Improved Yield of Endocervical Cells on Papanicolaou Smears in a Residency Setting

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Techniques employed in the collection of cervical cytology show a wide range of detection rates of endocervical cells. The presence of endocervical cells is currently considered to be an important factor in assessing the adequacy of a Papanicolaou smear. In a clinical trial in a university-based family practice center, the yield of endocervical cells was compared during several interventions. These interventions included wetting the cotton swab, changing the number of slides collected, and introducing an extended tip spatula. Clinic physicians were divided into experimental and control groups. Significant improvement in the yield of endocervical cells was found in the group using the extended tip spatula. There was no consistent effect of level of residency training on endocervical cell yield during any intervention.

The Papanicolaou smear, used for cervical cytological sampling since the 1940s,[1] has been shown repeatedly to be a reliable, inexpensive cancer-screening tool.[2] As cervical cancer is known to arise at or near the squamocolumnar junction, theoretically a Papanicolaou smear should sample this region to provide an adequate screening examination.

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The location of the squamocolumnar junction, 8 to 13 mm proximal to the cervical os in most adult females,[3] varies with the age of the patient.[4] In the infant the squamocolumnar junction exists on the ectocervix. During adolescence the squamocolumnar junction encompasses the external cervical os. As women age, the location of the squamocolumnar junction moves into the endocervix, until in perimenopausal women it is thought to be quite proximal to the cervical os. Other factors that affect the location and appearance of the squamocolumnar junction include pregnancy and cryotherapy. In this area, known as the transformation zone, the columnar cells of the ectocervix are converted to the stratified squamous cells of the vagina.

The successful collection of endocervical cells

from this region requires that several criteria be met. First, the physician must visualize the cervix adequately. Then, a sampling device must be used that can reach the squamocolumnar junction, collect cells from it, and transfer the cells on to a glass slide in a uniform fashion. The cytology laboratory must then fix, stain, and review the cellular material on the slide. The yield of endocervical cells is also thought to be affected by the age and parity of the patient, the presence of chronic inflammation or of red blood cells, previous douching, and timing in the menstrual cycle.[3-5]

A variety of collection devices used in the harvest of endocervical cells have included cotton swabs, plastic and wooden spatulas, and endocervical pipettes and aspirators. Studies evaluating collection techniques have ranged from comparisons of cancer-detection rates across different populations to a direct calculation of the false-negative rates in cases of known cervical cancer.[6] Although it is clear that sampling the endocervix at least twice (paired smears) improves the detection of cancer,[7,8] controversy remains regarding which devices and in what order provide the best possible cellular yield.

Clinic physicians in this study believed that the yield of endocervical cells in the patient population was inordinately low, although this clinical impression had not been documented. Recent literature suggests that many centers expect only a 50 to 60 percent yield of endocervical cells overall,[8,9] although some studies have reported finding endocervical cells in 90 percent of their screened patients.[10,11] Because the current literature suggests that the presence of endocervical cells is essential for the adequacy of the Papanicolaou smear, this study represents an effort to increase the yield of endocervical cells in a population served by a variety of practitioners.

Methods

From 1981 to 1984, 2,069 Papanicolaou smears were evaluated from women presenting to the Family Medical Care Center of the University of Missouri Health Sciences Center. Clinic services occurred on two floors (Floors A and B) and the training level of practitioners on the two floors was comparable. The practitioners included 34 residents, 9 attending physicians, and 4 nurse practitioners. All women regardless of age were admitted to the study if their cervical screening was performed during the study period. Only women with surgical absence of the cervix were excluded.

Prior to the study, Papanicolaou smears were performed using the same technique on both Floors A and B: a dry cotton swab was used to sample the endocervix, followed by a wooden Ayre spatula used for ectocervical scraping. During this baseline period, Papanicolaou smear reports and the physicians' level of training were recorded, as well as the yield of endocervical cells. If endocervical cells were found on any slide collected during the Papanicolaou smear, endocervical cells were reported as having been seen. Following this baseline period, a series of modifications in sample-collection techniques was designed.

The first intervention consisted of the substitution of saline-soaked cotton swabs for the dry swabs on both Floors A and B. Several drops of saline were applied to the end of a cotton-tipped applicator by the nursing assistant. Practitioners were encouraged to swab vigorously the endocervix for 10 to 20 seconds in order to increase the yield of endocervical cells. Papanicolaou smear reports were evaluated over a two-month period to measure the effect of this modification as compared with the baseline rate.

The next intervention involved the introduction of a wooden extended tip spatula on Floor B only. Floor A was utilized as the control group throughout the remainder of the study. Providers on Floor A continued to use the saline-soaked cotton swab and Ayre spatula. A three-slide method was used on Floor B, the experimental group, during a three-month period. The extended tip spatula was used first to collect endocervical material, followed by the saline-soaked cotton swab and Ayre spatula. The nursing assistant provided the practitioner with the appropriate sampling device in the order described. Clinic physicians were not encouraged to change their technique, nor were they provided with any specific education regarding the extended tip spatula.

Four staff cytotechnologists who were unaware of the order of the slides recorded the individual diagnoses of 381 slides (127 patients) from the experimental floor. The presence or absence of

Table 1. Summary of Study Design

Study Period	Floor A	Floor B
Baseline	Dry cotton swab, Ayre spatula	Dry cotton swab, Ayre spatula
First intervention	Saline-soaked cotton swab, Ayre spatula	Saline-soaked cotton swab, Ayre spatula
Second intervention	Saline-soaked cotton swab, Ayre spatula	Extended tip spatula, saline-soaked cotton swab, Ayre spatula
Third intervention	Saline-soaked cotton swab, Ayre spatula	Extended tip spatula, Ayre spatula

endocervical cells was noted for each slide. The standard laboratory quality-control practice of re-screening 10 percent of all specimens was continued during the study. In addition, all slides were evaluated by a cytotechnologist from outside the institution who was blinded to the initial diagnosis and specimen-collection order.

The final intervention was undertaken because of the excessive time involved in laboratory screening of three slides per patient. Floor A continued as the control group utilizing the same collection technique as described above. Floor B performed a two-slide collection utilizing the extended tip spatula followed by the Ayre spatula. The yield of endocervical cells was then calculated for each floor (Table 1).

Statistical methods included the use of chi-square analysis and the Student's *t* test.

Results

Baseline Period

During the baseline period, 533 women were screened for cervical cancer. Only 58 percent of the Papanicolaou smear reports from this period had endocervical cells present. This rate was identical on Floors A and B.

For the first intervention, saline-soaked cotton swabs were used throughout the clinic in an attempt to improve the adherence of endocervical cells to the collection device. Sixty-three percent of the Papanicolaou smears performed during this period contained endocervical cells, a rate not significantly different from the baseline rate (Table 2).

For the second intervention, a wooden extended tip spatula, available only on Floor B, was then utilized to reach higher into the endocervical canal. Obtained from International Cancer Screening Laboratory, San Antonio, Texas, the spatula is similar to the Ayre spatula. The difference is its 16-mm extended arm that can reach easily into a nulliparous cervix. The three-slide method on Floor B using the extended tip spatula as the first sampling device offered a significant improvement in the yield of endocervical cells. Endocervical cells were detected in 75 percent of these smears compared with 57 percent on Floor A ($P < .05$). Because of these encouraging results, the extended tip spatula was retained as the first collection device on Floor B (Table 3).

For the third intervention, the efficacy of a two-slide method using the extended tip spatula then was evaluated. Endocervical cells were detected in 71 percent of the Papanicolaou smears from Floor B. During the same period, 57 percent of the Papanicolaou smears from Floor A demonstrated endocervical cells ($P < .05$). A slightly higher yield of endocervical cells was found using the three-slide technique (75 percent) as compared with the two-slide method (71 percent), but this difference was not statistically significant (Table 3).

Table 2. Results of the First Intervention: Percentage of Endocervical Cells Found in Study Specimens

	Baseline (dry cotton swab, Ayre spatula)	First Intervention (saline-soaked cotton swab, Ayre spatula)
Floor A	58 (158/273)*	63 (84/133) ($P > .10$, $df = 1, \chi^2 = 1.04$)
Floor B	58 (151/260)	63 (68/108) ($P > .10$, $df = 1, \chi^2 = .76$)

*Number of patients with endocervical cells found/total number of patients

Five months after the Papanicolaou smears involved in the final intervention had been reviewed, a follow-up evaluation was performed. Both floors were still utilizing the collection techniques as described in the final intervention. On Floor A, the endocervical cell yield was 59 percent. On Floor B, the endocervical cell yield was 69 percent ($P < .05$) (Table 3). There was no consistent effect of level of experience (year of residency training) on endocervical cell yield during any intervention.

Quality Control

The variability in detection of endocervical cells by the four cytotechnologists was investigated. Technician variability ranged from 6 to 46 percent in the 381 slides (127 patients) from Floor B during the second intervention. These differences were statistically significant. Each cytotechnologist evaluated only a portion of the total slides. To determine whether technician diagnostic variation was an explanation for the high rate of Papanicolaou smears without endocervical cells, an expert cytotechnologist from outside the institution was chosen to rescreen the entire sample of study slides. The overall agreement on the presence of endocervical cells between the expert outside reader and the staff cytotechnologists was 89 percent. There was some tendency for the staff cytotechnologists to detect endocervical cells (26 slides, 7 percent) less often than the outside reader. However, in nearly all of these cases, the expert noted that endocervical cells were rare on those slides.

Discussion

The extended tip spatula provided a significant improvement in the yield of endocervical cells in this sample. This finding is consistent with previous studies.[8,9] In contrast, the cotton-tipped swab, dry or moistened with saline, proved to be less than adequate for the harvest of endocervical cells. Colon and Linz,[9] Rubio,[12] and Katz et al[13] have all found similar difficulties with the cotton swab. They suggest that the cotton swab is a source of false-negative cytologic smears and recommend that the use of the cotton swab be abandoned and replaced by the extended tip spatula. The use of the extended tip and Ayre spatulas allows sampling from both the endocervical canal and the ectocervix.

There was a slightly higher yield of endocervical cells with the three-slide method compared with the two-slide method, even though both interventions used the extended tip spatula as the first collection device. However, the two-slide method is less expensive because of reduced use of technologists' time. Furthermore, the yield using this method was not significantly lower than that found with the three-slide method, and the difference was not thought to be clinically significant. In

Table 3. Results of Subsequent Clinical Interventions: Percentage of Endocervical Cells Found in Study Specimens

	Floor A (control)	Floor B (experimental)
Second intervention	57 (104/184)*	75 (95/127) ($P < .05$, $df = 1$, $\chi^2 = 10.9$)
Third intervention	57 (66/116)	71 (69/97) ($P < .05$, $df = 1$, $\chi^2 = 4.6$)
Follow-up	59 (229/388)	69 (264/383) ($P < .05$, $df = 1$, $\chi^2 = 8.3$)

*Number of patients with endocervical cells found/total number of patients

addition, the difference in the endocervical cell yield between the control and experimental groups persisted over time using the two-slide method.

The yield of endocervical cells on Papanicolaou smears has been reported to range from 50 to 90 percent.[8-11] In the present study, the yield of endocervical cells was increased by improving the sampling devices. Some other factors that may affect this rate include the skill and technique of the clinician, laboratory determinants (fixing, staining, and interpretation of slides) and the characteristics of the patient sample. Regarding clinician characteristics, there was no evidence that year of residency training consistently affected the endocervical cell yield. The variation in the diagnosis of endocervical cells by laboratory personnel also did not explain the 60 to 70 percent overall yield. Little is known about the common characteristics of women with Papanicolaou smears without endocervical cells. This superficially heterogeneous group may have some important common features, such as cervical anatomical distinctions, nulliparity, or infrequent sexual intercourse, that may increase or decrease their risk of cervical cancer. Certainly learning more about these women would assist clinicians in establishing a consistent policy for Papanicolaou smear surveillance of this group.

Conclusion

In this study, the extended tip spatula significantly improved the yield of endocervical cells during cervical cytological sampling. Used with the Ayre spatula, the extended tip spatula provided acceptable levels of endocervical cells when compared with other studies done in the United States. Further investigation should focus on characteristics of women with repeated Papanicolaou smears without endocervical cells to determine whether this group requires increased surveillance for endocervical cancer.

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