

Original Studies

Appearance of the Genitalia in Girls Selected for Nonabuse: Review of Hymenal Morphology and Nonspecific Findings

Astrid H. Heger, MD, Lynne Ticson, MD, Lisa Guerra, MD, Julie Lister, FNP, Toni Zaragoza, FNP, Gina McConnell, RN, and Mary Morahan, LCSW

LAC+USC Violence Intervention Program, Department of Pediatrics, University of Southern California, Keck School of Medicine, Los Angeles, California

Abstract. *Study Objective:* To review all existing studies of genital anatomy in girls selected for nonabuse, clarify terminology used to describe hymenal morphology and nonspecific findings, and test consensus terminology in the reevaluation of hymenal morphology and nonspecific findings in 147 premenarchal girls selected for nonabuse.

Methods: Over six months, the authors identified and evaluated 147 premenarchal girls without history of sexual abuse who were referred for gynecological examination. Parents and patients were screened for possible abuse or significant past medical or behavioral history, and each girl was interviewed and then received a complete examination including a genital examination documented by colposcopy with both 35 mm camera and video capabilities. Using established terminology¹ each case was then independently reviewed and hymenal morphology and nonspecific findings documented.

Results: The study population consisted of 147 premenarchal girls; 76.9% were Hispanic, 12.3% African-American, and 10.3% Caucasian. Subjects had a mean age of 63 months (+/- 38). Hymenal configurations included: annular (concentric) 53%, crescentic (posterior rim) 29.2%, sleeve-like (redundant) 14.9%, septate 2%, and other (imperforate, cribriform) < 1%. Nonspecific findings included peri-hymenal bands, 91.8%; longitudinal intravaginal ridges, 93.8%; hymenal tags, 3.4%; hymenal bumps/mounds, 34%; linea vestibularis, 19%; ventral hymenal cleft/notch at 12 o'clock in 79% of annular or redundant hymens; ventral cleft/notch not at 12 o'clock, 19%; failure of midline fusion, 0.6%; hymenal opening size > 4 mm, 30.6%; erythema, 48.9%; change in vascularity, 37.4%; labial adhesions, 15.6%; posterior hymenal notch/cleft (partial), 18.3%; posterior notch/cleft (complete), 0%; posterior hymenal concavity or angularity, 29.5%. In addition, each case was assessed for the presence of a thickened (45.5%) or irregular (51.7%) and narrowed (22.4%) hymenal edge. Each case was also reviewed for exposed intravaginal anatomy (93%).

Conclusions: The authors concluded that improved techniques and photo documentation have provided examiners with a better understanding of hymenal morphology and that nonspecific genital findings are commonly found in a population of girls selected for nonabuse. A thorough understanding of normal studies and a consistent application of established terminology can prevent the misinterpretation of nonspecific or congenital findings as posttraumatic changes.

Key Words. Hymen, normal anatomy—Sexual abuse—Nonspecific hymenal anatomy

Introduction

There have been five research papers documenting normal anatomy in preadolescent girls selected for nonabuse. The five articles previously published have been widely quoted and used as the established baseline for normal anatomy in research projects reporting on children referred for possible sexual abuse. Since the last published report, there have been numerous articles documenting anatomical variations in girls with a history of sexual abuse. However, these additional anatomical variations have not been tested against a normal population.

The purpose of this research was twofold. First, we sought to enhance the understanding of normal anatomy through the review of all existing published articles reporting on genital findings in girls selected for nonabuse, analyzing the language and comparing definitions and findings. Second, after reviewing these articles, as well as published guidelines and curricula, the authors would test a selected list of nonspecific findings against a normal population. In order to compare the outcomes of this study with existing studies the authors would use the same basic methodology of selection and screening. The medical diagnosis of child

Address reprint requests to: Astrid H. Heger, MD, Executive Director, LAC+USC Medical Center, Violence Intervention Program, 1240 North Mission Road, Tr. 11, Los Angeles, CA 90033; E-mail: aheger@aol.com

sexual abuse can be a dangerous diagnosis when it relies solely on the results of a medical examination without any corroboration by an eyewitness or history from the child. In 1983,² with the introduction of the colposcope and photodocumentation for the diagnosis of sexual abuse or assault, the quality of peer review and research improved. Since then, photodocumentation has become the established scientific mechanism for comparing normal genital anatomy with nonspecific or congenital variations as well as posttraumatic changes associated with sexual abuse.³ Photodocumentation is used widely for second opinions and peer review, with the primary benefit being the use of photographs to replace the need for reexamination of the child or victim.

Over the past two decades there have been three major areas of debate, discussion, and research in the field of the medical diagnosis of sexual abuse. First, there was an early interest in determining a baseline for normal prepubescent genital anatomy. Between 1987 and 1992 there were five articles that reviewed genital anatomy in girls selected for nonabuse.⁴⁻⁸ Once a normal baseline was established, the second research focus was to investigate what findings are diagnostic of abuse. This question is particularly difficult when the examiner is asked to evaluate the child long after any acute trauma has healed. Few reports of healing trauma have been published over the past decade.^{9,10,11} Instead, most original articles since the mid-1980s reported on genital findings in children who had been referred for evaluation of possible sexual abuse. These studies cataloged lists of medical findings in children with a history of abuse, but only one recent article compared these findings with a group selected for nonabuse.¹²

During the past 17 years terminology and expertise in the field have rapidly improved and expanded. Since the last normal study in 1992, there has been an explosion of interest by established groups of medical professionals in developing a consensus for the diagnosis of child sexual abuse. These groups have published position papers defining terminology and significant findings.^{1,13} Other examiners¹⁴ created a classification scale to simplify the interpretation of findings. Training materials that primarily reflect individual experience were developed. These materials include self-taught computer-based or Internet instruction^{11,15,16} as well as curricula for the more traditional classroom experience. Whether it is a consensus paper, classification scale, or training curriculum, all should be tested against a normal population for validation of terminology and interpretation of findings.

Methodology

Literature Review

In order to clarify and standardize existing terminology and interpretation of anatomical variations, the

authors first adopted the definitions and terminology accepted by American Professional Society on the Abuse of Children (APSAC).¹ Then all definitions of terminology were extracted from the five existing "normal anatomy" articles and tested against the APSAC guidelines. Using these standards the published articles were then tested against each other and the subjects selected for nonabuse in this study.

The five original research articles published describing normal genital anatomy have been widely quoted and relied upon in developing consensus papers and curricula. They have also been used as the normal "baseline" or "control group" for later articles that reported on findings, both specific and nonspecific, associated with girls referred for evaluation of possible sexual abuse. The articles on girls evaluated for possible sexual abuse classified a wide range of findings, such as notching, concavities, narrowing, etc., that might be interpreted as nonspecific by some examiners or as possibly diagnostic or suggestive of healed trauma by others.

In order to clarify the interpretation of findings, this study evaluated premenarchal girls, selected for nonabuse, and documented both hymenal morphology and nonspecific findings previously not collectively tested in a normal study. The definitions of the selected nonspecific findings were adopted from the American Professional Society on the Abuse of Children¹ (Table 1). Because of the potential for misinterpretation or misapplication of terminology from existing research studies, the authors also reviewed previously published normal studies and compared their descriptions of hymenal morphology and definitions of nonspecific findings. The categories of nonspecific findings were based on definitions taken from the text of each article.

Methods

Over a six-month period of time, from July 1999 through January 2000, the LAC+USC Center for the Vulnerable Child (CVC) evaluated 147 premenarchal girls selected for nonabuse from the over 1000 cases referred to the CVC. Cases were referred from the LAC+USC Medical Network, the Pediatric Outpatient Clinics, and community-based primary care medical professionals. All 147 cases were referred because of findings documented during a normal pediatric well-child evaluation that resulted in a referral for a genital examination. The most common referring diagnosis included no hymen, erythema, "hole in hymen," and labial fusion. Medical Center protocol requires that any genital examinations of a prepubertal girl be completed by the pediatric staff of the CVC. Girls were excluded from the study if there was any history or

Table 1. APSAC Definitions**Hymenal Morphology:**

Annular (circumferential): hymen extends completely around the circumference of the vaginal orifice.

Crescentic (posterior rim): hymen with anterior attachments at approximately the 11 o'clock and 1 o'clock positions with no hymenal tissue visible between the two attachments.

Redundant (sleeve-like): abundant hymenal tissue that tends to fold back upon itself or protrude.

Fimbriated: Hymen with multiple projections or indentations along the edge, creating a ruffled appearance.

Septate: Hymen with bands of tissue that bisect the orifice, creating two or more openings.

Nonspecific Findings:

Periurethral/Peri-hymenal Bands: Bands of tissue lateral to the hymen that form a connection between the peri-hymenal structures and the wall of the vestibule. In the case of periurethral, these are small bands, lateral to the urethra that connect the periurethral tissues to the wall of the vestibule.

Intravaginal Longitudinal Ridges: Narrow, mucosa-covered ridges of tissue on the vaginal wall that may be attached to the inner surface of the hymen. They may be located in all four quadrants and are usually multiple in number.

Hymenal Tag: Elongated projection of tissue arising from any location on the hymenal rim.

Hymenal Bump or Mound: A solid localized rounded, thickened area of tissue on the edge of the hymen.

Linea Vestibularis: A vertical, pale/avascular line across the posterior fourchette and/or fossa navicularis.

Cleft/notch: An angular or V-shaped indentation on the edge of the hymenal membrane that may extend to the muscular attachment of the hymen.

Cleft Anterior: A shallow indentation that does not extend to the attachment of an annular hymen

Cleft Lateral: An indentation along the lateral margins of the hymen (2–4; 8–10)

Cleft Posterior: An indentation, notch, or V-shaped groove (4–8).

Failure of Midline Fusion: Congenital defect that may occur extending from the midline of the fossa navicularis to the anal verge.

Erythema: A redness of the hymenal membrane produced by congestion of the capillaries.

Vascularity (increased or prominent): Dilation of existing superficial blood vessels.

Labial Adhesions: The result of adherence (fusion) of the adjacent, outermost mucosal surfaces of the posterior portion of the vestibular walls.

Angularity of Hymen: Relatively sharp angles in the contour of the hymenal inner edge.

Concavity: A curved or hollowed U-shaped depression on the edge of the hymenal membrane.

Hymenal Orifice's Diameter: The distance from one edge of the hymen to the opposite edge of the hymenal orifice. Most commonly the horizontal measurement.

Transection of Hymen (complete): A tear or laceration through the entire width of the hymenal membrane extending to its attachment to the vaginal wall.

Transection (partial): A tear or laceration through a portion of the hymenal membrane...(recommends using partial tear rather than partial transection).

Narrow Hymenal Membrane: Term used to describe the width of the hymenal membrane as viewed in the coronal plane, i.e., from the edge of the hymen to the muscular portion of the vaginal introitus.

Thickened Edge: A term used to describe the relative amount of tissue between the internal and external surfaces of the hymenal membrane.

Irregular Hymenal Edge: A disruption in the smooth contour of the hymen.

suspicion of sexual abuse including behavioral changes as well as medical history of genital injuries, surgeries, diagnostic procedures, or medical treatment. Parents signed consents in compliance with Medical Center and Institutional Review Board standards and protocols. Parents were interviewed by trained social workers, nurses, or medical professionals using a standardized interview format documenting any concerns by parents regarding sexual abuse or history of behaviors suggestive of abuse, or any medical complaints and/or conditions that would impact the study. Each patient was screened using a standardized interview protocol that complies with the assessment guidelines adopted by APSAC¹ as well as local and institutional protocols.

A verbal consent was obtained from each girl over the age of three. Each girl was examined following the interview. Five different examiners participated in the

study. Three pediatricians and two nurse practitioners participated in the research study and all have extensive training and experience in the use of colposcopy and the gynecological examination of the preadolescent. All girls were examined using the same Cryo-medec MM 6000 colposcope with 35 mm camera and video attachments. Each subject was examined in the supine position using labial traction. If during the examination the posterior rim of the hymen was not adequately visualized, the patient was examined in the knee-chest position. Each girl was examined at 10× magnification with the camera on the horizontal, level with the center of the hymenal opening. There was a minimum of 10 to a maximum of 24 exposures taken during simultaneous videotaping of the examination. Slides and videos were processed in compliance with the same procedures and protocol used for the preservation of evidence for sexual assault cases.

Medical records, including history, clinical and photographic documentation, and interpretation by examining medical professional were collected and reviewed. All definitions were reviewed prior to and during the course of the research project. The examiners met daily as well as in weekly reviews to clarify definitions and terminology, hymenal morphology, and nonspecific findings. All cases were then independently reviewed by the two most experienced examiners, who have over 28 years of experience and are credentialed as court-appointed experts in the field of sexual abuse. These two reviewers, relying on accepted definitions established by APSAC,¹ reviewed all 147 cases and documented hymenal morphology and nonspecific findings on a standardized review form. In order to clarify terminology such as narrowing, thickened, irregular, or exposed intravaginal contents, the reviewers used photographs from established training materials as a visual guideline. Agreement between the reviewers was found to be 96% during the initial review. Follow-up reviews were made to reach consensus, or those features were eliminated from the study. At the outset the examiners decided that precise measurement of hymenal opening size was too subjective, and the reviewers, using the established photographic grid, documented hymenal opening size only as greater than or less than 4 mm. Data was collected, organized, and analyzed using SPSS Base 10 for Windows statistical software.

Background

The literature has five previously published research articles assessing the normal hymenal anatomy of the preadolescent child.⁴⁻⁸ Four specifically focused on the assessment of the child selected for nonabuse⁵⁻⁸ and relied on photodocumentation.

Pokorny's article⁴ in 1987 (n = 124) described the normal morphology of the hymen. She divided the hymens into groups. Fimbriated hymens were defined as redundant, gathered skirts of hymenal tissue with scalloped rims, circumferential hymens as smooth unfolded skirts of hymenal tissue with uniform annular rims. Posterior rims were crescentic smooth folds of tissue arranged from 2 o'clock through 11 o'clock around the introitus with minimal or no tissue anteriorly.

McCann's 1990 article⁵ evaluated 93 girls all selected for nonabuse, of whom 86 were examined using labial traction to aid in the visualization. He documented both hymenal morphology and nonspecific findings. Definitions of nonspecific findings (Table 2) included some terminology in use today, i.e., periurethral bands, mound, erythema, and intravaginal ridges, consistent with APSAC guidelines.¹ McCann did evaluate for the presence of other findings: 1)

“Angular configuration of hymenal edge: defined as a V-shaped or angular configuration of the edge of the hymen”; 2) Hymenal notch/cleft “a concave indentation on the edge of the hymen”; 3) Anterior hymenal cleft: “a disruption of the usual curl-like configuration of the 11–1 o'clock hymenal attachment sites of a crescent-shaped hymen. A tag was called a projection and vascularity was broken into two groups, increased and isolated. The midline avascular area is now called a *linea vestibularis*. In addition, McCann's study reported that with traction 53.8% had thickened hymens, and 41.9% had irregular hymenal edges, and that in 89.3% the authors were able to visualize vaginal contents. Although he describes an average hymenal rim width of 2.3 mm using traction, there is no description of the percentage of girls with narrowed hymenal rims of less than 1 mm.

In 1991, Berenson, Heger, and Andrews⁶ reviewed and reported on the hymenal anatomy of 468 newborns. Their analysis of hymenal morphology included annular described as circumferential; a hymen that surrounds the vaginal opening 360 degrees; crescentic or posterior rim of hymen with attachments at 11–1 o'clock; fimbriated: redundant and folded with a ruffled and/or fringed edge; septate, two hymenal openings with band of tissue between and cribriform, multiple hymenal openings and imperforate. Nonspecific findings (Table 3) included clefts, external ridges, longitudinal intravaginal ridges, tags, bumps, periurethral bands, and cysts. However, there remains some confusion in the authors' (AB, AH, and SA) use of the term “cleft.” The authors differentiate the single cleft, commonly found in annular hymens at 12 o'clock (24% of annular hymens) from the paired clefts, found laterally at 3 and 9 o'clock (6%). They give us further information by noting that these divisions or splits of the rim measured between .5 mm and 3 mm from rim to base. Although the newborn study enhanced the understanding of the prevalence of congenital findings at birth, it created debate over the presence or absence of clefts in the posterior rim of the hymen. The reader might conclude that some of the clefts described in this study that measured 3 mm extended to the base of the hymen while others of .5 mm were partial. Fimbriated hymens were defined as hymens having more than three clefts. The authors also report in the text of absence of “congenital clefts dorsally between 3- and 9-o'clock positions” and that these clefts “require further investigation.”

This could mean that in fimbriated hymens there were no posterior or dorsal clefts. If the authors had differentiated between clefts that extended to the base of the hymen (3 mm) and those that were partial (.5 mm) and included all fimbriated hymens (more than three clefts) with the location of the clefts and whether they were partial or complete, the confusion regarding

Table 2. Definition of Terms—McCann (1990)

1. Periurethral/peri-hymenal bands	Small bands of tissue connecting two opposing surfaces
2. Intravaginal ridge	A narrow, longitudinal ridge of mucosa-covered, fibrotic-like tissue that is attached to the inner surface of the hymen and located along either the lateral or posterior-lateral wall of the vagina
3. Midline hymenal tag/septal remnant	A small midline appendage attached to the edge of the hymen
4. Hymenal projection	A triangular projection that protrudes from the edge of the hymen into hymenal orifice
5. Hymenal mound	A localized, rounded and thickened area of tissue on the edge of the hymen
6. Midline avascular area	A narrow smooth, pale-appearing lesion located in the midline of the posterior fourchette or fossa navicularis
7. Anterior hymenal cleft	A disruption of the usual curl-like configuration of the 11 or 1 o'clock hymenal attachment sites of a crescent-shaped hymen creating a shallow groove medially
8. Erythema	A morbid redness of the skin or mucus membranes due to congestion of the capillaries
9. Vascularity	
Increased	Dilation of existing blood vessels
Isolated	Blood vessel at least twice the diameter of the surrounding vessels located in an area that normally would not contain a large vessel
10. Angular configuration of the hymenal edge	A V-shaped or angular configuration of the edge of the hymen
11. Rolled hymenal edge	A narrow, rolled appearance of the edge of the hymen
12. Irregular edge	Not defined but reported in table on hymenal findings

clefts in the posterior or dorsal 180 degrees might have been clarified. This author (AH) participated in the newborn study and is confident that the intent of the authors was to report the absence of complete clefts (extending to the base) in the dorsal or posterior 180 degrees of the hymen.

Gardner⁷ evaluated 79 premenarchal nonabused girls. In this study all girls were examined under anesthesia. Hymen morphology was categorized as posterior rim, annular, fimbriated, remnant (having less than 1–2 mm of tissue from hymenal base to rim), and imperforate. Nonspecific findings included vascularity, hymenal bumps, notches (perpendicular disruptions of the hymenal skirt of tissue, usually but not always down to the vaginal mucosa), tags, follicles, tethers (peri-hymenal bands), and midline-sparing (Table 4).

In 1992 Berenson et al⁸ reported on 201 prepubertal girls selected for nonabuse. The authors used similar descriptive terms (Table 5) as those used one year before in their newborn study (Table 4) for defining hymenal types, and again the cleft (notch) was defined

as a “concave indentation in the hymen border not extending to the junction between the hymen and vestibule. Clefts/notches were not recorded in the fimbriated hymen because of the fringed nature, or in crescentic hymens between 11–1 o'clock because of the normal absence of hymen. In this study the authors included “complete transections” as an “interruption in the hymen extending to the junction between hymen and vestibule.”

A comparison of the hymenal morphology and nonspecific findings from all studies are summarized in Tables 6 and 7.

Results

The study population of 147 patients consisted of 114 (76.9%) Hispanic; 18 (12.3%) African-American, and 15 (10.3%) Caucasian. The mean age was 63 months (+/– 38). Each child was assessed for Tanner staging; 139 were at Tanner I or latency age with a “skimpy hymen,” 8 were at Tanner II with the early

Table 3. Definition of Terms—Berenson et al Newborn Study (1991)

1. Periurethral bands	Symmetrical bands of tissue lateral to urethra; connected to the vestibular wall; sometimes called support bands or ligaments
2. Longitudinal intravaginal ridge (LIR)	LIR extending to or beyond the rim (of the hymen)
3. Hymenal tag	Flap or appendage extending \geq 1 mm from the (hymenal) rim
4. Bump	Solid elevation of tissue (hymenal)
5. Cleft (annular hymens only)	Division or split of the rim (not calculated in fimbriated hymens defined as having more than 3 clefts)
6. External ridge	Longitudinal ridge of the vestibular hymen from the rim to the fossa or to the urethra

Table 4. Definition of Terms—Gardner (1991)

1. Tethers	Delicate strands of tissue running between the hymen and the peri-hymen
2. Hymenal irregularities	Not defined
Asymmetry	
Tags	
Follicles	
3. Bumps	Protrusions from the free edge of hymen
4. Midline-sparing	Avascular, linear marking in the midline of posterior fourchette
5. Notches	Perpendicular disruptions of the hymenal skirt of tissue, usually but not always down to the vaginal mucosa
6. Vascularity, increased	Isolated or multiple thicker vessels present in the hymen, perihymen, or posterior fourchette
7. Hymenal orifice, enlarged	Orifices estimated to be greater than 1 cm
8. Hymenal remnant (narrow)	Having less than 1–2 mm from base to the free edge of the hymen.
9. Hymen, thick	Not defined, reported in table

effect of estrogen on the hymen. Of the 147 subjects, 78 (53%) were annular; 43 (29.2%) were crescentic; 22 (14.9%) were redundant (including fimbriated); 3 (2%) were septate; and one was imperforate. Perihymenal bands were found in 135 (91.8%); intravaginal longitudinal ridges in 138 (93.8%); hymenal tags in (5) 3.4%; bumps or mounds in 50 (34%); lineae vestibularis in 28 (19%); ventral hymenal notch at 12 o'clock in 79 (79%) of the 100 annular or redundant hymens; ventral hymenal notches between 9 and 3 o'clock but not at 12 o'clock in 28 (19%); failure of midline fusion in only one case (0.6%); hymenal opening size greater than 4 mm in 45 (30.6%); erythema in 72 (48.9%); increased vascularity in 55 (37.4%); labial adhesions in 23 (15.6%); partial hymenal cleft (posterior) in 27 (18.3%); posterior hymenal concavity in 43 (29.5%); and complete posterior hymenal cleft (trans-section) in 0%.

The reviewers also tested all photographs against a recent training mnemonic for the evaluation of the hymen (TINE; Thickened, Irregular, Narrowed, and Exposed intravaginal contents). In this study 67 (45.5%) were thickened; 76 (51.7%) were irregular; 33 (22.4%) were narrowed; and with labial traction 136 (93%) had exposed intravaginal contents.

Since there have been anecdotal reports of a narrowed hymenal edge being associated with overweight girls, each child was plotted for weight on the appropriate growth chart. The percentiles for weights were assessed for all patients. Results showed 78.7% (26/33)

of girls classified with a narrowed hymenal rim were over the 75th percentile for weight. Chi-square analysis yielded significant results ($\chi^2 = 4.869$, $df:1$, $P = .027$).

Discussion

A review and comparison of hymenal morphology and nonspecific findings indicates that there has been a range of various terms used to describe changes of the hymen. Descriptive hymenal morphology has allowed for a relative consistent comparison of the hymenal types between studies. However, nonspecific terms, e.g., notches and clefts most particularly, have been used inconsistently to describe a range of anatomical variations and have contributed to confusion in diagnosis. In addition, certain nonspecific findings, such as narrowing of the hymen or thickening or irregularity of the hymenal edge, have taken on a potential significance that may be unwarranted.

Hymenal Morphology

Some of the differences between the normal studies can be attributed to the age differences between the studies, since hymenal anatomy changes under the influence of estrogen. In this study, a higher percentage of hymens were determined to be annular (53.3%) than had been previously described, except for the newborn study (73%).⁶ In this study, the term “annular” also included hymens that had a cleft at 12

Table 5. Definition of Terms—Berenson et al Normal study (1992)

1. Periurethral bands	Symmetrical bands of tissue lateral to urethra etc; see Table 3
2. LIR	See Table 3
3. Hymenal tag	See Table 3
4. Bump	Localized rounded and thickened area of tissue on the edge of the hymen
5. Midline-sparing	Avascular area at the 6 o'clock position on the posterior fourchette
6. Notch (cleft)	A concave indentation in the hymen border not extending to the junction between hymen and vestibule
7. External longitudinal ridge	See Table 3
8. Complete transection	Interruption in the hymen extending to the junction between hymen and vestibule

Table 6. Comparison of Hymen Anatomy

Hymenal Anatomy Number	Pokorny 1987	McCann 1990	Berenson, Heger 1991	Gardner 1991	Berenson, Heger, 1992	Heger 2001
Median age (months)		66	Newborns	64	21	63
Annular/Concentric	27%	43%	73%	19%	22%	53%
Crescentic/Posterior Rim	45%	44%	7%	62%	36%	29.2%
Sleeve-Like Redundant	20%**				9%	14.9%**
Fimbriated			19%	8%	33%	
Septate		2%	1%		1%	2%
Other or Unable to Determine	7%	9%	<1%	5%/6.7%***		<1%

*Using traction

**Includes fimbriated

***Remnant

o'clock. In previous studies, annular hymens with ventral clefts may have been classified as posterior rim or crescentic.^{7,8} The terms redundant or "sleeve-like" and fimbriated "redundant gathered skirts of tissue"⁴ have been used interchangeably, and therefore for the purposes of this study the authors placed redundant and fimbriated hymens into one group (14.9%).

Summary. Variations of hymenal morphology have been consistently reported in all studies of normal anatomy. Efforts at improving consistency in the ap-

plication of terminology have enabled researchers to more clearly understand and compare individual studies.

Nonspecific Findings

Nonspecific findings continue to require a conservative interpretation. One author (AH) participated in writing three of the six articles compared in this report (see Table 7). For most of the nonspecific findings, i.e., periurethral/perihymenal bands, longitudinal intravaginal ridges, tags, bumps, vascular changes, labial adhesions, erythema, or even vaginal opening diameters, the num-

Table 7. Nonspecific Findings

Nonspecific Findings Number	Pokorny 1987	McCann 1990	Berenson, Heger 1991	Gardner 1992	Berenson, Heger 1992	Heger 2001
Periurethral/Perihymenal Bands		50.6/16%	Frequent	14%	98%	91.8%
Longitudinal Intravaginal Ridges		90.2%	56		25%	93.8%
Hymenal Tag		24.4%	13%	2%	3%	3.4%
Hymenal Bump or Mound		33.8%	<1%	11%	7%	34%
Linea Vestibularis		15.7%		23%	4%	19%
Ventral Hymenal Cleft/Notch at 12		1.2%	24% ³		8% ³	79% ⁶
Ventral Hymenal Cleft/Notch		6.6%	3.1%/6% ⁵	2%	8% ³	19%
Failure of Midline Fusion						0.6%
External Ridge			86%		15%	
Erythema		56%				48.9%
Change in Vascularity		30.9%		44%	5%	37.4%
Labial Adhesions		38.9%			17%	15.6%
Hymenal Notch/Cleft Posterior		5.8% ²	19% ¹		33% ¹	18.3%
Hymenal Concavity Posterior						29.5%
Transection (complete)		0	0	0	0	0
Thickened Hymenal Rim		53.8%		Frequent		45.5%
Irregular Hymenal Rim		41.9%		9%		51.7%
Narrow Hymenal Rim		UTD		6%		22.4% ⁺⁺
Exposed Intravaginal Contests 4		89.3% ⁴				93%

¹ Fimbriated Hymen (defined as >3+ clefts)² Angular Hymen³ Only Annular⁴ "Able to visualize vaginal interior"⁵ Clefts in annular hymens at 3 and 9 o'clock⁶ Annular or redundant hymens⁺Supine with traction⁺⁺75% with weight >75th percentile.

bers may vary, but most examiners agree that these are nonspecific and have little significance in coming to the conclusion that prior trauma caused these differences.

However, there are other nonspecific findings that continue to cause debate. For example, ten years ago the use of the words cleft and notch interchangeably created confusion. This confusion was fueled by the lack of a clear differentiation between a partial cleft or notch and one that extends to the base of the hymen.

Clefts/Notches. This study found that there is a clear difference between notches and clefts that are only partial and those that extend to the base of the hymen. Ventral hymenal clefts or notches occurred in 107 (72.7%) of all cases. In the 100 annular or redundant hymens, 79 had notches at 12 o'clock. In all hymens 28 (19%) notches or clefts were found elsewhere in the ventral 180 degrees. These ventral clefts or notches may be either partial or may extend to the base of the hymen. The authors also found that 27 (18.3%) of all cases had posterior clefts. These clefts were only partial. Complete clefts that extended to the base of the hymen were not found in the posterior 180 degrees. Ventral clefts or notches that extend to the base of the hymen are so common that they may have confused the differentiation between annular hymens with clefts and crescentic hymens. In fact, ventral clefts are almost impossible to assess in the crescentic hymen. Ventral clefts in the crescentic hymen were also excluded from the Berenson et al study of 1992.⁸ Posterior clefts were found to be common in this study in 27 cases (18.3%). It has been difficult to compare this study with other previous studies that collected data on clefts. In the 1991 Berenson article,⁶ the stated absence of clefts in the dorsal 180 degrees did not take into consideration a fimbriated hymen, which by the author's definition meant that there were more than three clefts. The fact that the authors did determine the depth of the clefts (.5–3 mm) suggests that they did differentiate between partial and complete. A total of 19% of the newborns had fimbriated hymens. It is probable that the presence of clefts (partial) in the dorsal 180 degrees should be expected in these 19% with fimbriated hymens. The conclusion that clefts were not present in the posterior 180 degrees would then be referring to "clefts that extended to the base of the hymen," since fimbriated hymens have partial clefts. It is important to note that Berenson et al,⁸ in their 1992 study of premenarchal girls, did include a finding described as a "transection (interruption in the hymen extending to the junction between hymen and vestibule)." They did not find any transections in the dorsal 180 degrees, but they did find 33% fimbriated hymens (i.e., with more than three clefts). In addition, they describe notches occurring between 8 and 4 o'clock, clockwise, but none between 5 and 7 o'clock.

In McCann's classic article of 1990, he describes notches/clefts in 6.6% (Table 6)⁵ but does not describe the locations except to differentiate anterior clefts in 1.2%. It is possible to interpret that in 6.6% these clefts/notches were posterior. In describing the hymenal edge contour/configuration McCann also describes an angular hymen as a "V-shaped or angular configuration of the edge of the hymen." McCann reports in his 1990 article that 5.8% had this angularity. Is this description what we later came to call a "concavity?"

Summary. Partial notches or clefts occur in 360 degrees of the hymenal rim. Complete notches or clefts are normally found ventrally, but complete clefts to the base of the hymen do not normally occur in the posterior rim between 3 and 9 o'clock.

Narrowing of the Hymen

We found that 33 (22.4%) hymens were "narrow," i.e., estimated to be less than 1–2 mm. We also found it impossible to be absolute in these measurements, and these were estimates at best. Additionally, we found that a significant number ($P = .047$) of these girls were over the 75th percentile for weight.

Berenson et al⁸ did attempt to measure the depth of the hymen, and it was determined to be more than 1.0 mm in all but five patients. In discussing this finding the authors state that "the amount of hymenal tissue reported inferiorly at the 6 o'clock position should be considered an estimate, since the actual attachment of hymenal tissue at the 6 o'clock position to the vaginal floor cannot be determined visually."⁸

Although McCann⁵ describes an average hymenal rim width of 2.3 mm using traction, there is no description of the percentage of girls noted to have hymens less than 1 mm. In the discussion, he admits that "determination of the width of the posterior hymenal rim and the attempt to calculate the percentage of the introitus covered by the hymen was difficult. Upon reviewing the photographs, we could only estimate where the edge of the muscular border of the vaginal introitus (begins)..."⁵

Summary. Any "narrowing" of the hymenal rim posteriorly is difficult to measure accurately and is at best an estimate. This "narrowing" can be normally found in over 20% of girls.

Irregular Hymenal Rim

In this study the presence of an irregular hymen edge was documented in 51.7%, in comparison to McCann's study,⁵ where they found 41.9%. Gardner⁷ reported that 9% of her subjects had an irregular rim.

Summary. Hymenal edge irregularities are common in preadolescent girls.

Exposed Intravaginal Contents

Using labial traction, these authors were able to easily visualize the vaginal contents in 93% of the cases. McCann⁵ reported a similar rate of 89.3%. The ability to visualize the intravaginal contents has not been described in most studies, but the ability to quantify the presence of ridges and rugae in 56% of the girls in Gardner⁷ or 25% in Berenson et al⁸ might be interpreted to mean that the examiner had good intravaginal visualization.

Summary. Examiners should expect to see the vaginal vault, and their ability to visualize the intravaginal contents is facilitated by good labial traction and enhanced when the child is relaxed.

Thickened Hymenal Rim

We found that 45.5% of all subjects had a thickened rim. This was less than McCann⁵ who found 53.8%. The only other study to note "thickness" was Gardner,⁶ who reported only that it was "frequent."

Summary. The relative thickness of the hymenal edge is hard to consistently quantify or document, particularly in two-dimensional representations, and hymenal thickness should be considered a nonspecific finding.

Conclusions

The authors found that there was a high incidence of nonspecific findings in this study of girls selected for nonabuse. Some nonspecific findings are consistently present in most studies of the normal anatomy (periuethral bands, longitudinal intravaginal ridges, tags, bumps, linea vestibularis, ventral clefts, erythema, labial adhesions, changes in hymenal opening sizes) and cause little remaining room for debate. Others are more controversial (i.e., clefts, narrowing, etc.). This normal study was designed to test those nonspecific findings against a normal population. It is the conclusion of the authors that the presence of clefts and notches posteriorly, concavities, narrowing of the rim, thickening, or irregularities, as well as the exposure of the intravaginal contents, should not be considered diagnostic of sexual abuse.

We agree that there needs to be a further clarification of the significance of partial clefts, notches, or concavities in the posterior 180 degrees and of possible narrowing of the hymenal rim. Clear terminology needs to be developed to enhance the understanding of nonspecific findings such as clefts, notches, partial, or complete, and to differentiate them from terminology that indicates posttraumatic changes such as partial or complete transection. Using these terms interchangeably can promote misdiagnosis in a highly charged field of pediatrics. In addition, there needs to be an

extensive longitudinal study of trauma caused by penetrating injuries, including sexual assault, to determine what findings can be relied on to be diagnostic of penetrating trauma and/or sexual abuse. Finally, the more we learn about the diagnosis of child sexual abuse, the more we are reminded that the most important diagnostic criterion in making the diagnosis is the history from the child.

Acknowledgments: The authors wish to thank Sonia Ehresman and Raphael Bernier for their help in preparing and analyzing the materials and data necessary for this research project.

References

1. American Professional Society on the Abuse of Children: Glossary of Terms and the Interpretations of Findings for Child Sexual Abuse Evidentiary Examinations. Chicago, IL, APSAC, 1998
2. Woodling BA, Heger A: The use of the colposcope in the diagnosis of sexual abuse in the pediatric age group. *Child Abuse & Neglect* 1986; 10:111
3. American Professional Society on the Abuse of Children: Practice Guidelines: Photographic Documentation of Child Abuse. Chicago, IL, APSAC, 1995
4. Pokorny SF: Configuration of the prepubertal hymen. *Am J Obstet Gynecol* 1987; 157:950
5. McCann J, Wells R, Simon M, Voris J: Genital findings in prepubertal girls selected for nonabuse: A descriptive study. *Pediatrics* 1990; 86:428
6. Berenson A, Heger A, Andrews S: Appearance of the hymen in newborns. *Pediatrics* 1991; 87:458
7. Gardner JJ: Descriptive study of genital variations in healthy, non-abused premenarchal girls. *J Peds* 1992; 120:257
8. Berenson A, Heger A, Hayes J, Bailey R, Emans SJ: Appearance of the hymen in prepubertal girls. *Pediatrics* 1992; 89:387
9. McCann J, Voris J, Simon M: Genital injuries resulting from sexual abuse: a longitudinal study. *Pediatrics* 1992; 89:307
10. Finkel MA: Anogenital trauma in sexually abused children. *Pediatrics* 1989; 84:317
11. Heger A, Emans SJ, Muram D: Evaluation of the Sexually Abused Child (2nd ed). Oxford University Press, 2000
12. Berenson A, Chacko M, et al: A case-control study of anatomic changes resulting from sexual abuse. *Am J Obstet Gynecol* 2000; 4:821
13. American Academy of Pediatrics, Committee on Child Abuse and Neglect: Guidelines for the Evaluation of Sexual Abuse of Children. *Pediatrics* 1999; (103):186
14. Adams JA: Evolution of a classification scale: Medical evaluation of suspected child sexual abuse. *Child Maltreatment* 2001; 6:31
15. McCann J, Kerns DL: The Anatomy of Child and Adolescent Sexual Abuse: A CD-ROM Atlas/Reference. St. Louis, MO, Intercorp., Inc, 1999
16. Adams JA, Kellogg N: Medical Evaluation of Suspected Child Sexual Abuse: An Introductory Course. Registration available via web site: <http://child-abuseCME.ucsd.edu>