Hymenal Characteristics in Girls with and without a History of Sexual Abuse

Sara T. Stewart a

a Harbor-UCLA Medical Center, Torrance, California, USA

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This article reviews the recent literature on physical findings related to the hymen in pubertal and prepubertal girls with and without a history of sexual abuse. Characteristics of normal hymenal anatomy, acute traumatic findings, and characteristics of healed trauma are discussed, particularly with regard to changes in the interpretation of these findings that have occurred over time.

KEYWORDS hymen, sexual abuse, trauma, anatomy

The social significance of the hymen is reflected in the origins of its name from Hymenaeus, the Greek god of marriage, as today it is commonly accepted in many cultures that the hymen remains unchanged until it is “broken” with the first episode of sexual activity. This social emphasis on the relation of the hymen to sexual activity has also been apparent in the medical and legal communities that work with victims of child sexual abuse. It has been well documented that the physical sequelae of sexual abuse can occur on multiple areas of the genitalia, yet there is often a focus among parents and nonmedical professionals on whether there has been particular damage to the hymen. While there has been significant progress over the past 20 years in the understanding of both normal variation in hymenal anatomy and of posttraumatic changes that occur with abuse, there are still areas of debate that require further longitudinal study.
EMBRYOLOGY

After the third month of gestation, the precursor of the uterus and proximal vagina, the uterovaginal primordium, comes in contact with the more anterior urogenital sinus (Figure 1). At this point of contact, the structures fuse and canalize to form the vaginal lumen. The most caudal portion of the vaginal lumen does not canalize completely, however, and remains separated from the cavity of the urogenital sinus by a mucosal barrier termed the hymen. This barrier completely covers the vaginal opening until after the fifth month of gestation, at which time partial degeneration, or “perforation,” of this barrier occurs. The hymen then remains as a thin, elastic membrane

FIGURE 1 Embryologic development of the urogenital system. Reprinted from T. L. Moore & T. V. N. Persaud (Eds.), “The Developing Human” (7th ed.), p. 312; copyright © 2003; with permission from Elsevier (color figure available online).
Hymenal Characteristics

made of collagenous connective tissue and squamous epithelium, surrounding the opening to the vaginal introitus (Larsen, 1998; Moore & Persaud, 2003; Pansky, 1982; Pokomy, 1987).

NORMAL HYMENAL ANATOMY

In order to recognize abnormal genital anatomy, the first step is to understand the range of what is normal. Toward this end, research has focused on characteristics of the hymenal orifice and hymenal edges, on the width and characteristics of the hymenal tissue itself, and on the effects of normal prepubertal and pubertal development of the hymen over time. Much of the published data on normal hymenal variation applies to prepubertal girls, and there is still a need for longitudinal study of normal hymenal anatomy as girls enter puberty and progress through adolescence.

Hymenal Configuration

In its 1998 publication titled *Glossary of Terms and Interpretations of Findings for Child Sexual Abuse Evidentiary Examinations*, the American Professional Society of the Abuse of Children (APSAC) standardized terminology for the most common configurations of hymenal tissue: annular, crescentic, septate, redundant, cribiform, fimbriated, and imperforate. While the presence of a particular configuration does not appear to be a marker for

![FIGURE 2 Annular hymen in a 7-year-old girl. Photo courtesy of S. Elvik (color figure available online).](image)
a history of sexual abuse (Berenson et al., 2000), a description of the configuration is a basic component of the overall description of hymenal anatomy.

The annular hymen can be seen at all ages and is defined as a circumferential ring of tissue with a centrally placed opening (Figure 2). It is most common early in life, accounting for 80% of the hymenal configurations in newborns studied (Berenson, Heger, & Andrews, 1991) but decreasing in prevalence with age such that it was noted in 10% of girls examined at nine years of age (Berenson, 1995; Berenson & Grady, 2002). In comparison, the crescentic hymen becomes more prevalent with age during the prepubertal years and has been found in 90% of nine-year-old girls studied (Berenson & Grady, 2002). The crescentic hymen is described as having hymenal attachments at the 11 and 1 o’clock positions with no anterior hymenal tissue in between these attachments when the patient is supine (Figure 3). It has been hypothesized that in some cases, an annular hymen with an anterior cleft at 12 o’clock may be the anatomic precursor of a crescentic hymen in a child (APSAC, 1998).

The redundant hymen is described as one with abundant hymenal tissue that folds over on itself or protrudes outward, and it is most commonly found in females under the influence of estrogen, such as neonates, and adolescents (Figure 4). Less common configurations include the septate, cribriform, fimbriated, and imperforate hymens. According to APSAC guidelines (1998), a septate hymen is defined by a band of hymenal tissue that traverses the hymenal orifice, creating an opening on each side of the septum. This septum does not extend internally into the vagina and is present

![FIGURE 3 Crescentic hymen in a 7 1/2-year-old girl. Photo courtesy of C. Berkowitz (color figure available online).]
only within the hymenal tissue. This differs from a cribriform hymen, which has multiple small openings separated by hymenal tissue. The fimbriated hymen has multiple fingerlike projections of hymenal tissue that extend into the hymenal orifice with indentations on the edge of the hymen, creating a ruffled appearance. An imperforate hymen has no central opening in the hymenal tissue at all and typically requires medical intervention to allow for release of menstrual blood at puberty. It most commonly presents in a pubertal female with primary amenorrhea and with a blue or purple mass behind the hymen.

Hymenal Edges

Many characteristics of the hymenal edges have been standardized (APSAC, 1998) and are generally accepted as normal variations of hymenal anatomy, while others have yet to be well studied in a longitudinal manner. Common findings include hymenal tags, clefts or notches, bumps or mounds, external hymenal ridges, and intravaginal ridges. A cleft or notch is defined as an angular or “V” shaped indentation of the edge of the hymenal membrane that persists during multiple examination techniques, and it is characterized by its depth and location. A cleft may be shallow (superficial) or deep depending on whether its downward extension is less than or greater than 50% of the distance to the base of the hymen, and it may be anterior (ventral), lateral, or posterior (dorsal) in location.

Berenson and colleagues (1991) noted that clefts were present on the anterior and lateral hymen in 35% of neonates studied and that no clefts
were noted on the posterior hymen. Anterior and lateral clefts become less prevalent by three years of age; however, new lateral superficial clefts may develop in nonabused females up to the age of nine years (Berenson, 1995; Berenson & Grady, 2002). Anterior, lateral, and posterior clefts have also been noted in adolescents with no history of prior sexual activity (Adams, Botash, & Kellogg, 2004; Emans, Woods, Allred, & Grace, 1994). While most shallow clefts that develop postnatally in nonabused, prepubertal girls occur anteriorly between the 9 and 3 o’clock positions, these clefts have been documented in the posterior hymen as well (Berenson et al., 2000; Heger et al., 2002).

Hymenal tags are defined as elongated projections of hymenal tissue that arise from any location on the hymenal rim. These differ from bumps or mounds, which are solid, localized, rounded, and thickened areas of tissue on the edge of the hymen (APSAC, 1998). Both of these findings are considered to be normal variants of hymenal anatomy. Hymenal tags have been noted in 13% of newborns (Berenson et al., 1991), with no significant change in the prevalence of this finding in nonabused girls followed up to nine years of age (Berenson, 1995; Berenson & Grady, 2002). New tags have been noted to develop as extensions of intravaginal or external hymenal ridges, at the site of projections from fimbriated hymens, and after cleavage of hymenal septae (Berenson, 1995; Berenson & Grady, 2002). No difference in the prevalence of hymenal tags has been noted between abused and nonabused prepubertal girls (Berenson et al., 2000).

Recent studies have found hymenal mounds to be present in 34–69% of nonabused girls, with increased prevalence of this finding with age (Berenson & Grady, 2002; Heger et al., 2002). A mound may occur with or without an adjacent shallow cleft at the junction of the hymen with an intravaginal or external ridge or may occur independently in any location on the hymen (Berenson, Heger, Jayes, Bailey, & Emans, 1992; Berenson et al., 2000). Similar to hymenal tags, mounds have also been noted at the site of prior projections in a fimbriated hymen or as an extension of a prior external hymenal ridge (Berenson, 1993).

External hymenal ridges are midline, longitudinal ridges of tissue on the external surface of the anterior or posterior hymen that usually extend to the edge of the hymen (APSAC, 1998). Berenson and colleagues (1991) noted their presence in 87% of newborns examined, and subsequent studies have found that the prevalence in prepubertal girls decreases with age (Berenson, 1995; Berenson & Grady, 2002). Intravaginal ridges are mucosa-covered ridges of tissue on the vaginal wall that may attach to the inner surface of the hymen. They occur in all quadrants of the vagina, may be multiple in number, and may be easily visible through the hymenal opening in prepubertal girls with no history of abuse (APSAC, 1998). Berenson and colleagues (2000) found no difference in the prevalence of hymenal mounds, intravaginal ridges and external hymenal ridges between cohorts of abused and nonabused prepubertal girls.
Effect of Estrogen

The estrogenized hymen is characterized by thick mucosa and abundant tissue. It is noted in the newborn and infant due to the influence of maternal estrogen and the infant’s own high level of estriol production during the first few months of life (Berenson, 1993). By three years of age, estrogen levels have fallen and most hymens become flat with no redundant folds. The mucosa becomes thinner with sharp edges, and is typically red in color with a visible fine vascular pattern (Berenson, 1995). At puberty, estrogen levels rise, and the hymenal mucosa again becomes thickened, dull pink in color, and less sensitive to touch than the prepubertal hymen. It becomes elastic in consistency and redundant with abundant tissue relative to the size of the hymenal orifice.

Hymenal Width

Study of the width of the hymen arose from the question of whether or not the healing of acute hymenal trauma may result in a change in hymenal width. Berenson and colleagues (1992) noted that at least one millimeter of hymenal tissue was present at the inferior hymenal rim in 98% of prepubertal girls with no history of sexual abuse, and conversely, the presence of less than one millimeter of hymenal tissue at the 6 o’clock position was noted only in prepubertal girls with a history of prior sexual abuse (Berenson et al., 2002). In contrast, Heger and colleagues (2002) studied girls at Tanner stage 1 to 2 with no history of genital penetration and found that 22% had hymenal rims less than one to two millimeters wide. Almost 80% of the girls in Heger’s study with narrow hymenal widths had a body mass index greater than the 75th percentile for age, yet the consistency of this association has yet to be established.

Study of hymenal width at the lateral positions of 3 and 9 o’clock has also yielded findings with little clinical utility, as measurements of less than one millimeter have been noted in both abused and nonabused girls at these locations (Berenson et al., 2002). Some portion of these variable results may be due to differing examiner techniques in taking measurements, variable amounts of traction during the exam, and different perceptions of what constitutes the base of the hymen. Whatever the reason for the variability, however, no reliable criteria for abnormal hymenal widths have been established to date.

Transhymenal Diameter

Older studies proposed the use of the horizontal diameter of the hymenal orifice as a clinical tool for detecting patients with undisclosed histories of sexual abuse. This measurement can be examiner-dependent, however, and can vary for a given child, thus it is not predictive of a history of
sexual abuse (McCann, Voris, & Simon, 1992). Factors known to affect the diameter of the orifice include the age of the child at the time of the exam (Berenson & Grady, 2002), the examination position, the degree of hymenal traction during the exam, the state of relaxation of the child, and the type of hymenal configuration.

Berenson and colleagues (2002) compared the transhymenal diameters from cohorts of abused and nonabused prepubertal children, and while the average transhymenal diameter was found to be larger in the abused children in the knee chest position, there was significant overlap of the actual measurements from both groups. As a result of this overlap, no transhymenal diameter with both the necessary high sensitivity and specificity could be determined for use as a clinical screening tool.

**FREQUENCY OF ABNORMAL FINDINGS IN VICTIMS OF SEXUAL ABUSE**

Retrospective and case control studies have found that the majority of pubertal and prepubertal girls have a normal genital examination after an incident of sexual abuse. Data limited to prepubertal children examined within 72 hours of the alleged abuse has shown that only 23% of children had evidence of anogenital injury, and only 16% of those injuries were hymenal (Christian et al., 2000). Broader studies of prepubertal and pubertal girls presenting both acutely and beyond 72 hours from the time of the abuse have found normal anogenital exams in 21% to 96% of cases (Adams, Girardin, & Faugno, 2000; Adams, Harper, Knudson, & Revilla, 1994; Heger, Ticson, Velasquez, & Bernier, 2002; Kellogg, Menard, & Santos, 2004; Muram, 1989). When these cohorts are narrowed to include only girls with a history of genital penetration, these trends persist, as Heger and colleagues found that only 6% of girls who disclosed prior anal or vaginal penetration had an abnormal examination. Kellogg and colleagues (2004) studied pregnant adolescents in an attempt to create a cohort with definitive evidence of prior penetration and found that 64% had a normal exam or nonspecific findings. This cohort included one adolescent pregnant with her second child and two adolescents who had undergone gynecologic procedures within two months of the time of examination; all had normal genital examinations.

The likelihood of visualizing traumatic genital findings has been associated with several factors. These include the time since the incident, a history of pain or bleeding at the time of the abuse, and the examination technique (Adams et al., 1994; Adams et al., 2000; Christian et al., 2000). There has been no association of the likelihood of findings with the age or Tanner stage of the child at the time of the abuse or with a history of vaginal penetration (Adams et al., 1994; Christian et al., 2000). The presence of genital
HYMENAL FINDINGS IN VICTIMS OF SEXUAL ABUSE

The clinical distinction between a congenital variant of hymenal anatomy and a healed area of prior trauma can be difficult to make in a definitive manner. Studies have documented the variability in physician interpretation of genital findings in cases of sexual abuse, and as a result there has been an effort to standardize the descriptive terminology used as well as the interpretation of these findings (Adams, 2008; APSAC, 1998; Paradise et al., 1997).

Acute Findings

The manifestations of acute hymenal trauma commonly include findings such as partial tears, complete transections, erythema, edema, ecchymoses and submucosal hemorrhage (APSAC, 1998; McCann et al., 1992). Tears, transections, and ecchymoses have been further classified as definitive evidence of blunt force or penetrating trauma (Adams, 2008).

Among pubertal victims, the most common acute genital findings noted by Adams and colleagues (2000) included tears of the posterior fourchette, erythema of the labia minora, hymen, cervix and posterior fourchette, and swelling of the hymen. Hymenal tears were an uncommon finding in their study, occurring in 3% of girls without a history of prior sexual activity and in 19% with a history of prior consensual sexual activity. Few studies in the medical literature document longitudinal follow-up and time to resolution of acute hymenal changes, but McCann and colleagues (1992) found complete resolution of erythema and edema within 18 days and of submucosal hemorrhage within 27 days.

Acute lacerations of the hymen are typically termed as partial tears through a portion of the width of the mucosa, or as complete transections that extend to the base of the hymen at its attachment to the vaginal wall (APSAC, 1998). Depending on the time interval since the abuse, a tear or transection may be in the acute stage, in the early stages of healing, or may be completely healed at the time of the examination. Any tear or transection involving subepithelial tissues heals via the process of repair, which includes the formation of granulation tissue and subsequent scar tissue. Granulation tissue is typically red in color due to its vascularization, and as it progresses to scar tissue it contracts and becomes paler in color (Finkel, 1989; Figure 5).

Nonacute Findings

Given that many children do not reveal their histories of sexual abuse until weeks, months, or years after the incident, key issues in the interpretation
of the genital examination include the distinction between normal findings and healed traumatic findings and the acknowledgement of cases when these two categories cannot be distinguished. In order to standardize the interpretation of genital findings, classification scales have been developed using terms such as “indeterminate or nonspecific finding,” “concerning for or highly suggestive of abuse or trauma,” and “diagnostic of blunt force or

FIGURE 5 Granulation tissue on hymen at 5 o’clock position in a 17-year-old adolescent. Photo courtesy of S. Elvik (color figure available online).
penetrating trauma” (Adams, 2008, p. 436; Adams, Harper, & Knudson, 1992; Adams & Knudson, 1996). Research has focused on changes in the amount of hymenal tissue as well as on the quality of the edges of the hymen as possible areas of change with penetrating hymenal trauma. This has resulted in the standardized description of the superficial or deep cleft, hymenal transection, and absent hymenal tissue (Figure 6). All of these findings have differing levels of specificity as indicators for healed hymenal trauma.

FIGURE 6 Deep hymenal clefts and areas of absent hymenal tissue in a 7-year-old girl. Photo courtesy of S. Elvik (color figure available online).
Hymenal Clefts

Two key characteristics are utilized in interpreting the specificity of a hymenal cleft as evidence of penetrating trauma: location and depth. The shape of the cleft as a rounded “U” or angular “V” has been shown to have no association with abuse status (Berenson et al., 2000). The depth of a cleft is classified as superficial or deep, depending on whether it extends less than or greater than 50% of the width of the hymenal membrane. The location is termed according to the position on the hymen when the patient is in the supine position. A cleft may occur in the anterior (ventral), lateral, or posterior (dorsal) hymen.

The presence of clefts in the anterior and lateral hymen has been documented in nonabused, prepubertal girls up to nine years of age, and no difference in the prevalence of this finding has been noted in comparisons of abused and nonabused girls (Berenson, 1995; Berenson & Grady, 2002; Heger et al., 2002). Heger and colleagues noted both superficial and complete clefts in the anterior 180 degrees of the hymen in 73% of nonabused girls, thus indicating that the depth of an anterior or lateral cleft does not appear to have diagnostic significance in trying to distinguish between those with and without a history of genital penetration. The development of new superficial lateral clefts has also been noted in nonabused girls up to nine years of age (Berenson & Grady, 2002), and therefore the documented development of this finding in a prepubertal girl is a nonspecific finding.

There has been more debate surrounding the interpretation of clefts in the posterior hymen. In 1992, Berenson and colleagues found that of 211 nonabused prepubertal girls studied, none had clefts present between the 4 and 8 o’clock positions on the hymen and subsequently concluded that the presence of any cleft in this area likely indicated a history of genital penetration. APSAC (1998) reiterated this conclusion with the statement that posterior hymenal clefts are typically due to trauma. More recently, however, Heger and colleagues (2002) published the results of examinations of 147 nonabused girls in Tanner stages 1 and 2 and noted that 18% of their subjects had shallow clefts in the posterior hymen. Berenson and colleagues (2000) also noted superficial clefts in the posterior hymen of prepubertal girls, with no statistical difference in the prevalence when cohorts of abused and nonabused girls were compared. As a result of these more recent studies, the presence of a superficial cleft in the posterior hymen can best be termed a nonspecific finding at present (Adams, 2008). While an unknown percentage of superficial clefts may actually be posttraumatic findings, at our current state of medical knowledge, such clefts should not be interpreted as possible evidence of abuse in the absence of a clear, consistent, disclosed history.

Studies of deep clefts in the posterior hymen have consistently shown the absence of this finding in nonabused, prepubertal girls (Berenson, 1995; Berenson et al., 2000; Berenson & Grady, 2002; Heger et al., 2002).
Conversely, Berenson and colleagues (2000) found deep posterior clefts to be present only in abused, prepubertal girls. There have been fewer published studies regarding this finding in adolescents. Adams and colleagues (2004) found that while the presence of a deep posterior cleft was noted in adolescents with and without a prior history of sexual activity, it was significantly more common in those who were sexually active. Thus, the presence of a deep cleft in the posterior hymen is considered to be an indeterminate finding in prepubertal and pubertal girls (Adams, 2008; Adams et al., 2004) and is a finding that requires further study in both age groups.

Hymenal Transections

Healed hymenal transections, or “complete clefts” are defined as areas of prior hymenal tears that extend to the base of the hymen where it attaches to the vaginal wall (Adams, 2008; Adams et al., 2004; Emans et al., 1994; Heger et al., 2002). Multiple studies have noted the presence of hymenal transections only in prepubertal girls with a history of disclosed sexual abuse (Berenson, 1995; Berenson et al., 2000; Berenson & Grady, 2002), yet Heger and colleagues (2002) documented the presence of complete clefts in the anterior hymen in nonabused girls at Tanner stages 1 and 2. This finding was not present in the posterior hymen, however, and led to the conclusion that “complete clefts to the base of the hymen do not normally occur in the posterior rim between three and nine o’clock” (Heger et al., 2002, p. 34). While the classification scale by Adams terms hymenal transections or complete clefts to be “clear evidence of blunt force or penetrating trauma” (Adams, 2008, p. 437). This interpretation can most clearly be applied to transections of the posterior hymen.

Complete clefts have been noted in adolescent girls both with and without a history of sexual activity but are significantly more common in those who are sexually active (Adams et al., 2004; Emans et al., 1994). Conversely, studies of sexually active adolescents have noted the absence of a complete cleft in up to 94% of girls studied (Adams et al., 2004; Kellogg et al., 2004). Thus, while the presence of a complete hymenal cleft is strongly suggestive of a history of prior genital penetration, its absence is not inconsistent with a history of consensual or nonconsensual sexual activity. The location of a complete cleft as lateral or posterior has also been shown to be nondiagnostic in distinguishing between adolescents with and without a history of sexual abuse or consensual sexual activity (Emans et al., 1994).

Absent Hymenal Tissue

One of the first issues to be addressed in the medical literature on child sexual abuse was the assertion that the absence of hymenal tissue may be a congenital finding and not the result of trauma. This assertion was disproved, however, by two separate studies that documented the presence
of a hymen in a combined cohort of 1599 newborns (Berenson et al., 1991; Jenny, Kuhns, & Arakawa, 1987).

In older girls, the absence of hymenal tissue between the 11 and 1 o’clock positions is a normal finding and a component of the definition of a crescentic hymen. Absent tissue in the posterior hymen, however, is classified as “clear evidence of blunt force or penetrating trauma” and is defined as “a wide area in the posterior half of the hymenal rim with an absence of hymenal tissue, extending to the base of the hymen, which is confirmed in the knee-chest position” (Adams, 2008, p. 437).

Other Notable Characteristics

Both an irregular hymenal rim and a thickened hymenal edge have been proposed as characteristics that may reflect the presence of hymenal scarring; however, these findings have also been noted in nonabused study populations. An irregular rim has been noted in 9–52%, and a thickened edge has been found in 46–54% of prepubertal nonabused girls (Heger et al., 2002; McCann, Wells, Simon, & Voris, 1990; Gardner, 1992). These findings may reflect an estrogen effect, a folded hymen or an infection in the nonabused child, or may represent edema or scarring in the abused child. These findings can therefore best be termed nonspecific findings or normal variants (see Adams, this issue; Adams, 2008).

CONCLUSION

In 2000, Berenson and colleagues found that when the genital examinations of abused and nonabused girls were compared, only 2.5% of abused girls had physical findings that differed from that found in the nonabused group. This exemplifies one of the consistent concepts to come out of research in child sexual abuse over the past 20 years: that most victims have either normal genital exams or findings that cannot be definitively distinguished from non-abuse-related conditions. As the medical community continues to study normal hymenal development and patterns of healing on the hymen, it is important to realize that often it is the history that the child discloses that is of utmost significance in making a diagnosis of sexual abuse. Likewise, as genital findings are termed “normal” or “nonspecific,” this should not be interpreted as meaning that sexual abuse could not have occurred (see Berkowitz, this issue).

REFERENCES


**AUTHOR NOTE**

Sara T. Stewart, MD, is an associate professor of Pediatrics at the David Geffen School of Medicine at UCLA and the medical director of the Child Crisis Center at Harbor-UCLA Medical Center.