostasis after specimen removal. Chemical hemostatic agents, including Monsel's solution, are frequently used to control oozing from the excision bed, particularly when diffuse capillary bleeding persists despite cautery or suturing. Suture materials and drivers are also essential: delayed absorbable sutures used with a Heaney needle driver allow placement of hemostatic stitches, such as cervical "figure-of-eight" sutures or other techniques that compress bleeding stromal tissue and stabilize the operative site. Excisional instruments define the "cold knife" nature of the procedure. A scalpel mounted on a 45-degree angled handle, or a long-handled 11-blade, is typically used to create a controlled conical incision through the ectocervix and into the endocervical canal. Long-handled Mayo scissors may be used to complete the excision or refine the specimen base, supporting controlled tissue release with minimal thermal artifact. If an endocervical curettage is planned as part of the evaluation, an endocervical curette should be included in the set to obtain additional sampling from the canal [12][13][14]. Collectively, these instruments and materials enable CKC to be performed with high technical precision while supporting patient safety, specimen integrity, and reliable hemostasis in a controlled operative setting.

Personnel

Cold knife conization (CKC) is a technically precise excisional procedure performed in an operating room setting and requires coordinated participation from a dedicated perioperative team to ensure procedural safety, effective hemostasis, and preservation of specimen integrity for histopathologic interpretation. The primary surgeon—typically an obstetrician–gynecologist with appropriate surgical expertise—is responsible for confirming the

indication, determining the planned cone dimensions, executing the excision, and managing intraoperative bleeding. Because CKC is often performed under regional or general anesthesia, anesthesia personnel are essential not only for induction and maintenance of anesthesia, but also for physiologic monitoring and hemodynamic management, particularly as cervical manipulation and vasoconstrictor use can produce cardiovascular responses. Anesthesia clinicians additionally support airway protection when indicated and optimize analgesia to reduce postoperative pain and facilitate recovery. Operating room surgical technicians provide sterile field support by preparing instrumentation, ensuring the availability of excisional and hemostatic tools, and anticipating procedural needs as the surgeon progresses through exposure, incision, specimen retrieval, and bleeding control. Their role includes maintaining sterility, facilitating efficient instrument exchange, and supporting specimen handling in a way that avoids fragmentation or crush artifact—factors that can compromise margin assessment. The operating room nurse circulator functions as the procedural coordinator, managing patient safety checks, positioning and pressure-point protection, documentation, and intraoperative logistics. This role is particularly important during lithotomy positioning, when neurovascular injury risk increases, and during transitions such as catheter placement, medication administration, and specimen labeling. The circulator also acts as a communication bridge between sterile and non-sterile team members, ensuring timely availability of additional supplies (eg, sutures, hemostatic agents, cautery accessories) and assisting with adherence to institutional protocols, including surgical time-outs and counts. Collectively, these personnel create a structured operating environment in which procedural accuracy, hemostatic control, and patient-centered care can be delivered reliably, while minimizing perioperative complications and ensuring that diagnostic objectives are met [12][13].

Preparation

Preoperative preparation for CKC is designed to establish optimal procedural conditions for safe excision and accurate diagnosis. CKC is typically performed under general or regional anesthesia, which allows effective pain control and minimizes movement during cervical traction and incision. After anesthesia induction, the patient is positioned in the dorsal lithotomy position using candy cane or Allen stirrups to provide stable access and visualization of the cervix. Because lithotomy positioning carries risk of nerve compression and musculoskeletal strain, careful alignment, padding, and documentation are essential components of preparation. The vagina is prepared using an antimicrobial solution such as chlorhexidine (commonly referenced as Hibiclens) or povidone-iodine, followed by sterile draping in the standard fashion to maintain asepsis and reduce infectious risk [13]. Bladder management is individualized: many clinicians prefer straight catheterization to decompress the bladder and improve exposure, though some elect to keep the bladder full based on technique preferences and perceived anatomic advantages. Considerations regarding antibiotic prophylaxis illustrate the importance of evidence-informed preparation. The American College of Obstetricians and Gynecologists has recommended a single prophylactic antibiotic dose prior to certain procedures to reduce postoperative infection risk; however, a Cochrane review found no demonstrated benefit for routine perioperative antibiotics in diagnostic excisional procedures, highlighting variability in practice and the need for individualized decision-making based on patient risk factors and institutional policy [15]. Intraoperatively, colposcopic assessment may be performed to enhance lesion localization and guide excision margins. Application of 5% acetic acid or Lugol iodine solution can improve visualization of abnormal epithelium and clarify the transformation zone, depending on surgeon preference and the clinical scenario [13]. To reduce intraoperative bleeding, vasopressin may be injected into the cervix as a vasoconstrictive adjunct, provided there are no contraindications and cardiovascular monitoring is appropriately maintained [16]. Taken together, these preparation steps align operative efficiency with patient safety, ensuring adequate exposure, infection prevention measures, and strategies to minimize blood loss while optimizing the diagnostic quality of the excised specimen [13][14][15][16].

Technique or Treatment

Cold knife conization (CKC) is performed with the dual priorities of obtaining an intact diagnostic specimen and maintaining meticulous hemostasis in a highly vascular tissue. The operative sequence begins with the same foundational step required for any diagnostic excisional cervical procedure: achieving stable, unobstructed visualization of the cervix and transformation zone. A weighted speculum is inserted to retract the posterior vaginal wall, and the anterior vaginal wall is elevated with a right-angle retractor to fully expose the cervix. Once the cervix is visualized, the anterior lip is grasped with a single-toothed tenaculum to provide traction and stabilize the cervix during incision. Traction not only improves exposure but also helps the surgeon maintain a consistent excisional plane while minimizing unintended tissue tearing. At this stage, some clinicians elect to place lateral hemostatic "stay" sutures at the 3 o'clock and 9 o'clock positions at the cervicovaginal junction. These sutures are intended to compress the lateral vascular supply and provide a measure of bleeding control during the excision; however, evidence is mixed, and some

studies suggest that routine placement may not confer a meaningful hemostatic benefit [16][17]. Consequently, their use is often individualized based on lesion characteristics, anticipated bleeding risk, and surgeon preference. When vasopressin is used as an adjunct to reduce intraoperative bleeding, it is typically administered as a dilute solution in patients without contraindications. A common approach is injection of approximately 10 to 15 mL in divided aliquots at the 2, 4, 8, and 10 o'clock positions, with the surgeon observing for visible tissue blanching as a marker of effective local vasoconstriction [13]. Because vasopressin can have systemic cardiovascular effects, anesthesia monitoring and careful dosing discipline are essential whenever it is employed. Once exposure and hemostatic preparation are complete, the surgeon proceeds to circumferential incision of the cervix. The scalpel blade is angled inward toward the endocervical canal to create a cone-shaped specimen that encompasses the transformation zone and any visible or suspected lesion. Many surgeons begin the incision at the posterior cervix. This strategy is pragmatic: posterior bleeding tends to track less directly into the visual axis, and beginning posteriorly may reduce the likelihood that early blood loss will obscure the operative field before the circumferential cut is established [16][17].

The excision itself is performed using a controlled "saw-cutting" motion, advancing circumferentially while maintaining the planned depth and angle so that the lesion and transformation zone remain fully included within the cone boundaries. Intraoperative countertraction can be provided using toothed forceps or Allis forceps applied to the developing specimen, gently elevating the cone bed to facilitate deeper dissection while taking care to avoid crushing or tearing the epithelium, which could compromise margin assessment. The objective throughout the dissection is to preserve specimen integrity and avoid fragmentation, as an intact specimen improves the pathologist's ability to evaluate margin status and to determine whether dysplasia or glandular abnormality extends to excision edges. Once the circumferential dissection reaches the desired depth, the base of the cone is commonly released using long-handled Mayo scissors, allowing a clean separation of the specimen from the remaining cervical stroma. After specimen removal, additional sampling decisions are guided by clinical risk and diagnostic needs. Sharp curettage of the remaining endocervical canal may be performed because it can help detect residual pathology, including glandular lesions such as adenocarcinoma in situ (AIS), that may extend beyond the excised cone [18][1][19]. In contrast, routine endometrial curettage is not generally required unless the patient has risk factors or clinical features suggestive of endometrial pathology, such as postmenopausal status, cytologic findings concerning for AIS, or unexplained abnormal uterine bleeding [18][1][19]. Hemostasis is then secured using the surgeon's preferred approach, which may include electrocautery for focal bleeding points, interrupted absorbable sutures for stromal compression, topical chemical hemostasis with agents such as Monsel's solution, or a combination of these techniques. Evidence suggests that multiple hemostatic strategies can be effective, and selection is typically individualized based on bleeding intensity, cervical anatomy, and the need to preserve tissue for future assessment [16][17]. Finally, specimen orientation is a crucial procedural step that directly affects diagnostic utility. A suture is commonly placed at the 12 o'clock position on the cone specimen as a reference marker for the pathologist. This orientation allows the pathology team to map margin involvement to anatomic location, which can inform follow-up planning, guide re-excision decisions if needed, and improve the precision of subsequent surveillance or treatment [16][17][18][19].

Complications

Cold knife conization (CKC) is a highly effective diagnostic and, in selected cases, therapeutic procedure; however, it carries a distinctive complication profile that reflects the cervix's vascularity, the depth of excision required for adequate histologic evaluation, and the potential impact of tissue removal on future cervical function. Among all adverse events, bleeding remains the most clinically significant and most frequently encountered complication. Hemorrhage may occur intraoperatively during the excision and hemostatic phase, or postoperatively—most commonly within the first two weeks—when eschar separates, sutures loosen, or local infection and inflammation compromise the healing cone bed. The cervix's arterial inflow, largely derived from lateral cervical branches, contributes to the potential for brisk bleeding, particularly when excision is deep or when hemostasis is suboptimal. A wide array of techniques is available to control intraoperative bleeding, and the approach is typically individualized based on the bleeding pattern and operator preference. Topical hemostatic agents such as Monsel paste or chemical cauterizing agents like silver nitrate can be applied to diffuse oozing. Mechanical measures such as vaginal packing may provide temporary compression, while suturing the cone bed or placing hemostatic stitches at key vascular points can provide more definitive control. In some cases, electrocautery is used to coagulate visible bleeding sites, although excessive cauterization may increase the risk of later stenosis and can compromise tissue edges if applied indiscriminately. Despite these measures, major postoperative bleeding is not uncommon in reported series, with incidence ranging from approximately 2% to 17%, depending on the population studied, operative technique, and definitions applied [20][13].

A subset of patients may require escalation beyond outpatient management, including return to the operating room for recauterization or additional suturing to secure hemostasis when bleeding is persistent, heavy, or associated with hemodynamic compromise [20][13]. Because delayed bleeding can occur after discharge, patient education regarding warning signs—such as soaking pads, passage of large clots, dizziness, or syncope—is an essential preventive strategy and a key component of postoperative safety planning [19][20][13].

Infectious complications after CKC are relatively uncommon, reflecting the generally clean-contaminated nature of the procedure and the cervix's capacity for healing. Reported infection rates are low, occurring in approximately 1% of patients, and most cases can be managed successfully with oral antibiotics when identified early [20]. Nevertheless, clinicians should remain attentive to symptoms such as fever, malodorous discharge, escalating pelvic pain, or abnormal bleeding patterns that may signal infection, especially because infection can also contribute to secondary hemorrhage and delayed healing. Late complications primarily relate to alterations in cervical anatomy and function. Cervical stenosis is a recognized delayed outcome, particularly in cases involving deep excision or aggressive cauterization, and it is more frequently encountered in postmenopausal patients [20]. Stenosis can manifest clinically as difficulty in future cervical sampling, impaired menstrual outflow in premenopausal individuals, infertility, or pain. When suspected, evaluation may involve clinical examination and, if necessary, passage testing of the endocervical canal. Treatment is typically mechanical dilation of the canal, although recurrence can occur and follow-up is often required. Cervical insufficiency is another important late complication, reflecting the cervix's role as a structural support during pregnancy. By removing substantial stromal tissue, CKC can reduce cervical competence, potentially increasing susceptibility to mid-trimester loss or preterm birth in later pregnancies [20].

The obstetric implications of excisional conization have been studied extensively, yet data remain heterogeneous and no randomized controlled trials definitively quantify the magnitude of risk across all populations. Overall, the literature suggests that CKC is associated with a higher risk of preterm delivery and intraamniotic infection than LEEP, largely attributed to the typically greater depth and volume of tissue excised with CKC [21][22][19][18][13][23]. Depth of conization appears to be a particularly relevant factor. One study reported that cone depths of at least 18 mm were associated with increased risk of early-onset neonatal sepsis and intraamniotic infection, and numerous other studies have similarly linked increasing excision length with higher rates of preterm labor and adverse pregnancy outcomes [21][22][19][18][13][23]. Importantly, cumulative excisional burden matters: undergoing multiple conization procedures is associated with a progressively increased risk of preterm birth, suggesting a dose–response relationship between cervical tissue loss and pregnancy vulnerability [21][22][19][18][13][23]. These data have practical implications for procedural planning and patient counseling. For individuals with future pregnancy plans, limiting the amount of cervical tissue removed—while still achieving adequate diagnostic and oncologic assessment—becomes a central operative principle. This balance requires careful preoperative assessment of lesion extent, thoughtful selection of excision modality, and meticulous surgical technique aimed at preserving cervical length and stromal integrity without compromising the diagnostic accuracy needed to safely exclude invasive disease [21][22][19][18][13][23].

Clinical Significance

Cold knife conization (CKC) occupies a distinct position in the diagnostic and therapeutic pathway for cervical intraepithelial neoplasia (CIN) because it combines high-quality histopathologic assessment with effective excision of premalignant disease. Its clinical significance is best understood through three interrelated domains: oncologic control (including recurrence risk), diagnostic reliability (particularly margin interpretability), and opportunities for recurrence prevention through adjunctive strategies such as HPV vaccination. Although multiple excisional techniques exist, CKC has historically been valued for producing a specimen that is anatomically intact and minimally affected by thermal artifact, thereby strengthening the precision of histologic interpretation and post-procedural risk stratification. Recurrence of CIN after excisional treatment is influenced by patient and disease characteristics, and the recurrence risk after CKC is not uniform across all populations. Factors such as age, severity of dysplasia at presentation, immunologic status, and the adequacy of excision are all clinically relevant. Nevertheless, aggregate data suggest that the average recurrence risk for CIN 2 or CIN 3 following CKC is approximately 1.4% [20]. This relatively low recurrence rate supports CKC as a highly effective approach for definitive management in appropriately selected patients, particularly when the principal clinical objective is durable disease eradication combined with robust histologic assessment. Importantly, comparative evidence indicates that CKC is associated with the lowest recurrence rates among commonly used conization modalities [24]. While recurrence differences across techniques may partially reflect selection bias and lesion characteristics, the consistently strong performance of CKC underscores its continuing relevance in modern practice [24].

A major contributor to CKC's clinical value is specimen quality. Unlike electrosurgical excision, which can produce thermal coagulation artifact at tissue edges, CKC is performed using a scalpel and therefore tends to preserve epithelial architecture and margin integrity. Although CKC generally requires an operating room and anesthesia resources—factors that increase logistical complexity and may limit use in some settings—this investment can yield a diagnostic advantage: CKC is recognized for providing a specimen with the most intact and interpretable margins among excisional techniques [25]. Margin status is not a mere descriptive pathology feature; it is a clinically actionable prognostic variable. Negative margins provide reassurance that dysplasia has likely been completely removed, supporting routine post-treatment surveillance. In contrast, positive margins—defined by dysplastic epithelium extending to the specimen edge—imply incomplete excision and correlate with increased risk of persistent or recurrent disease, particularly when endocervical margins are involved [26]. This association is clinically significant because endocervical margin involvement suggests residual disease within the canal, where lesions may be more difficult to visualize and sample, thereby necessitating closer surveillance, repeat excision in selected cases, or structured follow-up with cytology, HPV testing, and colposcopic assessment [25][26].

Beyond surgical technique and pathology, CKC's clinical significance increasingly includes post-treatment prevention strategies aimed at reducing recurrence risk. Persistent or recurrent high-grade squamous intraepithelial lesion (HSIL) is often driven by ongoing or recurrent HPV infection, and therefore interventions that reduce HPV persistence may translate into meaningful reductions in disease recurrence. Evidence suggests that HPV vaccination administered after cervical conization may provide protective benefit against recurrent dysplasia. In a 2020 study, HPV vaccination was associated with a marked reduction in recurrent or persistent HSIL following excisional treatment [27]. While clinical decisions about vaccination should consider patient age, prior vaccination status, and local guideline recommendations, these data reinforce the contemporary view that optimal CIN management is not limited to excision alone. Instead, a comprehensive, prevention-oriented approach—combining high-quality excision, risk-based follow-up informed by margin status, and immunoprophylaxis where appropriate—maximizes the likelihood of durable disease control and reduces the cumulative burden of repeat procedures and their associated reproductive risks [27].

Enhancing Healthcare Team Outcomes

Cold knife conization (CKC) is not merely a technical surgical act; it is a coordinated perioperative pathway that depends on effective collaboration across multiple clinical disciplines to ensure diagnostic accuracy, procedural safety, and continuity of follow-up. The procedure is typically performed by a general gynecologist and, in higher-risk scenarios or when invasive disease is suspected, may be undertaken by a gynecologic oncologist. Because CKC is commonly conducted in an operating room or ambulatory surgical facility and often requires regional or general anesthesia, multiple team members become essential contributors to patient-centered outcomes, including anesthesiology clinicians, operating room nurses and technicians, presurgical and postsurgical nursing staff, and pathologists. Each role addresses distinct points of vulnerability—hemodynamic instability, bleeding risk, specimen integrity, patient education, and surveillance adherence—such that outcomes depend less on any single professional's actions and more on the quality of interprofessional coordination. Effective anesthesiology involvement begins with preoperative assessment, where comorbidities, airway considerations, and bleeding risk are reviewed, and intraoperative management plans are tailored to the anticipated physiologic effects of cervical manipulation and potential vasoconstrictor use. Continuous monitoring during CKC is particularly important because cervical injection of agents such as vasopressin, if used, may produce cardiovascular responses, and because hemorrhage—while often controllable—can be rapid and clinically significant. Operating room nurses and surgical technicians support sterile technique, safe positioning in lithotomy, instrument readiness, and efficient procedural flow, all of which reduce avoidable complications and shorten operative time. Nursing attention to positioning is especially relevant to preventing peripheral nerve injury and pressure-related complications, while intraoperative documentation and surgical counts contribute to broader safety systems that protect patients from preventable harm [26][27][28].

Pathology is central to CKC's diagnostic and therapeutic value. Clear communication between the surgical team and pathology regarding specimen orientation, clinical suspicion (e.g., concern for adenocarcinoma in situ), and prior cytology/biopsy results enhances interpretive precision. Proper specimen labeling and orientation, such as marking the 12 o'clock position, allows the pathologist to localize margin involvement and supports risk-based follow-up planning. Because management decisions often hinge on margin status and lesion type, delays or ambiguities in pathology reporting can disrupt care continuity; thus, timely, standardized reporting and accessible clinician–pathologist communication directly contribute to improved outcomes. Pre- and post-procedure nursing care further strengthens patient safety and satisfaction. Presurgical nurses reinforce preoperative instructions, confirm medication reconciliation (including anticoagulants), and ensure that consent and patient understanding are

adequate. Postsurgical nurses monitor early complications such as bleeding, vasovagal episodes, pain, urinary retention, or anesthesia-related adverse events. They also provide practical discharge counseling on warning signs that warrant urgent evaluation, including heavy bleeding, fever, escalating pelvic pain, malodorous discharge, or syncope. Because delayed hemorrhage can occur after discharge, this education is not ancillary; it is a preventive intervention that can reduce morbidity through earlier presentation and treatment [28].

Interprofessional communication and care coordination are essential across the entire episode of care, from procedural planning to postoperative surveillance. Shared protocols and clear escalation pathways enable teams to respond promptly to bleeding or suspected infection and to coordinate timely follow-up appointments and test scheduling. Beyond immediate perioperative outcomes, long-term success depends heavily on patient education and continuity of care. Gynecology clinicians and primary care clinicians should collaboratively ensure that patients understand the rationale for CKC, the balance of benefits and risks—including potential future fertility and pregnancy implications—and the importance of adherence to follow-up based on pathology results. Counseling should also include prevention strategies that reduce future cervical cancer risk, such as consistent condom use to lower HPV transmission risk, HPV vaccination where appropriate, and strict adherence to recommended cervical cancer screening guidelines. When the healthcare team functions as an integrated unit—linking operative excellence with pathology precision, nursing surveillance, and longitudinal preventive counseling—CKC can achieve its intended goals of accurate diagnosis, effective treatment, and sustained reduction in cervical cancer risk [28].

Nursing, Allied Health, and Interprofessional Team Interventions

Nursing and allied health professionals are integral to safe, patient-centered care across the full conization continuum, from preprocedure preparation through postoperative recovery and long-term surveillance for cervical dysplasia. Nurses, nurse practitioners, and physician assistants frequently serve as the primary point of contact for patients navigating abnormal cervical screening results, and they play a decisive role in translating diagnostic findings into understandable information, reducing anxiety, and ensuring that patients are adequately prepared for the procedure. Preoperatively, nursing interventions include comprehensive education regarding the purpose of conization, what to expect on the day of surgery, anesthesia considerations, and the practical implications of excisional treatment, including potential bleeding, cramping, activity restrictions, and follow-up timelines. This counseling should be individualized, culturally sensitive, and framed in a way that supports informed consent and shared decision-making, particularly when patients have fertility concerns or previous traumatic healthcare experiences. During the perioperative period, nursing practice focuses on safety, monitoring, and advocacy. Nurses support standardized safety processes such as verification of patient identity, confirmation of procedure and site, allergy review, and medication reconciliation, including documentation of anticoagulant or antiplatelet use. In the operating room setting, nursing staff ensure correct patient positioning in lithotomy with appropriate padding, protect pressure points, and coordinate sterile field maintenance, thereby reducing risk for nerve injury, infection, and procedural delays. Nursing vigilance is also critical for early recognition of adverse events such as vasovagal episodes, excessive bleeding, or anesthesia-related complications. Nurse practitioners and physician assistants may contribute by assisting with procedural flow, communicating intraoperative findings to families when appropriate, and supporting immediate postoperative planning based on operative and clinical risk factors [28].

Postprocedure, nursing and allied health interventions emphasize complication prevention, symptom management, and adherence to follow-up. Nurses monitor for hemorrhage, pain, urinary retention, fever, or signs of infection and provide clear discharge instructions about expected symptoms versus warning signs requiring urgent evaluation. Education commonly includes guidance on pelvic rest, activity modification, and medication use, as well as reinforcement of when to resume routine activities and how to access care if delayed bleeding occurs. Allied health contributions include supportive care, assessment of psychosocial needs, and facilitation of follow-up monitoring, particularly for patients facing barriers such as transportation limitations, low health literacy, or limited access to specialist services. Coordination with pathology and scheduling systems is also a key team function, ensuring that results are communicated promptly and that surveillance testing (cytology, HPV testing, colposcopy) is arranged according to risk and margin status. Because nursing responsibilities and scope of practice vary across settings, interventions should align with local protocols and the level of training and expertise. Regardless of setting, maintaining up-to-date, evidence-based practice is essential. Interprofessional collaboration—among gynecology, anesthesia, pathology, nursing, and allied health—supports consistent messaging, reduces errors in transitions of care, and improves adherence to long-term screening and prevention strategies, thereby optimizing outcomes for individuals undergoing conization for cervical dysplasia [28].

Conclusion:

Cold knife conization occupies a vital role in the diagnostic and therapeutic management of cervical intraepithelial neoplasia, offering unparalleled accuracy in margin assessment and histopathologic interpretation. Its clinical value lies in producing an intact specimen with minimal thermal artifact, which is essential for determining disease extent and guiding follow-up strategies. Despite its advantages, CKC is not without risks: hemorrhage, infection, cervical stenosis, and obstetric complications underscore the need for meticulous surgical technique and vigilant postoperative care. Nursing professionals are central to this process, ensuring patient education, safe positioning, intraoperative monitoring, and comprehensive discharge counseling to prevent delayed complications. Interprofessional collaboration enhances procedural safety and continuity of care, linking operative precision with pathology accuracy and preventive strategies such as HPV vaccination. Ultimately, CKC exemplifies a patient-centered approach that balances diagnostic rigor with reproductive considerations, reinforcing its continued relevance in modern gynecologic practice. By integrating evidence-based protocols, structured follow-up, and team-based interventions, healthcare providers can optimize outcomes, minimize recurrence, and contribute to long-term cervical cancer prevention.

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