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Comparison of Methods for Identifying Ano-Genital Injury After Consensual Intercourse

Therese Zink, MD, MPH^{*},

Department of Family and Community Medicine, University of Minnesota, Minneapolis, MN

Jamison D. Fargo, PhD,

Department of Psychology, Utah State University, Logan, UT

Rachel B. Baker, PhD, RN,

Cincinnati Children's Hospital Medical Center, Cincinnati, OH

Carol Buschur, RN, MSNc,

The University Hospital, Cincinnati, OH

Bonnie S. Fisher, PhD, and

Division of Criminal Justice, University of Cincinnati, Cincinnati, OH

Marilyn S. Sommers, PhD, RN, FAAN

School of Nursing, University of Pennsylvania, Philadelphia, PA

Abstract

Objective—The purpose of this report is to compare consensual intercourse related ano-genital injury prevalence by using three different forensic examination techniques: 1) direct visual inspection, 2) colposcopy and 3) toluidine-blue contrast application.

Methods—Using a descriptive, comparative design, 120 female volunteers, aged 21 years or older, were examined after consensual sexual intercourse using the above techniques. Ano-genital injuries were noted using the TEARS classification (Tears, Ecchymoses, Abrasions, Redness, and Swelling).

Results—Direct visualization and colposcopy yielded similar ano-genital injury findings. However, more tears and abrasions of the external genitalia were identified with toluidine-blue than with direct visual inspection or colposcopy ($p < .05$). More tears were identified on the anus following toluidine-blue as compared to direct visualization ($p < .05$), but not colposcopy. Fewer ecchymoses were identified on the internal genitalia and fewer areas of redness were identified on both the external and internal genitalia when toluidine-blue was used as compared to either direct visualization or colposcopy ($p < .05$).

Conclusions—The scientific community needs to continue to build information about ano-genital injury prevalence following consensual sexual intercourse. Understanding the ano-genital injury patterns, including frequency and prevalence, that occur with consensual sexual intercourse will help to identify the difference between injury related to consensual vs. non-consensual sexual intercourse. At this time, toluidine-blue staining may add value to the sexual assault forensic

Corresponding Author: Therese Zink, MD, MPH, zink0003@umn.edu, Professor, Dept. of Family and Community Medicine, University of Minnesota, MMC 81, 420 Delaware Street SE, Minneapolis MN 55455, 612 625 9197 phone, 612 624 2613 fax.

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examination. It is the healthcare provider's role to collect all possible evidence and the courts' role to determine what evidence is admissible and to ensure a rightful conviction.

Keywords

injury; consensual sex; colposcopy; toluidine blue

INTRODUCTION

Little has been published about the ano-genital injury related to consensual sexual intercourse. Several investigators sought to understand the forensic sexual assault examination used for injury detection and compare injuries resulting from consensual versus non-consensual sexual intercourse.¹⁻³ Others have studied genital injury as a naturally occurring event in samples of healthy women.^{4, 5} While injury prevalence varies from 11% to 75%, the findings generally indicate that microtrauma does occur after consensual intercourse. Of these investigators, Fraser et al. had the largest sample (n=107) of sexually active women. Participants, ages 18 to 35 years, had an injury prevalence of 61%, with the most common types of lesions being petechiae, erythema, abrasions, and edema. They found a higher prevalence of injury when the examination followed intercourse within 24 hours.⁵

Understanding the injury pattern from consensual intercourse may enlighten our understanding of the ano-genital injury after sexual assault. From a health care standpoint, physical injuries need to be detected and treated so that they heal without complications. Injuries also need to be documented so that if legal proceedings are initiated, they can be used as evidence throughout the criminal justice process.

Currently, the forensic examination may include direct visualization, colposcopy, and the application of a contrast media to identify difficult-to-visualize or microscopic injuries. A 2007 survey of the 549 active sexual assault nurse examiner programs around the U.S. found that responding programs (n=231) reported that 64% always used a colposcope and 32% always used toluidine-blue contrast.⁶ Genital injury prevalence varies by method used during the forensic examination, with genital injuries reported in 5% to 57% of sexual assault survivors who were examined by using direct visualization, in 40% to 58% who were examined using toluidine-blue contrast, and in up to 87% who had a forensic examination using colposcopy.^{1,7-10}

To date, few studies have compared injury frequency and prevalence when using different visualization methods after consensual sexual intercourse. The purpose of this report is to compare consensual intercourse-related ano-genital injury prevalence using three different forensic examination techniques: 1) direct visual inspection, 2) colposcopy, and 3) toluidine-blue contrast application. We sought to determine if toluidine-blue application provides additional data on genital injury prevalence in the consensual sexual intercourse population as compared to the other two techniques.

METHODS

Using a descriptive, comparative design, 120 female volunteers, aged 21 years or older who were healthy and English-speaking, were recruited from the local community through posters in health centers, churches, on campus, and by word of mouth. A sample that was representative of sexual assault survivors in terms of race or ethnicity, age, and the time interval between intercourse and examination was desired. A probability sample was not feasible, so the distributions of race/ethnicity (Black, White), age (21-24, 25-34, 35-44, 45-54, 55-64, 65+ years old), and time interval between sexual intercourse and examination (1-

4, 5–8, 9–12, 13–16, 17–20, 21–24 hours) from a sexual assault survivor registry ($N = 761$) based in a large Midwestern urban locale in the United States was used to guide (i.e., match) the number and age of Black and White participants who were enrolled, as well as to guide the time between consensual sexual intercourse and the examination, which was randomly assigned to each participant. A maximum 24-hour time interval between sexual intercourse and the examinations was chosen to reduce the effect of injury healing.

Exclusion criteria included injury to the genitalia in the previous month, pregnancy, hysterectomy, menses at the time of examination (which decreases visibility of injury), treatment for an abnormal pap smear or sexually transmitted infection in the past 6 months, or history of gynecologic cancer. Participants were also excluded if they had a previous abnormal colposcopic examination or required cervical procedures such as cryosurgery, cone biopsy, or LEEP.

The University's Institutional Review Board approved the study protocol and all participants provided written informed consent. Participants were screened between December 1, 2002 and February 28, 2005, and all examinations were completed by June 30, 2005. Qualified participants were scheduled for a face-to-face interview, given an examination appointment, and requested to have consensual sexual intercourse with a male partner at an assigned time interval prior to the colposcopic examination. The type of consensual sexual encounter was not specified, other than the request that the partners have sexual intercourse. At a follow-up appointment, participants were interviewed about the encounter, including the performed sexual behaviors, use of lubricants and birth control, length of the encounter, and use of sexual enhancements or alcohol or drugs, and then underwent a standard forensic sexual assault examination. A pregnancy test and a test for sexually transmitted infections were part of the examination procedure. If a participant had a positive pregnancy test, she was informed of the results and data collection was stopped. If the test for sexually transmitted infections was positive, the participant's data were excluded from analysis, she was referred for treatment, and the infection was reported to the public health department as outlined in the informed consent document.

Examinations consisted of visual inspection of the external genitalia, colposcopy of the external genitalia, insertion of the speculum, and internal examination with visual inspection followed by colposcopy, and then removal of the speculum and toluidine-blue contrast application to the external genitalia and peri-anal area (considered the external area approximately 5 cm around the anus), followed by visual inspection. For the colposcopy portion of the examination, a Cooper Surgical Leisegang[®] colposcope system was used with the magnification at 3.5. Toluidine-blue contrast was applied using a 1% aqueous solution of the contrast medium to the external genitalia and anus and then removing it with cotton balls moistened in water-based lubricant. The current study was completed in conjunction with a parent investigation to determine if injury prevalence varied across the continuum of skin color.¹¹ Two experienced nurse sexual assault forensic examiners (SAFE), each of whom had previously completed more than 250 forensic examinations including colposcopy, performed all the study examinations. The examiners received additional training from a primary care physician expert in physical examination and colposcopy technique prior to the initiation of the study, with follow-up quality control sessions every six months during data collection. The examiners were not part of the study team and were not aware of the hypotheses of the study. They were asked to complete the examination and to identify and count the types and number of injuries at each location by using the three techniques: visual inspection, colposcopy, and toluidine-blue application.

Ano-genital injury frequency was defined as the number of injuries counted by the examiner during each aspect of the examination: visual inspection, colposcopy, and toluidine-blue

application. *Injury prevalence* was defined as the proportion of women with an occurrence of injury, calculated as injury frequency divided by the total sample ($n = 120$). *Injury type* was determined using the TEARS classification system: **T**ears were defined as any breaks in tissue integrity including fissures, cracks, lacerations, cuts, gashes or rips; **E**cchymoses were defined as skin or mucous membrane bruising; **A**brasions were defined as excoriations caused by the removal of the epidermal layer and with a defined edge; **R**edness was defined as skin or mucous membrane that was abnormally inflamed due to irritation or injury without a defined edge or border; and **S**welling was defined as edematous tissues.^{2, 12} *Ano-genital injury location* was the anatomic site of injury: external genitalia (labia majora, labia minora, periurethral area, perineum, posterior fourchette, and fossa navicularis); internal genitalia (hymen, vagina, cervix); and anus (anus, rectum).

Data were double entered and discrepancies were rectified by consultation with the principal investigator of the parent study. Basic descriptive statistics of injury frequency and occurrence (i.e., at least one injury) were computed for each examination technique (visual, colposcopy, and toluidine-blue) and injury location. Comparison of injury frequency as observed across examination techniques was performed by conducting a series of generalized mixed-effects models, where injury frequency served as the outcome variable, examination technique was a predictor variable with three levels (visualization, colposcopy, and toluidine-blue), and the participant served as a cluster variable in order to account for a lack of independence of observations (i.e., participants were examined using all three techniques). As the outcome variable was a frequency or count of injury occurrence, a Poisson model was specified. Comparison of injury occurrence across examination techniques was conducted using a similar statistical process, with the exception that the outcome was binary (presence of at least one injury versus no injury), necessitating the application of a logit, rather than a Poisson, statistical model. An *a priori* sample size analysis conducted for the parent investigation indicated a sample of 120 participants was adequate to detect significant differences as small as 10% in the primary study outcomes. All statistical analyses were conducted using the R program for statistical computing and its lme4 package for mixed-effects models.^{13, 14}

RESULTS

A summary of the demographic and consensual intercourse participants' characteristics is presented in Table 1. The ages of the participants ranged between 21 to 68 years ($M = 32.54$, $SD = 8.98$) and 50% were Black/African American. Although less than half were married (43%), all the women had a "steady partner." A majority (44%) reported having intercourse 1–2 times a week; about one third (34%) reported a frequency of 3–5 times a week. Time between intercourse and examination ranged between 1 to 23 hours ($M = 8.23$ hours, $SD = 6.33$); note that the protocol dictated a maximum 24-hour time period between intercourse and examination to reduce the effects of wound healing. Five women (4%) reported anal intercourse. Fifty-five percent of the participants had at least one ano-genital injury detected after consensual intercourse.¹² Analyses could not be conducted on the frequency or occurrence of swelling as it was rarely observed among the study participants, thus those data are not presented.

Table 2 presents the total number, or frequency, of each injury type (tears, ecchymoses, abrasions, redness) by ano-genital location and examination technique as observed in the sample. Examiners identified significantly more tears and abrasions on the external genitalia when using toluidine-blue (56 and 20 injuries, respectively) as compared to when direct visual inspection (39 and 12 injuries, respectively) or colposcopy (38 and 12 injuries, respectively) techniques were used ($p < .05$ for both contrasts from both analyses, i.e., tears and abrasions). Significantly fewer areas of redness on both the external and internal

genitalia were observed when using toluidine-blue (3 injuries from both methods) as compared with both direct visualization (17 and 18 injuries, respectively) and colposcopy (17 and 15 injuries, respectively) ($p < .01$ for both contrasts in both analyses, i.e., redness on external and internal genitalia). Significantly fewer ecchymoses were also observed on the internal genitalia when using toluidine-blue (1 injury) as compared to direct visualization (11 injuries) or colposcopy (11 injuries) techniques ($p < .05$ for both contrasts). Finally, direct visualization lead to the observation of significantly fewer tears (2 injuries) than when toluidine-blue was used (11 injuries) ($p < .05$). However, there was no statistical difference between the number of tears detected on the anus using toluidine-blue (2 injuries) vs. colposcopy (6 injuries) ($p = .240$).

Table 3 presents the percent of participants with at least one injury, again stratified by ano-genital injury location, injury type, and examination technique. On the external genitalia, the use of toluidine-blue enabled investigators to detect a significantly higher percentage of individuals with tears (25%) and abrasions (13%) as compared with direct visualization (18% and 8%, respectively) or colposcopy (17% and 8%, respectively) ($p < .05$ for both contrasts in both analyses, i.e., tears and abrasions). However, significantly fewer areas of redness were observed on the external genitalia when using toluidine-blue (3%), as compared to visual (9%) or colposcope examination (8%) ($p < .05$ for both contrasts). Significantly fewer participants were observed to have ecchymoses and areas of redness on the internal genitalia with the toluidine-blue technique (1% and 3%, respectively) as compared to the direct visualization (8% and 13%, respectively) or colposcopy (8% and 13%, respectively) techniques ($p < .05$ for both contrasts in both analyses, i.e., ecchymoses and redness). As can be observed from these results as well as the data presented in Tables 2 and 3, direct visualization and colposcopy yielded similar ano-genital injury findings, however, toluidine-blue use resulted in increased detection of tear and abrasion injuries in the external genitalia, and decreased detection of redness (both external and internal genitalia) and ecchymoses (internal genitalia only).

DISCUSSION

Injury rates for our consensual participants (55%) fell between the 10% to 75% of previous studies.^{1,2,4,5} The use of toluidine-blue allowed the examiners to identify a significantly higher prevalence of tears and abrasions on the external genitalia than when either direct visualization or colposcopy was used. With regard to the application of these findings to the forensic sexual assault examination, the questions to consider are as follows: 1) Is the ability of the examiner to use toluidine-blue to detect microtrauma related to consensual as compared to non-consensual intercourse, and therefore not useful in the forensic examination? 2) Does the addition of toluidine-blue contrast help examiners identify additional trauma that may be important in the sexual assault forensic examination?

Medical-legal research has shown that the presence of injury (or documented injury), especially severe injury, can be a significant predictor of successful prosecution of sexual assault cases.¹⁵⁻¹⁸ Therefore, injury documentation is important in the forensic examination of sexual assault victims.¹⁵ Whether or not toluidine-blue should be used routinely in sexual assault forensic examinations to detect ano-genital injuries not visible through either direct observation or colposcopy remains to be determined. Until empirical models are developed that reliably predict which ano-genital injury pattern is associated with consensual sexual intercourse and which ano-genital injury pattern is associated with non-consensual sexual intercourse, it is important for sexual assault examiners to identify all ano-genital injuries. Toluidine-blue could be applied after all other evidence is collected in those jurisdictions that do not admit testimony of the toluidine-blue examination into evidence, because it may contribute to overall injury detection.

In our study and others, toluidine-blue was most useful for detecting tears and abrasions on the external genitalia and anus.^{1, 9} Other studies have suggested that survivors with anal injuries are more likely to have extra-genital injuries (face, head, or neck).² Thus, the identification of an anal injury should key the examiner into inspecting the survivor for other injuries.

Limitations

Because the sample for the study was composed of community volunteers who underwent a forensic examination following consensual sexual intercourse, there may be biases associated with participant self-selection (e.g., interested participants may have been more sexually active). Injury prevalence was calculated based on injury detection by three methods: visual inspection, colposcopic magnification, and toluidine-blue application. While these three methods are considered state-of-the-art, human error may lead to ano-genital injury misidentification. Injuries may be missed or false positives may occur if the examiners classify areas as injured when they are actually naturally occurring pigment differences or structural changes such as an episiotomy scar. The order of the examinations, moving from direct visualization to colposcopy to toluidine-blue may bias the findings, with examiners gaining experience throughout the steps of the examination, thereby identifying more injuries. The speculum could also cause microtrauma later detected by toluidine-blue.³

The study findings must be viewed with regard to differences in the consensual and non-consensual populations. All participants were examined within 24 hours to reduce the effects of wound healing, whereas most sexual assault programs examine patients up to 72 hours after sexual assault. Finally, while the consensual population is often used to understand injury prevalence and frequency in the non-consensual population, the forensic examination contains many components such as patient history and the context of the assault in addition to examination techniques that may lead to differences in the two populations. On the other hand, studying women after consensual sexual intercourse continues to be a viable mechanism to refine injury detection methods that then can be tested in clinical populations.

CONCLUSIONS

The scientific community needs to continue to gather information about ano-genital injury prevalence following consensual sexual intercourse. Understanding the ano-genital injury patterns, including frequency and prevalence, that occur with consensual sexual intercourse will help to identify the difference between injury related to consensual vs. non-consensual sexual intercourse. At the present time, toluidine-blue staining may add value to the sexual assault forensic examination; it should not be excluded because it changes the appearance of the tissue and limits the data that may be needed as evidence in criminal justice proceedings. In such jurisdictions, toluidine-blue can be applied after evidence is collected. It is the healthcare provider's role to collect all possible evidence and the courts' role to determine what evidence is admissible and to ensure a rightful conviction.

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References

1. McCauley J, Guzinski G, Welch R, Gorman R, Osmer F. Toluidine blue in the corroboration of rape in the adult victim. *Am J Emerg Med* 1987;5:105–108. [PubMed: 2435297]
2. Slaughter L, Brown CRV, Crowley S, Peck R. Patterns in genital injury in female sexual assault victims. *American Journal of Obstetric and Gynecology* 1997;175:609–616.

3. Jones JS, Rossman L, Hartman M, Alexander CC. Anogenital injuries in adolescents after consensual sexual intercourse. *Acad Emerg Med* 2003;10:1378–83. [PubMed: 14644791]
4. Norvell MK, Benrubi GI, Thompson RJ. Investigaton of microtrauma after sexual intercourse. *Journal of Reproductive Medicine* 1984;29:269–271. [PubMed: 6716372]
5. Fraser IS, Lahteenmaki P, Elomaa K, et al. Variations in vaginal epithelial surface appearance determined by colposcopic inspection in healthy, sexually active women. *Human Reproduction* 1999;14:1974–1978. [PubMed: 10438412]
6. Logan TK, Cole J, Capillo A. Sexual assault nurse examiner program characteristics, barriers, and lessons learned. *Journal of Forensic Nursing* 2007;3:24–34. [PubMed: 17479563]
7. Massey JB, Garcia CR, Emich JP. Management of sexually assaulted females. *Obstetrics and Gynecology* 1971;38:29–36. [PubMed: 5109235]
8. Gray-Eurom K, Seaberg DC, Wears RL. The prosecution of sexual assault cases: Correlation with forensic evidence. *Annals of Emergency Medicine* 2002;39:39–46. [PubMed: 11782729]
9. Lauber AA, Souma ML. Use of toluidine blue for documentation of traumatic intercourse. *Obstetrics & Gynecology* 1982;60:644–648. [PubMed: 7145256]
10. Slaughter L, Brown CRV. Colposcopy to establish physical findings in rape victims. *American Journal of Obstetrics and Gynecology* 1992;166:83–86. [PubMed: 1733223]
11. Sommers MS, Zink T, Fargo JD, et al. Forensic rape examination and genital injury: Is skin color a source of health disparity? *Am J of Emerg Med*. 2008 In Press.
12. Sommers MS. Defining patterns of genital injury from rape and sexual assault: A review. *Trauma, Violence, & Abuse: A Review Journal* 2007;8:270–280.
13. R Development Core Team. R: A language and environment for statistical computing. Vienna, Austria: 2008.
14. Bates, D.; Sarkar, D. R Package version 0.9975–12. lme4: Linear mixed-effects models using S4 classes 2007.
15. McGregor MJ, Marion LG, Wiebe E. Examination for sexual assault: Is the documentation of physical injury associated with the laying of charges? *Canadian Medical Association Journal* 1999;160:1565–1569. [PubMed: 10373997]
16. McGregor MJ, Du Mont J, Myhr TL. Sexual assault forensic medical examination: Is evidence related to successful prosecution? *Ann Emerg Med* 2002;39:639–647. [PubMed: 12023707]
17. Sommers MS, Fisher BS, Karjane H. Using colposcopy in the rape exam: Healthcare, forensic, and criminal justice issues. *Journal of Forensic Nursing* 2005;1:1–8.
18. Rambow B, Adkinson C, Frost T, Peterson G. Female sexual assault: Medical and legal implications. *Annals of Emergency Medicine* 1992;21:727–731. [PubMed: 1590616]

Table 1

Demographic and Consensual Intercourse Participant Characteristics (n = 120)

Age	
Mean \pm SD	32.54 \pm 8.98
Race/Ethnicity	
White/Caucasian	57 (48%)
Black/African American	60 (50%)
Latina	2 (1%)
Other	1 (<1%)
Married	52 (43%)
Consensual Intercourse Characteristics	
Frequency of intercourse	
<1/month	1 (<1%)
1/month	6 (5%)
>1/month	16 (13%)
1–2/week	53 (44%)
3–5/week	41 (34%)
1/day	4 (3%)
Hours between intercourse and examination	
Mean \pm SD	8.23 \pm 6.33

Table 2
 Injury Frequency by Ano-genital Region and Injury Type for all Consensual Intercourse Participants (N = 120).

Ano-genital Region	Tears			Ecchymoses			Abrasions			Redness					
	Visual	Colp	Tol-Blue	Visual	Colp	Tol-Blue	Visual	Colp	Tol-Blue	Visual	Colp	Tol-Blue	Total		
External Genitalia	39	38	56	59*	0	0	0	12	12	20	22*	17	15	3	17
Internal Genitalia [†]	6	6	1	6	11	11	1	4	4	1	5*	18	18	3	18
Anus	2	6	11	11	0	0	0	1	1	1	1	4	4	2	5

Abbreviations: Colp, Colposcopy; Tol- Blue, Toluidine-Blue.

[†]Internal genitalia = Tol-Blue only for Hymen.

*Total frequency exceeds frequency of any individual examination technique alone.

Swelling was rarely observed so the data are not presented.

Table 3

Injury Occurrence: The Number and Percent of Participants with at Least One Injury by Ano-genital Region and Injury Type for all Consensual Intercourse Participants (*N* = 120).

Ano-genital Region	Tears			Ecchymoses			Abrasions			Redness				
	Visual	Colp	Tol-Blue	Visual	Colp	Tol-Blue	Visual	Colp	Tol-Blue	Visual	Colp	Tol-Blue	Total	
External Genitalia	21 18%	20 17%	30 25%	31 26%	0 0%	0 0%	0 0%	10 8%	16 13%	17 14%	11 9%	9 8%	3 3%	11 9%
Internal Genitalia [†]	3 3%	3 3%	1 1%	3 3%	9 8%	1 1%	10 8%	4 3%	1 1%	5 4%	4 3%	16 13%	3 3%	16 13%
Anus	2 2%	3 3%	5 4%	5 4%	0 0%	0 0%	0 0%	1 1%	1 1%	1 1%	5 4%	5 4%	2 2%	5 4%

Abbreviations: Colp, Colposcopy; Tol- Blue, Toluidine-Blue.

[†] Internal genitalia = Tol-Blue only for Hymen

Swelling was rarely observed so the data are not presented.