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Clinical Effect of Modified Continuous Locking Suture for Wound Reconstruction After Cold Knife Conization of the Cervix

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Abstract: *Objective*: To evaluate the efficacy of modified continuous locking suture for wound reconstruction after cold knife conization (CKC) of the cervix. *Methods*: A total of 100 patients with highgrade squamous intraepithelial lesions (HSIL) who underwent CKC between July 2022 and December 2023 were enrolled and divided into a study group (modified continuous locking suture, n = 50) and a control group (traditional U-shaped suture, n = 50). Perioperative indicators and follow-up outcomes were compared between the two groups. *Results:* Operative time, intraoperative blood loss, and hospital stay in the study group were significantly lower than those in the control group ($P < 0.001$). No statistically significant differences were observed between the two groups in terms of late postoperative bleeding, fever, margin negativity, satisfactory cervical molding, wound healing at 3 months, satisfactory cervical shaping at 6 months, cervical stenosis at 12 months, or HPV clearance rate (all $P > 0.05$). *Conclusion*: The modified continuous locking suture can shorten operative time and reduce blood loss without increasing the risk of complications, representing a safe and effective option for wound reconstruction after cervical conization.

Keywords: Cold knife conization; Continuous locking suture; High-grade squamous intraepithelial lesion; Wound reconstruction; Cervical stenosis

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1. Introduction

Cervical cancer remains one of the common malignancies among women worldwide. Standardized screening and timely identification and management of precancerous lesions are central to reducing the burden of cervical cancer [1]. High-grade squamous intraepithelial lesions (HSIL) represent the most critical type requiring standardized management in secondary prevention of cervical cancer. The

of histologically confirmed HSIL (CIN 2 or CIN 3) should integrate patient age, lesion risk, future fertility desires, and follow-up compliance. In clinical practice, cold knife conization (CKC) remains the primary treatment option [2]. Treatment of HSIL requires a balance among complete lesion excision, accuracy of pathological evaluation, and preservation of cervical function [3]. CKC has certain advantages in terms of specimen integrity and thermal damage control, but it also has some limitations [4]. The management of the wound after conization is directly related to surgical efficiency, postoperative recovery, follow-up accessibility, and cervical function protection in young patients. Existing studies have noted the impact of different excision instruments and suture methods on CKC outcomes. Wang et al. [5] compared different conization instruments and suture techniques and found that technical details were associated with postoperative bleeding and other outcomes. Chen et al. [6] compared four-quadrant suture, modified Sturmdorf suture, and circular suture, also suggesting that the suture method after cervical conization affects operative time, intraoperative blood loss, and cervical shaping outcomes. This study compares the modified continuous locking suture with the traditional U-shaped suture in terms of perioperative indicators and 12-month follow-up outcomes for wound reconstruction after CKC, aiming to provide more specific clinical evidence for wound management following cervical conization.

2. Materials and methods

2.1. Study design and participants

This was a comparative cohort study. A total of 100 patients who underwent cold knife conization between July 2022 and December 2023 were enrolled. Based on the different methods of cervical wound management after conization, patients were divided into a study group (n=50) and a control group (n = 50). The study group received modified continuous locking suture, while the control group received traditional U-shaped suture. Perioperative data were recorded for all patients, and follow-up was completed at 3, 6, and 12 months postoperatively.

2.1.1. Inclusion criteria

(1) Histologically confirmed CIN II–III or HSIL with an indication for cervical conization;
(2) Underwent cold knife conization;
(3) Complete perioperative records and follow-up data;
(4) Consented to postoperative follow-up.

2.1.2. Exclusion criteria

(1) Suspected or confirmed invasive cervical cancer requiring extended surgery;
(2) Pregnant patients;
(3) Patients with acute genital tract infection, coagulation disorders, or severe systemic diseases;
(4) Previous cervical surgery that might affect postoperative cervical morphology evaluation;
(5) Incomplete data or loss to follow-up.

2.2. Surgical methods

Both groups were placed in the lithotomy position, with routine disinfection and draping. After adequate anesthesia, the cervix was fully exposed. The resection margin was determined based on iodine staining,

colposcopic findings, lesion extent, and transformation zone type. A cold knife was used to perform a cone-shaped excision along the outer margin of the lesion, aiming to remove the transformation zone and suspicious tissue completely. The excised specimen was marked according to standard orientation and sent for pathological examination, with care taken to avoid thermal damage that could affect margin assessment.

In the study group, after conization, the bleeding points, residual cervical tissue thickness, and cervical canal position were evaluated. A modified continuous locking suture was performed using absorbable suture material. The suture started from one edge of the cervical wound and proceeded continuously along the circumference of the wound edge, incorporating the cervical mucosal margin and stromal layer into the suture, with each stitch forming a locking loop. The surgeon adjusted the stitch spacing, depth, and tension according to the wound size, oozing status, and tissue thickness, ensuring even tension distribution along the wound circumference. At the end of suturing, the absence of active bleeding was confirmed, and cervical canal patency was checked to avoid cervical os deformation or cervical stenosis due to excessive tightening.

In the control group, the cervical wound was managed with traditional U-shaped suture after conization , with main bleeding points ligated and routine cervical shaping performed according to the wound condition . Both groups received routine postoperative observation for vaginal bleeding, infection prevention, lifestyle guidance, and follow-up arrangements.

2.3. Observation target

Primary perioperative indicators included operative time, intraoperative blood loss, and hospital stay. Secondary perioperative indicators included late postoperative bleeding, postoperative fever, pathological margin status, and satisfactory cervical molding during the perioperative period. Follow-up indicators included wound healing at 3 months postoperatively, satisfactory cervical shaping at 6 months, occurrence of cervical stenosis at 12 months, and HPV clearance at 12 months.

2.4. Statistical methods

Data were collated and analyzed using the Python 3.11 statistical environment.

3. Results

3.1. Enrollment of study subjects

A total of 100 patients undergoing cervical cold knife conization were enrolled in this study, with 50 cases in the study group and 50 cases in the control group. Perioperative data collection and follow-up data at 3 months, 6 months, and 12 months postoperatively were completed for both groups, and all patients were ultimately included in the statistical analysis.

3.2. Comparison of perioperative continuous indicators

The study group showed significantly shorter operative time, less intraoperative blood loss, and shorter hospital stay compared with the control group, and all differences were statistically significant (all $P < 0.001$). The operative time in the study group was shortened by an average of 16.76 minutes, intraoperative blood loss was reduced by an average of 8.38 mL, and hospital stay was shortened by an average of 0.46 days compared with the control group. See **Table 1**.

Table 1. Comparison of perioperative continuous indicators between the two groups

Indicator	Study group(n = 50)	Control group(n = 50)	Mean difference (95%CI)	U-value	*P*-value
Surgery time (min)	28.96 ± 4.44; 30.00 (25.00,31.00)	45.72 ± 5.87; 45.00 (41.00,50.75)	-16.76 (-18.83,-14.69)	37.000	< 0.001
Intraoperative blood loss (mL)	22.02 ± 7.47; 20.00 (15.00,28.00)	30.40 ± 6.60; 30.00 (25.00,35.00)	-8.38 (-11.18,-5.58)	480.000	< 0.001
Hospital stay (d)	3.12 ± 0.39; 3.00 (3.00,3.00)	3.58 ± 0.73; 3.00 (3.00,4.00)	-0.46 (-0.69,-0.23)	818.500	< 0.001

Note: Continuous variables are expressed as mean ± standard deviation or median (P25, P75); between-group comparisons were performed using the Mann-Whitney U test; the mean difference was calculated as the study group value minus the control group value.

3.3. Comparison of perioperative safety and pathological outcomes between the two groups

The study group and the control group each had 1 case (2.00%) of late postoperative bleeding, and each had 3 cases (6.00%) of postoperative fever. The negative margin rate was 96.00% in the study group and 98.00% in the control group; the perioperative cervical reshaping satisfaction rate was 88.00% in the study group and 92.00% in the control group. The differences between the two groups for all the above indicators were not statistically significant (all $P > 0.05$). See **Table 2**.

Table 2. Comparison of perioperative safety and pathological outcomes between the two groups

Indicator	Study group (n = 50) n (%)	Control group (n = 50) n (%)	Rate difference % (95% CI)	Statistic/test	*P* value
Late postoperative bleeding	1 (2.00)	1 (2.00)	0.00 (-5.49, 5.49)	Fisher	1.000
Postoperative fever	3 (6.00)	3 (6.00)	0.00 (-9.31, 9.31)	Fisher	1.000
Negative margin	48 (96.00)	49 (98.00)	-2.00 (-8.68, 4.68)	Fisher	1.000
Satisfactory cervical remodeling	44 (88.00)	46 (92.00)	-4.00 (-15.73, 7.73)	Fisher	0.741

Note: The rate difference is calculated as the incidence or attainment rate in the study group minus that in the control group; for negative margins and satisfactory cervical shaping, “negative/satisfactory” is defined as the target event, whereas for the other indicators, “occurrence” is defined as the target event.

3.4. Comparison of postoperative follow-up outcomes between the two groups

At 3 months postoperatively, the rate of good wound healing was 96.00% in the study group and 90.00% in the control group; at 6 months postoperatively, the rate of satisfactory cervical shaping was 92.00% in the study group and 88.00% in the control group; at 12 months postoperatively, the incidence of cervical stenosis was 6.00% in the study group and 8.00% in the control group; and the HPV negative conversion rate was 86.00% in the study group and 82.00% in the control group. None of the differences in the above followup outcomes between the two groups reached statistical significance (all $P > 0.05$). See **Table 3**.

Table 3. Comparison of postoperative follow-up outcomes between the two groups

Indicator	Study group (n=50) cases (%)	Control group (n=50) cases (%)	Rate difference % (95% CI)	Statistic/Test	*P* value
Good wound healing at 3 months postoperatively	48 (96.00)	45 (90.00)	6.00 (-3.93, 15.93)	Fisher	0.436
Satisfactory cervical remodeling at 6 months postoperatively	46 (92.00)	44 (88.00)	4.00 (-7.73, 15.73)	Fisher	0.741

Indicator	Study group (n=50) cases (%)	Control group (n=50) cases (%)	Rate difference % (95% CI)	Statistic/Test	*P* value
Cervical stenosis at 12 months postoperatively	3 (6.00)	4 (8.00)	-2.00 (-11.99, 7.99)	Fisher	1.000
HPV clearance	43 (86.00)	41 (82.00)	4.00 (-10.35, 18.35)	χ^2=0.074	0.785

Note: The rate difference is calculated as the incidence or achievement rate of the study group minus that of the control group; for cervical stenosis, "occurrence" is the target event, whereas for the other indicators, "good/satisfactory/negative conversion" are the target events.

4. Discussion

In this study, the operative time in the study group was shorter than that in the control group. This difference is more likely attributable to the wound management after conization rather than the excision of the lesion itself. Traditional U-shaped suturing requires multiple interrupted ligations at separate points ; the more dispersed the hemostatic points, the more time the surgeon tends to expend in repeated cycles of "supplementary stitching – knot tying – re-assessment." Continuous locking suture, by contrast, integrates wound edge apposition and hemostasis into a single continuous maneuver. For cone biopsy wounds with relatively diffuse oozing, this suturing method reduces repeated repositioning and redundant knot tying, thereby saving time. Intraoperative blood loss in the study group was less than that in the control group. Continuous locking suture may provide relatively uniform circumferential compression on the wound edges through its locking mechanism, and the suture tension is continuously distributed along the cervical circumference, which reduces the chance of single-point suture cutting through tissue or loosening. Postoperative bleeding and infection following cold knife conization (CKC) have consistently been important factors affecting patient recovery [7], and the present study did not increase the incidence of delayed postoperative bleeding. The fundamental requirement of cervical conization is complete excision of the lesion with evaluable margins. Since CKC causes less thermal damage, pathological margin interpretation is generally clearer [3]. The satisfactory cervical reshaping rate at 6 months postoperatively was slightly higher in the study group than in the control group, though the difference was not statistically significant. Theoretically, continuous locking suture can maintain the morphology of the external cervical os through circumferential wound edge integration; however, the " satisfaction" indicator adopted in this study still carries a degree of subjectivity. Future studies should incorporate measurements of the external cervical os diameter, cervical canal probing results, colposcopic image scoring, or three-dimensional ultrasound parameters, so as to enable more stable evaluation of cervical morphology. Cervical stenosis may affect menstrual flow, cervical cytology sampling, and colposcopic follow-up, and is of particular importance for patients who require long-term screening or have fertility aspirations [8]. In the present study, the incidence of cervical stenosis at 12 months in the study group was not higher than that in the control group, suggesting that the modified continuous locking suture method did not show an unfavorable signal in preserving cervical canal patency. This finding is consistent with the operative principle of avoiding excessive tightening during suturing and confirming cervical canal patency upon completion of the procedure. Postoperative persistent HPV infection is associated with factors such as margin status, residual lesions, menopausal status, and HPV16 infection [9]; other studies have shown that the HPV negative conversion rate after cervical conization in patients with

high-grade squamous intraepithelial lesions (HSIL) increases with extended follow-up duration[10]. In this study, the suturing method did not reduce the postoperative HPV negative conversion rate, nor did it demonstrate an increased risk of persistent HPV positivity.

The clinical value of the modified continuous locking suture method lies primarily in process integration. It accomplishes hemostasis, wound edge apposition, and reconstruction of the external cervical os within the same continuous suturing sequence, making it suitable for patients with adequate cervical stump tissue, diffuse wound oozing, and no need for extended resection for invasive cancer. For centers with high volumes of cervical lesion diagnosis and treatment, standardized continuous locking suture procedures help reduce inter-operator variability and facilitate training and quality control. This technique is not applicable to all patients. When the cervical stump tissue is thin, the cone excision is overly extensive, the lesion is located deep within the cervical canal, or the patient has definite fertility plans, the surgeon should adjust tension according to tissue condition and excision depth, and consider segmental suturing or local reinforcement when necessary. In promoting this technique, it is important to avoid prioritizing "continuity" and "speed" at the expense of cervical canal patency and tissue blood supply.

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Disclosure statement

The authors declare no conflict of interest.

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