

Colposcopic Accuracy in a Residency Training Program: Defining Competency and Proficiency

Daron G. Ferris, MD, and Max D. Miller, EdD

Augusta, Georgia

Background. The determination of proficiency in procedural skills has evoked keen interest, but meaningful guidelines are limited by the absence of pertinent clinical data. Colposcopic accuracy is defined as the clinical correlation between a colposcopic impression and a histologic report. The colposcopic accuracy of physicians in a university-based family practice residency colposcopy program was evaluated.

Methods. Demographic information, clinical findings, and laboratory results of patients evaluated by colposcopy were prospectively recorded. Colposcopic accuracy was calculated based on the agreement of the colposcopic impression with the histologic interpretation within one histologic grade.

Results. Colposcopic examinations were performed on 282 patients. Histologic evidence of premalignant cervical disease was identified in 115 patients as follows: mild dysplasia, 72; moderate dysplasia, 24; and severe

dysplasia, 19. The colposcopic impression agreed within one histologic grade in 188 of 205 patients for a colposcopic accuracy rate of 91.7% (95% CI = 87.1% to 95.1%).

Conclusions. Given an acceptable latitude of clinical correlation between the colposcopic impression and histologic interpretation, the colposcopic accuracy of family physicians compared favorably with that reported by other colposcopists. The more common colposcopic errors were overestimation of low-grade disease and underestimation of high-grade disease. Colposcopic accuracy at an essential minimal proficiency level of 80% should form the basis for assessing specialized perceptual ability and therefore determining colposcopic competency.

Key words. Colposcopy; cervix neoplasms; clinical competency; competency-based education.
(*J Fam Pract* 1993; 36:515-520)

Physicians of various medical specialties are being trained in colposcopy and related procedural skills that will enable them to comprehensively evaluate and treat lower genital tract disease. Family physicians, like other physicians, have enthusiastically accepted modern diagnostic technology. Several studies have evaluated the status of colposcopy practice and training in family practice residency programs.^{1,2} The colposcopy experience of family physicians in terms of patient demographics, epidemiologic data, and types of disease encountered have been

reported for general practitioners in private practice,^{3,4} for community-hospital-based family practice residency programs,^{5,6} and for a university-based program.⁷ However, data from clinically based research that has critically analyzed the accuracy, proficiency, and competency of family physician colposcopists is limited.

The accuracy of the colposcopic visual inspection is critically important, as detection of abnormal cervical cytology is dependent on proper visual identification of disease as well as on obtaining sufficient abnormal epithelial tissue to permit microscopic assessment. A precise visual colposcopic assessment will correlate well with cytologic and histologic findings. The absence of cytologic, colposcopic, and histologic correlation frequently results in conservative decisions regarding treatment and follow-up evaluations. Proficient colposcopic assessment

Submitted, revised, February 4, 1993.

From the Medical Effectiveness Education and Research Program, Department of Family Medicine, Medical College of Georgia, Augusta. Requests for reprints should be addressed to Daron G. Ferris, MD, Department of Family Medicine, Medical College of Georgia, Augusta, GA 30912.

enables differentiation of disease severity. Thus, within a large, complex cervical lesion with varying degrees of premalignant alteration, the most severe disease will be biopsied. The pathologist will then be provided with a specimen that reflects the most severe abnormality. Because histologic interpretations also are somewhat subjective, the criterion standard for colposcopy-based diagnosis actually involves a cumulative and balanced assessment of cytologic and histologic findings and the colposcopic impression.

The accuracy of the colposcopic impression may be viewed then as a potential proficiency measure because of its integral role in and impact on the diagnosis of cervical disease. Consequential clinical management decisions are also dependent on the diagnostic accuracy of the colposcopic examination.

How accurately do the colposcopic impressions of family physicians correlate with cytologic and histologic results? Is there a level of accuracy for colposcopy that can be used to measure proficiency? In an attempt to answer these critical questions, the accuracy of a colposcopy training program was assessed and a definition of clinical proficiency was quantitatively suggested.

Methods

A university-based family practice residency program established a colposcopy service to educate residents and provide prompt, easily accessible gynecologic care for patients. Educational tools,^{8,9} resource materials,¹⁰ and a curriculum were developed for training residents. The equipment used for teaching and patient care included the following: a multimagnification colposcope with a video colposcopy system (camera, VHS video recorder, and video monitor); a colposcope-mounted 35-mm camera; a cerviscope and power unit for cervicography (National Testing Laboratories, Fenton, Mo),¹¹ typical colposcopy surgical instruments; a cryosurgical unit with accessories; and an electrosurgical unit. A standard light microscope permitted review of histopathology specimens.

Male and female patients with a defined indication for colposcopy were referred to the colposcopy clinic. Indications for referral were abnormal cervical cytology, atypical or positive cervigram, history or presence of human papillomavirus infection, or having a sexual partner with the previously noted infections or abnormalities. Patients were referred from resident and faculty clinics, satellite practice units, and external health care clinics (county health department, private practice, etc). All patients were scheduled for colposcopic appointments within 30 days of referral.

Primarily, colposcopic procedures were performed by family practice residents under faculty supervision as previously described.¹⁰ Cytologic and histologic specimens usually were interpreted at one of two laboratories by certified cytotechnologists or pathologists. Colposcopic impressions were determined by consensus agreement between resident and faculty colposcopists. All colposcopic impressions were recorded immediately following cervical biopsy sampling. Clinical findings and laboratory results were prospectively recorded. For each patient, cytologic assessment, colposcopic impression of disease severity, and subsequent histologic analysis were recorded. Cytology was recorded using the Papanicolaou system or Bethesda System.

Colposcopic impressions were recorded as either normal, leukoplakia, inflammation, low-grade lesion, or high-grade lesion. Colposcopic impressions were commonly determined by formulating Reid's Colposcopic Index scores.¹² High-grade lesions were differentiated for correlation purposes based on total index scores. Histology was interpreted as normal, leukoplakia, cervicitis, atypia, mild dysplasia, moderate dysplasia, or severe dysplasia. We determined a priori, based on previous research, that a colposcopic impression within one grade of the histologic assessment would be defined as an accurate match.¹³ Our intent was to measure the degree of accuracy achieved by family practice colposcopists and to compare this with previously published reports.

Data were analyzed by the chi-square test, except in tables with an expected frequency of less than five in one or more cells, in which case Fisher's exact test was used. Data were further analyzed by calculating proportions of agreement between colposcopic impression and histologic interpretation. Confidence limits for binomial proportions were calculated.

Results

During the investigation, 3467 Papanicolaou smears were performed at the clinic. Of these, 665 (19.2%) were reported as class II or more severe. Two hundred eighty-two patients were colposcopically examined at the family practice clinic. A total of 401 examinations and/or treatments were performed from August 1989 to June 1992. The mean age of the subjects was 30.4 years and the range was from 12 to 89 years. The mean age of first sexual intercourse was 16.9 (± 2.9 SD) years and the lifetime mean number of sexual partners was 5.7 (± 15.2 SD). Thirty-two percent of the patients were nulliparous and 4.3% were pregnant at the time of examination. A history of previous cervical cryosurgery and laser therapy was reported by 9.7% and 2.2% of patients, respectively.

Table 1. Nature of the Examination and Abnormal Colposcopic Findings (N = 282)

	No. (%)
Examination outcome*	
Satisfactory colposcopy	228 (84.1)
Unsatisfactory colposcopy	43 (15.9)
Abnormal colposcopic findings†	
Acetowhite epithelium	152 (53.9)
Punctation	80 (28.3)
Mosaic	60 (20.3)
Exophytic condyloma	31 (11.0)
Leukoplakia	8 (2.8)
Atypical vessels	8 (2.8)
Polyp(s)	7 (2.5)
Erosion	0 (0.0)

*Examination outcome was not recorded for 11 patients.

†Findings are not mutually exclusive. Colposcopic findings are reported in the basic colposcopic terminology approved by the International Federation of Cervical Pathology and Colposcopy (IFCPC).¹⁴

A recently abnormal Papanicolaou smear was the most common indication (62.8%) for colposcopic examination. The clinical presence of genital condyloma (15.4%) was the next most common indication for colposcopy. Abnormal cervicography, exclusive of an abnormal Papanicolaou smear from the same patient, was the reason for evaluation of 8.1% of patients. The remaining indications for colposcopy included an abnormal cervical lesion (2.0%), a sexual partner infected by human papillomavirus (0.8%), and indications termed "other" (10.9%).

Abnormal colposcopic findings are reported in Table 1. Few examinations were unsatisfactory as a result of the inability to visualize the entire squamocolumnar junction or the inability to delineate the margins of a pathologic lesion. Acetowhite epithelium was the most common finding of the abnormal transformation zone (53.9%), followed by vascular changes of punctation (28.3%) and mosaic pattern (20.3%). Two to three cervical biopsies were collected from 70.9% of 129 pa-

tients, and a single biopsy was collected from 24% of the women. The endocervical curettage results were positive for 8.1% of patients.

The clinical correlation of cytologic and histologic findings and the colposcopic impression is of critical importance during colposcopy. In Table 2, the colposcopic impressions (ie, visual impressions) are compared with histologic results. The colposcopic prediction of low-grade disease was exactly correct for 63 of 72 (87.5%) patients with actual low-grade disease as confirmed by histologic examination. The colposcopic impression of high-grade disease was exactly correct for 13 of 43 (30.2%) patients with true high-grade disease. The overall exact agreement was correct for 120 of 190 patients (63.2%, 95% CI = 55.9% to 70.0%). Of note, 112 of 115 (97.4%) patients with histologic evidence of dysplasia were colposcopically identified as having dysplasia.

Clinically, the colposcopic impression must correlate within one degree of severity with the histologic interpretation.¹³ Using this standard, the clinical correlation between the colposcopic impression and histologic report was accurate in 188 of 205 (91.7%, 95% CI = 87.1% to 95.1%) patients. In 13 patients with high-grade disease, a colposcopic impression of low-grade disease was documented, resulting in an 8.3% clinical disagreement rate and a 91.7% agreement rate. In four patients with only inflammatory or atypical cellular changes, a colposcopic impression of high-grade disease was documented. Hence, the clinical disagreement for high-grade colposcopic impression was 16%. Overall, in 15 of 205 (7.3%) cases, disease severity was underestimated, and in 4 of 205 (1.0%) cases, disease severity was overestimated.

The consistency of colposcopic accuracy over time is shown in the Figure. The data represent a clinical correlation for agreement of plus or minus one degree of

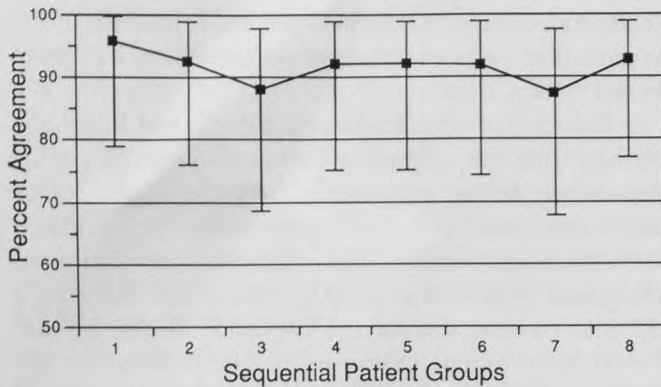
Table 2. Colposcopic Impressions Compared with Histologic Findings (N = 205)

Histologic Finding	Colposcopic Impression					Cancer	Total
	Normal	Leukoplakia	Inflammation	Low-Grade Disease*	High-Grade Disease†		
Normal	0	1	0	1	0	0	2
Leukoplakia	0	0	0	1	0	0	1
Cervicitis	2	0	0	13	2	0	17
Atypia	12	3	3	50	2	0	70
Mild dysplasia	0	0	1	63	8	0	72
Moderate dysplasia	1	0	0	15	8	0	24
Severe dysplasia	1	0	0	13	5	0	19
Total	16	4	4	156	25	0	205

NOTE: Agreement between histologic and colposcopic findings is defined as correlation within one degree of severity. For example, a colposcopic impression of normal would agree with an histologic interpretation of normal (same) or low-grade disease (within one degree), but would not agree with high-grade disease (more than one degree of histologic severity).

*Low-grade disease consistent with abnormal colposcopic finding with minor changes (human papillomavirus [HPV] changes or mild cervical intraepithelial neoplasia [CIN I]).

†High-grade disease consistent with abnormal colposcopic finding with major changes (CIN II, CIN III/carcinoma in situ [CIS]).



The agreement between the colposcopic impression and histologic report based on 205 patients sequentially examined over a 3-year period (vertical bars represent 95% CI).

disease severity. The range of mean colposcopic accuracy varied between 95.8% and 87.5%.

Discussion

Colposcopy is characterized by four procedural steps: visualization, assessment, sampling, and correlation. At an absolute minimum, a colposcopist must be able to locate the disease; colposcopically assess the severity of lesions; determine the most severe lesion to biopsy; and correlate the colposcopic impression with the cytologic and histologic findings. We used these criteria to assess the perceptual abilities of colposcopists. These criteria have the necessary validity (accuracy) and reliability (consistency) characteristics to measure procedural proficiency. We have shown this method is a reliable technique for assessing colposcopy skills. The clinical correlation between cytologic findings, the colposcopic impression, and histopathology is necessary to make effective management decisions in cases in which cervical premalignant and malignant disease is detected. As recognized by the American Society of Colposcopy and Cervical Pathology, correlation also establishes the "cornerstone for development of expertise in colposcopy."¹⁵ Our study showed a clinical correlation of 91.7% between colposcopic impression and histologic assessment. As such, the degree of correlation becomes a measure of colposcopic proficiency and of the validity of colposcopic findings. When clinical correlation data are serially compiled, a temporal proficiency curve (consistency) is generated. In this study, a reasonably flat curve, which demonstrated a sustained, moderately high level of colposcopic accuracy, was achieved.

Staffl and Mattingly¹³ reported similar correlation with colposcopic findings in 560 patients. Their colposcopic to histologic correlation was 85.0%, compared

with our overall accuracy rate of 91.7%. The severity of disease was underestimated in 3.3% and overestimated in 11.7% of patients in the Staffl and Mattingly study, compared with rates of 7.3% and 1.0%, respectively, in our study. The reported differences may be explained by the greater spectrum of cervical disease, particularly severe premalignant disease, and cancer, encountered by Staffl and Mattingly in their tertiary care center. A colposcopic accuracy rate as high as 97%, however, has been reported by other physicians in a clinical setting similar to Staffl and Mattingly.¹²

Benedet et al¹⁶ have recently described a quality-control program for colposcopy in British Columbia. Their study documented an 86% correlation of colposcopic impressions with cervical biopsy interpretations in an analysis of 3252 consecutive patients examined by 35 colposcopists. The authors then established an 80% quality control index or minimum threshold of acceptable practice. Only 3 of 35 colposcopists failed to achieve this level of colposcopic accuracy.

Considering the level of colposcopic accuracy reported in this study and by others,^{12,13,16} it would appear prudent to include the colposcopic accuracy index (CAI) as a critical training and clinical practice proficiency measure. This definition of proficiency complements a competency-based approach to colposcopy education. Those colposcopists who fail to achieve or regularly maintain an index score of 80% should receive additional training. Colposcopy proficiency assessed solely by ill-defined requirements based on the number of procedures a physician completes is simplistic and effectively inconsistent. Procedural learning curves are likely to vary between individuals based on their previous knowledge and experience. Colposcopists who consistently demonstrate colposcopic accuracy rates above 80% can reasonably be defined as proficient provided they do not fail to biopsy more severe coexisting disease and do not misdiagnose cervical cancer.

Clinical competency criteria traditionally consist of knowledge and understanding, technical skills, clinical skills, problem-solving tasks, and interpersonal attributes.¹⁷ In colposcopy training and practice, specific measures of competency must include: identification of the most severe lesions (visualization); satisfactory knowledge of basic colposcopy curricular content, proficiency in recognizing normal cervical anatomy and in distinguishing types of cervical abnormalities (assessment); demonstration of proper psychomotor skills, and witnessed satisfactory performance of colposcopic examinations (sampling); and demonstration of proper management and triage (correlation). Although proficiency should not be measured by the number of procedures performed, numerous learning experiences, in conjunc-

tion with expert preceptorship, are essential to achieving colposcopic competency. With this in mind, the CAI represents an excellent contemporary standard for determining and monitoring clinical competency.

Colposcopy competency is dependent on a proper colposcopically directed biopsy of the most severe cervical disease. Unfortunately, colposcopists may not always obtain biopsies of the more severe premalignant changes.¹⁸ A clinical colposcopy proficiency measurement requiring an extensive excisional specimen criterion standard is impractical, potentially flawed, limited in scope, and likely unethical. However, future proficiency assessments may include review of histologic data obtained from excisional treatment procedures, such as the increasingly popular ELECTZ procedure.

Colposcopists are not entirely responsible for the disagreement between the colposcopic impression and the histologic assessment. A certain degree of interobserver variability even occurs between pathologists when histologically grading cervical intraepithelial neoplasia.¹⁹ The degree of interobserver agreement appears best for severe disease (cancer and CIN III) and worse for low-grade disease. Experienced histopathologists have shown that the greatest interobserver variability occurs when attempting to distinguish reactive squamous proliferations from CIN I.¹⁹ The same differentiation is also difficult for the colposcopist, as demonstrated in our investigation. Colposcopists must be able to differentiate atypical squamous metaplasia findings of acetowhite epithelium and fine, closely spaced vascular patterns from the similar characteristics of low-grade disease. Thus, the rationale for colposcopic agreement of plus or minus one degree of disease severity is reasonable and valid.

In this study, the discrepancy between colposcopic impression and histologic interpretation was greater for high-grade than for low-grade disease. Frequently, the subtle features of high-grade disease are overlooked, especially when positioned within a larger area of prominent acetowhite epithelium typical of low-grade disease.²⁰ Such an underestimation of severe disease may result in inadequate therapy. Also, overinterpretation of atypical squamous metaplasia (atypia/chronic cervicitis) was common. The colposcopist may overestimate minor benign cervical epithelial and vascular alterations that mimic low-grade premalignant disease features. The error is common when the colposcopist has knowledge of a preexisting minor cytologic smear abnormality. The apparent colposcopic overestimation of low-grade disease in this study, however, may be an excessive representation based on a falsely negative histologic standard.²¹

The proficiency curve effect and high colposcopic accuracy rate reported may be limited by several factors.

First, the data were based on a small number of patients with primarily low-grade disease. Furthermore, a potential bias existed since the pathologists who evaluated the histologic results were also furnished with the colposcopic impression on the pathology requisition form. The study design was not unlike others, however, as this provision of clinical information is necessary.

In summary, given a reasonable latitude of clinical correlation between the colposcopic impression and the histologic interpretation, the accuracy of family physicians compares well with that reported by other colposcopists. Our proficiency curve is flat, reflecting a continuous high rate of colposcopic accuracy. In our study, well-trained generalist physicians delivered high-quality, technically sophisticated health care.

Colposcopic accuracy, at an essential minimal proficiency level of 80%, should form the basis for determining and maintaining colposcopic competency. The colposcopic accuracy index threshold of 80% appears to be a reasonable proficiency level and a useful goal for training programs. Assessment of procedural-skill proficiency should be based on objective evidence of adequate training, as well as on a clinical performance critique, rather than on completion of an arbitrary number of procedures.

Acknowledgments

This endeavor would not have been possible without the outstanding efforts of Lisa Woodward, Betty Miller, RN, and Elizabeth Williams, RN. Barbara Miller assisted with manuscript preparation, and Mark Litaker provided data analysis and statistical support.

References

1. Ferris DG, Miller MD. Colposcopy practice and training in family practice residency programs. *J Am Board Fam Pract* 1992; 5:153-6.
2. Gordon PR. Colposcopy training in family practice residency programs. *Fam Med* 1991; 23:310-2.
3. Chomet J. Screening for cervical cancer: a new scope for general practitioners? Results of the first year of colposcopy in general practice. *BMJ* 1987; 294:1326-8.
4. Johnson DB, Rowlands CJ. Diagnosis and treatment of cervical intraepithelial neoplasia in general practice. *BMJ* 1989; 299:1083-6.
5. Pfenninger JL. Colposcopy in a family practice residency: the first 200 cases. *J Fam Pract* 1992; 34:67-72.
6. Everett WD, Solomon P, Wheeler L. Experience with colposcopy in a family practice center. *Fam Pract Res J* 1991; 11:283-90.
7. Rodney WM, Huff M, Euans D, Hutchins C, Clement K, McCall JW. Colposcopy in family practice: pilot studies of pain prophylaxis and patient volume. *Fam Pract Res J* 1992; 12:91-8.
8. Ferris DG, Waxman AG, Miller MD. Colposcopy and cervical biopsy educational training models. *Fam Med*. In press.
9. Ferris DG. Electrosurgical loop excision of the cervical transformation zone; pre-clinical training proficiency. *Fam Med*. In press.
10. Champion MJ, Ferris DG, di Paola FM, Reid R, Miller MD.

- Modern colposcopy: a practical approach. Augusta, Ga: Educational Systems, Inc, 1991.
11. Staff A. Cervicography: a new method for cervical cancer detection. *Am J Obstet Gynecol* 1981; 139:815-25.
 12. Reid R, Scalzi P. Genital warts and cervical cancer. VII. An improved colposcopic index for differentiating benign papilloma viral infections from high-grade cervical intraepithelial neoplasia. *Am J Obstet Gynecol* 1985; 153:611-8.
 13. Staff A, Mattingly RF. Colposcopic diagnosis of cervical neoplasia. *Obstet Gynecol* 1973; 41:168-76.
 14. Staff A, Wilbanks GD. An international terminology of colposcopy: report of the Nomenclature Committee of The International Federation of Cervical Pathology and Colposcopy. *Obstet Gynecol* 1991; 77:313-4.
 15. Bent AE, Calkins JW, Gaudiano FJ, McIntyre-Seltman K, Torres JE. Core curriculum for teaching colposcopy in residency programs. Washington, DC: Education Committee, American Society for Colposcopy and Cervical Pathology, 1992:27.
 16. Benedet JL, Anderson GH, Maticic JP, Miller DM. A quality control program for colposcopic practice. *Obstet Gynecol* 1991; 78:872-5.
 17. Norman GR. Defining competency: a methodological review. In: Neufeld VR, Norman GR, eds. *Assessing clinical competence*. New York: Springer Publishing, 1985.
 18. Buxton EJ, Luesley DM, Shafi MI, Rollason M. Colposcopically directed punch biopsy: a potentially misleading investigation. *Br J Obstet Gynaecol* 1991; 98:1273-6.
 19. Ismail SM, Colclough AB, Dinnen JS, et al. Observer variation in histopathological diagnosis and grading of cervical intraepithelial neoplasia. *BMJ* 1989; 298:707-10.
 20. Reid R, Crum CP, Herschman BR, et al: Genital warts and cervical cancer. V. The tissue basis of colposcopic change. *Am J Obstet Gynecol* 1984; 149:293-303.
 21. Byrne P, Jordan J, Williams D, Woodman C. Importance of negative result of cervical biopsy directed by colposcopy. *BMJ* 1988; 296:172.