

Minimally Invasive Cervical Brush Biopsy Approach Research Summary

Fabric-Based Tissue Sampling, Collection, Storage and Transport Systems (Kylon®) Device Research

1. Fabric-Based Exocervical and Endocervical Biopsy in Comparison with Punch Biopsy and Sharp Curettage

Winter M, Cestero RM, Burg A, Felix JC, Han C, Raffo AM, Vasilev S.

This was a randomized trial of 55 patients which compared fabric -based endocervical and exocervical biopsy tools at private practice and county hospital sites in Southern California. The patient and physician subjectively rated bleeding (exocervical) and pain (endocervical and exocervical) from the biopsy procedure(s). Fabric-based biopsies were abundant full-thickness curettage and showed significantly less pain, bleeding, and trauma than the conventional biopsy methods ($p < .0001$). The benefits of a less invasive biopsy could increase the willingness to perform multiple biopsies, increase disease detection, and improve patient satisfaction and compliance.

Journal of Lower Genital Tract Disease - 2012 Apr; 16(2):80-7

2. Trans-Epithelial Endocervical and Exocervical Biopsy with Minimally Invasive Fabric-Based Devices

Burg A, Felix JC, Winter M

Specimen adequacy and biopsy depth were evaluated from microscopic examination of residual discard hysterectomy specimens as well as evidence from clinical biopsy specimens in 5 discard hysterectomy specimens and 31 clinical cases. The biopsies were trans-epithelial in quality and depth and could be oriented to render a consistent histopathologic diagnosis. Biopsy sites from all five residual discard exocervical and endocervical hysterectomy specimens showed areas of denudation of the epithelium at or below the basement membrane. All clinical biopsy specimens were diagnostic. Therefore, instruments with a minimally invasive design intended to reduce the pain and bleeding associated with cervical biopsy provided diagnostic abundant histological exocervical and endocervical samples in-vivo.

Journal of Lower Genital Tract Disease: April 2012 - Volume 16 - Issue 5 - p S2

3. Comparison of Tissue Yield Using Frictional Fabric Brush Versus Sharp Curettage for Endocervical Curettage

Diedrich JT, Bentz JS, Rathore S

The aim of this retrospective blinded case-control study was to evaluate and compare the diagnostic yield of conventional endocervical curettage (ECC) with fabric-based ECC in a consistent physician group of eighty-one colposcopists. Using conventional ECC technique, 9234 ECC's were performed from September 2011 to October 2013. All colposcopists subsequently converted to fabric curettage and an additional 774 ECCs were performed. Using the conventional ECC technique, 7809 (84.6%) of specimens were satisfactory, 1037 (11.2%) were limited, and 388 (4.2%) were inadequate, where repeat biopsy was recommended. With fabric ECC, 705 (91.1%) of specimens were satisfactory, 64 (8.3%) were limited, and 5 (0.6%) were inadequate, where repeat biopsy was recommended. There were significantly fewer inadequate specimens with the fabric-based ECC (4.2% vs 0.6%, $p < .001$). There were significantly more CIN 2+ diagnoses using fabric over conventional curettage (3.8% vs 2.3%, $p < .01$)

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4. High Correlation of Fabric-based Cervical Biopsy to Subsequent LEEP

Clark BD, Golembeski CP, Sitelman A

The utility of exocervical colposcopic biopsy and endocervical curettage is validated when diagnostic results correlates highly with cases where an excision specimen of the entire transformation zone is provided. Forty-six cases referred for Loop Electrical Excision Procedures (LEEP) were preceded by colposcopic fabric based exocervical biopsy and endocervical curettage. The highest neoplastic grade of the colposcopic biopsy(ies) were compared with the reference excision highest grade. There were 34 of 46 fabric based colposcopic biopsy cases where CIN 2+ (fourteen CIN 3, twenty CIN 2 cases) were found in the excision specimen with a mean interval of 31.5 days (range 7-114 days) from colposcopy to excision. In 32 of 34 cases (94%), fabric exocervical biopsies showed either CIN 2 or CIN 3 (CIN 2+). In the remaining two cases, the fabric ECC specimen showed CIN 2+ (6%) as the sole evidence. Thus, 100% of CIN 2+ cases proven with excision were predicted by and correlated with antecedent fabric based colposcopic biopsy.

Journal of Lower Genital Tract Disease: April 2014 - Volume 18 - Supplement 1 5, p-S22.

5. Observation of a Robust Immune Inflammatory Response Following Frictional Fabric Biopsy During Colposcopy

Clark BD, Golembeski CP

Sixteen cervical excisional specimens were microscopically examined within 30 days of exocervical colposcopic biopsy and endocervical curettage procedure(s) taken with fabric-based biopsy devices for the presence and intensity of a histopathological immune inflammatory response. A robust immune response may be responsible for immune recognition of dysplasia and HPV, and possibly contribute to disease regression during the wound healing process. Photomicrographs of subsequent LEEP specimens showed biopsy sites where the epithelium was in repair, under which a persistent inflammatory and cell based immune response was evident with monocytes, plasma cells, and lymphocytes. This is different than was evident with prior observation of LEEP specimen biopsy sites following conventional biopsy/curettage. Cell based, and humoral immune recognition of human papillomavirus should be investigated to see if it correlates with the apparent inflammatory response.

Journal of Lower Genital Tract Disease: April 2014 - Volume 18 - Supplement 1 5, p-S21

6. Feasibility to Diagnose Cervical Cancer During Colposcopy Using Fabric-Based Minimally Invasive Biopsy Device

Yetur P, and Worsch L

This study evaluated the ability of fabric devices to diagnose cervical malignancy during colposcopy. Colposcopists conducted workups in 221 cases from a well screened low-risk private practice (mean age 33; range 20-58) using fabric-based cervical biopsy devices (120 CIN 1, 8 CIN 2/3 and 2 Cervical Carcinomas as the "highest grade" pathology result). Cancer was diagnosed in 0.5% of colposcopic workups, and were preceded by: 1. HSIL and 2. AGUS Pap smear results resulting in: 1. nonkeratinizing squamous cell carcinoma (age 30) and 2. poorly differentiated carcinoma, small cell type (neuroendocrine) with focal mixed features of nonkeratinizing squamous cell carcinoma (age 41). The biopsy specimens were abundant, trans-epithelial, contained large epithelial elements, abnormal vascular patterns and pleomorphic nuclei.

Journal of Lower Genital Tract Disease: April 2016 - Volume 20 Number 2 - Supplement 1, p-S22

7. Feasibility of Obtaining Diagnostic Trans-Epithelial Vaginal Biopsies with Frictional Brush Devices

Yetur P, Tu J, McClellan S, Flynn D, Worsch L

This was a retrospective study where 272 patients (mean age 55) were referred for colposcopy with abnormal cytology and/or human papilloma virus results who underwent frictional fabric biopsy. Pressure and rotation on vaginal mucosa sidewall or fornix lesions were performed. Frictional rotational brush biopsy removed multiple trans-epithelial diagnostic samples extending into superficial submucosa in 94% of cases from a surface area of about 6-10 mm in diameter. Biopsies showed: 165 normal, 85 Low-Grade, 3 High-Grade, 3 Malignant, and 17 Insufficient (6%). Biopsied areas appear to sustain minimal bleeding or patient discomfort. Thus, frictional biopsy specimens from area suspicious for vaginal neoplasia appear diagnostic with a small insufficiency rate (6%). It appears to be a less traumatic alternative to conventional punch biopsy.

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8. Photo-Micrographic Comparison of Spiral Bristle and Fabric-Based Minimally Invasive Exocervical Biopsies Relative to Punch Biopsy

Yetur P, Worsch L, Guo R, Tran A.

This was a retrospective study of examiners unaware of the upcoming "audit" comparing 221 Fabric-Based (Kylon® fabric, SoftBiopsy® device) exocervical biopsies with 158 stiff Spiral Bristle-Base devices (Spirabrush CX®) after referral for colposcopy with abnormal cytology and/or human papilloma virus results. Pressure and rotation on cervical mucosa on the lesion and areas likely encompassing one quadrant around lesions was performed. Frictional rotational brush biopsy removed multiple trans-epithelial diagnostic samples extending into superficial submucosa but appeared larger and of greater depth using the Fabric-Based biopsy device versus the Spiral Bristle device. The Spiral Bristle device pathology showed; 88 CIN 1 and 7 CIN 2/3 lesions, where the Fabric-Based device results showed; 120 CIN 1, 8 CIN 2/3 and 2 Cervical Carcinomas. Both devices produced diagnostic trans-epithelial specimens, however, the fabric-based specimens on average in every diagnostic category appeared larger and more frequently transepithelial.

Journal of Lower Genital Tract Disease: April 2017 - Volume 21 Number 2 - Supplement 1, p-S28.

9. Observation of a Robust Immune Inflammatory Response Following Frictional Fabric Cervical Biopsy and Endocervical Curettage.

Sitelman A, Diedrich J, Lonky NM

Twelve colposcopic biopsy cases that utilized Kylon® frictional fabric devices for exocervical biopsy and endocervical curettage were reviewed. Seven cases had loop excision procedures for CIN 2+ within 30 days of the colposcopic biopsies, and areas of the biopsy were evaluated. A unique robust inflammatory immune response with plasma cells and lymphocytes were noted under the regenerating epithelium into the lower dermis/submucosa in 6 of the 7 cases. The remaining 5 excisional treatments occurred after 30 days of the biopsy, and this response was not seen. It is theorized that frictional excision may induce an adjuvant effect with a release and recognition of human papillomavirus into the biopsy sites with a subsequent apparent immune reaction. This was a confirmation of the Clark et al. study with identical methodology.

Journal of Reproductive Medicine: July 2019,; 64: 261-264.

Stiff Bristle Brush Device Research: SpiraBrush CX®

1. A Stiff Bristled, Spiral-Shaped Ectocervical Brush: A Device for Trans-Epithelial Tissue Biopsy

Monk BJ, Cogan M, Felix JC, Lonky NM, Bentz JS, Marshall CJ, Cestero RM, Rowe LR, Lonky, SA

Before large loop excision of the transformation zone, 47 women with cervical intraepithelial neoplasia underwent a trans-epithelial brush biopsy of a portion of a colposcopically identified lesion, followed by a punch biopsy of the remaining portion. Brush biopsy samples were processed using liquid-based cytology and cell block techniques. The histological diagnosis of a subsequent loop excision specimen was compared with the brush histology and showed the brush biopsy result correlated within one grade with high-grade disease in 79.3% of these women using a cell block technique and 76.7% using liquid cytology, superior to punch biopsy correlation. There was significantly less pain ($P < .001$) and significantly less bleeding ($P < .001$) with the brush biopsy.

2. **Obstet Gynecol. 2002 Dec;100(6):1276-84 Trans-Epithelial Sampling of the Uterine Ectocervix with a Stiff-Bristled, Spiral Shaped Brush**

Tewari D, Lonky NM, Wilcynsky S, Rowley MA, Lonky SA, Johnson P.

To measure the depth of sampling of the uterine ectocervix with the use of a stiff-bristled, spiral-shaped brush (SpiraBrush CX®), eligible hysterectomy specimens were examined post-biopsy. The ectocervix was brushed with an inked SpiraBrush CX® in four quadrants with either light (gentle) or heavy (forceful) pressure. Heavy pressure resulted in the entire removal of epithelium in six samples, with the depth of sampling ranging from 0.2 mm to 0.7 mm. The stroma was disrupted in one sample. Results were uninformative in five samples. Sampling of the uterine ectocervix with the SpiraBrush CX® were trans-epithelial as defined by histologic crater depth.

Journal of Lower Genital Tract Disease 2004 Oct;8(4):276-9

Studies Utilizing “Brush Biopsy” Devices for Cervical Dysplasia or Cancer Diagnostics

1. **A Rapid High-Volume Cervical Screening Project using self-sampling and isothermal PCR HPV Testing**

Goldstein A, et al,

This was a prospective trial conducted in Mongolia where there were 3345 women were screened using self-collected HPV tests: , 624 (18.7%) were HPV+. Of these, 88.5% HPV+ women underwent same-day colposcopy and 78 were treated. Later consensus histology results obtained on 197 women indicated 20 CIN2+, of whom 15 were detected and treated/referred at screening (10 by thermal ablation, 4 by LLETZ. Diagnostic samples using the fabric-based biopsy devices were obtained as the basis for the determination of the pathology results.

Infectious Agents and Cancer, 2020 15:64, <https://doi.org/10.1186/s13027-020-00329-0>

2. **Initial evaluation of a new cervical screening strategy combining human papilloma vixrus genotyping and automated visual examination: The Human Papillomavirus Automated Visual Examination Consortium.**

Befano BA, et al,

A prospective study involving 9 clinical sites (Brazil, Cambodia, Dominican Republic, El Salvador, Eswatini, Honduras, Malawi, Nigeria, and Tanzania) was performed. Patients were screening with on-site HPV testing with genotyping and high risk cases underwent colposcopy incorporating computerized visual examination.

SoftBiopsy® and Soft-ECC® were used in some of the research sites for reference pathology diagnosis in comparison to digital image predictions. Data from 1832 HPV-positive participants confirmed that HPV genotype and automated cervical visual evaluation classification strongly and independently predict risk of histologic CIN3.

JNCI: Journal of the National Cancer Institute 2025, 117(10), 2124-2129. <https://doi.org/10.1093/jnci/djaf054>

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