

## Mini-Reviews

# Genital Findings in Prepubertal Girls: What Can Be Concluded from an Examination?

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**Abstract.** *Introduction:* Interpretation of genital findings is a key component of the medical examination for suspected child sexual abuse. This study seeks to review the extent of evidence-based research on genital findings in prepubertal girls.

*Methods:* Literature review on normal genital anatomy in non-abused girls, case control studies comparing abused and non-abused girls, and observations of healing where the mechanism of injury is documented.

*Results:* A prolific literature exists on children examined for suspected abuse. By comparison there is a very little literature on children screened for non-abuse. Primary data on normal genital anatomy in girls after the neonatal period was found in 10 papers of non-abused girls and 6 case-control studies. The screening methods used to ensure that only non-abused children were assigned to non-abused groups were of variable standards. The evidence base on prepubertal girls selected for non-abuse using robust methodology is very small. The evidence base on healing of documented genital injury is contained in two case series, and a small number of case reports. Almost the entire evidence base on prepubertal genital anatomy in girls is derived from the USA.

*Conclusions:* Knowledge of the American studies and the limited extent of the total evidence base are essential to interpretation. A posterior rim of hymen measuring at least 1 mm is always present unless there has been trauma. There is such a wide range of normal hymen orifice size, that measurements are generally unhelpful. Genital injuries generally heal rapidly and most heal without residua. Hymen healing does not leave scarring, but scarring or vascular changes may occur to surrounding tissues. Except for deep lacerations hymen injury leaves no evidence of trauma. A full thickness transection through the posterior hymen is reliable evidence of trauma and does not heal without surgical repair.

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**Key Words.** Prepubertal genital anatomy—Child sexual abuse—Prepubertal genital injuries—Genital healing

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## Introduction

Since the early 1980s, doctors have been examining children for evidence where there is a suspicion of sexual abuse. In girls this often entailed looking for features in the hymen such as tears or scarring or estimating the hymen measurements.<sup>1</sup> Physical findings were the hallmarks of physical abuse and neglect and so it was expected that with sexual abuse there would also be abnormal findings. High rates were reported in children examined in the UK.<sup>2–4</sup> Many of these were findings that currently would be accepted as normal or non-specific.<sup>5</sup> Around the same time pediatricians in the USA commented that “experience with cases of possible sexual abuse has taught us that much work still needs to be done in understanding normal prepubertal female anatomy and interpreting findings in sexual abuse cases.”<sup>6</sup> In the USA it was recognized early on that physical signs were usually absent.<sup>7</sup> This conclusion has been consistent with large series of examinations subject to blinded peer review of photodocumented findings.<sup>8</sup> In acknowledgement that findings were most often normal, examination techniques were sought to improve visualization of micro trauma. These included photodocumentation with magnification, particularly with use of the colposcope. The search for micro trauma proved unhelpful; however, photodocumentation became the established medium for recording examinations. It has been standard in the USA for over 20 years. The situation is very different in the UK, where services for acute child sexual assault are seriously deficient and photodocumentation has only very recently become standard in Sexual Assault Referral

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Centers. It was still not available in 45% of other examination venues surveyed in 2005.<sup>9</sup>

Despite deficiencies in documentation, definitive medical statements about ‘abnormal’ genital findings are common in cases proceeding through the UK court system.<sup>10</sup> Physical findings, when identified, have a powerful influence on any court process. It is as true now as in the 1980s that research describing the genitalia of children carefully selected for non-abuse provides essential information to assist interpretation of these examinations. In view of the high rate of diagnostic or supportive findings reported in cases reaching the UK courts, it is timely to review the literature on genital anatomy in prepubertal girls.

### Methods

A review of the literature on the subjects of normal genital anatomy in prepubertal girls, healing of genital injuries in prepubertal girls, and the medical diagnosis of child sexual abuse was performed using the following resources:

MEDLINE (PubMed) 1950 to date  
 EMBASE 1974 to date  
 CINAHL 1982 to date  
 SCOPUS 1900 to date

Subject headings used were normal prepubertal genital anatomy, prepubertal genital examination, hymen examination, child sexual abuse, pediatric/child and forensic genital examination, pediatric/child genital/hymen injury. The Cochrane Library was not helpful, because randomized trials are not relevant to this area of medical practice. There was no attempt to search the ‘gray literature’ (conferences, abstracts, theses, and unpublished papers). A preliminary scrutiny of titles and abstracts was undertaken and full papers were obtained and reviewed if the paper in question addressed issues relevant to the topic.

Articles that did not address the relevant topic and studies that did not report relevant outcomes were excluded. Papers were hand searched for additional titles that did not appear in the database searches. The non-English literature is difficult to review, not only because of translation difficulties, but also because the descriptive terminology used for the hymen is not necessarily directly comparable to accepted terminology used in the English-language literature. Papers included are only those in English.

Papers specifically detailing anal rather than genital anatomy are not considered here. Papers documenting only newborn hymen data have been excluded from the tables, because the possibility of sexual abuse is generally an issue arising after the neonatal period.

However, they are included in the text where the relevance of newborn data is discussed.

Papers included are:

1. Primary data on genital findings in non-abused prepubertal girls (Tanner stage 1) after the newborn period
2. Case control studies comparing non-abused girls with girls believed to have been abused
3. Papers documenting healing of genital injuries in prepubertal girls.

Where more than one paper may include data on the same normative/control children this has been noted. Papers were evaluated for study design and for reported genital findings, with particular attention to the method by which children were assigned to a ‘non-abused’ or ‘low risk’ classification.

### Results

Searching under the subject heading ‘child sexual abuse’ brings up over 7000 titles. The other subject headings bring up a relatively small number of papers. A majority of the papers are case series and case reports of the genital findings of children examined for a suspicion of sexual abuse. No control data is provided in these papers so they are not included here. There are many papers on sexually transmitted infection and various gynecological symptoms in prepubertal children, practice guidelines and training issues, and review type articles that do not contain any primary data on genital anatomy. One of the main findings of this review was the lack of any evidence-based studies from the UK. The few evidence-based studies available have almost all been conducted in the USA.

#### The Newborn Hymen

A small number of papers documented the genital findings on several thousand neonates,<sup>11–14</sup> although numerically the largest was merely a letter confirming that the hymen was consistently present during examination of 25,068 newborn girls.<sup>14</sup> The main relevance of neonatal data is the confirmation that a hymen has been consistently present in newborns with a vagina.

Longitudinal data on children examined in the newborn period and then variously re-examined at 1–9 years of age has been included.<sup>15–17</sup> These papers likely include the same children examined on more than one occasion, who are thus potentially counted more than once when considering the numbers examined for non-abuse. By comparison, the number of papers addressing the normal genital anatomy of prepubertal children is very small.

#### ‘Normal’ Non-abused Children

Table 1 summarizes ten research papers.<sup>15–24</sup> This shows that the normative data has been derived almost

**Table 1.** Studies of Non-abused Prepubertal Girls

Authors, Year	Country	Type of Study	Normal/ Non-abused	Age Range	Photo-documented	Selection	Data Collected	Comments
Pokorney, 1987 <sup>18</sup>	USA	Normative	124	9 weeks to 10 years	No	Children seen for gynecological examination	Configuration, age, race, reason for referral	Many questions cannot be answered until prospective studies are done
Goff et al, 1989 <sup>19</sup>	USA	Normative	273	< 1 year to 7 years	No	Children undergoing routine medical	Hymen measurements	Orifice measurements rarely exceed 4 mm, and increase with age
McCann et al, 1990 <sup>20</sup>	USA	Selected for non-abuse	93	10 months to 10 years	Yes Magnified views, callibrated measurement	Volunteers for “free research examination” Structured interview & health questionnaire with parents	Hymen features Hymen orifice diameters	The determination of CSA can rarely rely on examination alone Transverse hymen orifice diameter range of 1–11 mm
Gardner, 1992 <sup>21</sup>	Australia	Selected for non-abuse	79	3 months to 11 y 7 mths	Yes	Random—girls undergoing surgery. Excl if hx of abuse or genital symptoms	Hymen features If > 1 finger’s breadth then called > 1 cm	A wide range of variation A high frequency of irregularities, as previously reported in girls examined for abuse
Berenson et al, 1992 <sup>22</sup>	USA	Normative	211	1 month to 7 years	Yes	Parental interview and notes review - excluded if any suspicion of abuse	Hymen configurations and measurements	Wide range of findings—no scarring & no “notches” noted between 4 and 8 o’clock. Heger later clarified they meant full thickness notches (transections) not seen <sup>23</sup>
Berenson, 1993 <sup>15</sup> Berenson 1995 <sup>16</sup>	USA	Longitudinal	134 (42)	NN & 3 yrs (42also ex at 1 year)	Yes	Neonatal exam then structured interview for risk prior to later exams	Hymen configurations and measurements	Configuration changed from birth to 3 years, often from annular or fimbriated at birth to crescentic
Berenson & Grady, 2002 <sup>17</sup>	USA	Non-abuse Longitudinal	93	3-9 years	Yes	Neonatal exam then structured interview for risk prior to later exams	Hymen configurations and measurements	An increase in the rate of crescentic configuration and orifice diamters with age
Heger et al, 2002 <sup>23</sup>	USA	Selected for non-abuse	147	Premenarchal Mean 63 mths	Yes	* Selected from 1000 cases referred to Centre for Vulnerable Children—structured interview to determine abuse status	Hymen configurations and measurements	High rate of non-specific findings
Myhre et al, 2003 <sup>24</sup>	Norway	Selected for non-abuse	195	5-6 years	Yes	Invited. No in-depth interview with child alone. Exclusion by history or exam finding of blunt or penetrating trauma	Hymen orifice measurements & width of rim at 6 o’clock	Outward folding of the hymen rim could be mistaken for attenuation or even absence of the posterior rim.

Total Cases 1349 (excluding duplicated cases & including only those with screening, 873 cases)

\*These normative control children had been referred to the specialist centre for genital examination because of findings documented during a paediatric well child examinations.

exclusively from USA research. Several of the studies were problematic because the children were simply undergoing examination as part of routine health screening or being treated for a non-genital complaint.<sup>18,19,21</sup> There was no means of assuring that abused children were not included.

McCann et al<sup>20</sup> performed the first study on children screened for non-abuse. Unfortunately, the screening method used to select children included the examiners' opinion about whether the examination findings were normal, based on changes associated with sexual abuse in uncontrolled reports. More robust screening tools (such as the child sexual behavior inventory, lone interview, and psychological assessment) to ensure children were assigned to the correct grouping were used in studies published from 1993 onwards. If one considers only those studies where robust screening methods were used, and taking into account that some normative cases may have featured in more than one study, the normal genital evidence base is tiny. It potentially contains less than 1000 girls across the prepubertal age range in studies evaluating girls for non-abuse (Table 1). Even these include 147 cases referred to a Centre for Vulnerable Children for evaluation because of 'genital findings' documented elsewhere.<sup>23</sup> Presumably the referral of these 147 girls was prompted by concern that the genital findings indicated abuse. Their inclusion may be justified by the relatively rigorous evaluation that led to a conclusion they were not abused. It would have been of value to know what the anatomical findings were that had prompted referral in the first place.

### Case Control Studies

Table 2 lists case control studies that have compared children examined for suspected abuse with control children.<sup>25-30</sup> These studies conclude that there are few anatomic findings from child sexual abuse. Inadequate selection or screening of controls for prior abuse is problematic with the earlier papers.<sup>25-27</sup> This criticism has been stated elsewhere.<sup>31,32</sup> The authors were setting out with a hypothesis that there would be differences, and to assess causality. For any association to be found causal, the methods used need to be sound. More robust screening tools to ensure children were assigned to the correct grouping were used in the studies published after 2000. However, the largest study in the case control group contained only children referred to a specialist center evaluating children for possible sexual abuse.<sup>28</sup> This study assigned children to high or low risk groups on the basis of the genital findings and structured interviews. Considering that all the children were referred because of a concern about sexual abuse, the appropriateness of including the low-risk group among data on non-abuse is questionable. A further problem with this

study is that, like the McCann study,<sup>20</sup> it included the genital findings when categorizing children to be a low risk status. Any study that includes the data to be established to define the study population is seriously flawed.

Thus the most rigorously controlled data is that provided by Berenson et al.<sup>29,30</sup> Screening of the abused cases included a penetration rating scale. Screening of non-abused children included parental interview and lone interview with the child, a 37-item child sexual behavior inventory developed to detect undisclosed abuse, and a medical record search. Children were excluded from the non-abused group if there was any suspicion of abuse, any history of a genitourinary complaint, or any event such as trauma that could have affected the genital appearance. The groups were carefully matched for age and ethnicity. These studies showed that superficial notches in the hymen are a normal finding, that a complete transection in the inferior rim only occurs with trauma, and that hymen orifice measurements will not help in the assessment of trauma.

### Hymen Size

The issue requiring clarification is what size of hymen is 'abnormal' in a prepubertal child? Early attempts to answer this question focused on the opening size. A number of studies in the 1980s suggested that a hymen opening greater than 4 mm was too wide, despite inadequate normative data.<sup>1,19,27,33</sup> Hobbs and Wynne suggested an upper limit of 8 mm but also did not provide any normative controls.<sup>2</sup> By 1990 there was sufficient data to say that all of this was wrong.<sup>20</sup> The hymen opening size is not a test for sexual abuse. It varies with type of hymen, the position of the child, the method of examination and degree of relaxation and cooperation of the child.<sup>34</sup> It also increases with the child's age and weight.<sup>17</sup>

In regard to the 'narrow hymen rim', only a hymen thickness of < 1 mm at 6 o'clock has not been documented in non-abused children.<sup>30</sup> However, this finding is so rare that it also excludes most children who have been abused. Among children examined for non-abuse by Heger et al, 22.4% were found to have a 'narrow rim' measuring 1-2 mm.<sup>23</sup>

### Trauma

Forensic examinations in prepubertal children very rarely follow an acute event, and therefore a third source of relevant data is healing patterns observed following trauma where the mechanism of injury is documented. The data documenting healing of genital trauma in girls is summarized in Table 3.<sup>35-40</sup> Very few longitudinal observations have been published documenting how hymen injuries heal. The bulk of the data is in 2 papers.<sup>39,40</sup> The first of these

**Table 2.** Case Control Comparative Studies

Authors Year	Country	Abused/ High risk of abuse	Non-abused	Age Range	Photo- documented	Non-abused Selection criteria	Data Collected	Comments	
Emans et al, 1987 <sup>25</sup>	USA	119	127		No	Routine health exam. No screening for factors associated with sexual abuse	Hymen opening diameters	Considerable overlap. No difference in hymen opening diameter.	
White et al, 1989 <sup>26</sup>	USA	242	23	1–12 years	No	Friends of authors	Vaginal introital diameter	An introital diameter > 4 mm is highly associated with sexual contact.	
Lillibridge & Kappes, 1993 <sup>27</sup>	USA	53	111	Prepubescent 1–121 months	No	Routine health exam No risk factors in history	Hymen orifice diameters and area	Lack of sexual penetration is suggested by opening area of 24.1 mm <sup>2</sup> (Hz diameter 6.9 mm). Masturbation may increase size.	
Berenson et al, 2000 <sup>29</sup>	USA	192	200**	3–8 years	Yes	Recruited from waiting room of pediatric clinics. Screening—parent and child interviews, child sexual behavior inventory, medical record review. Exclusion based on history of trauma or genital complaints.	Hymen features	Equal rates of non-specific variations. Superficial hymen notches present in both groups. Few anatomic differences, and these are rare in abused children.	
Ingram et al, 2001 <sup>28</sup>	USA	733with penetration 634without penetration	659	3–12 years	No, but colposcope grid used	All cases recruited from children referred to specialist center for sexual abuse. Assigned to high or low risk on basis of disclosures on structured interview or physical examination findings	Transverse hymen orifice diameter in different positions	No differences in transverse hymen orifice diameter between the different groups.	
Berenson et al, 2002 <sup>30</sup>	USA	189	197**	3–8 years	Yes	Recruited from waiting room of pediatric clinics. Screening—parent and child interviews, child sexual behavior inventory, medical record review. Exclusion based on history of trauma or genital complaints.	Hymen orifice measurements and thickness of posterior rim at 6 o'clock	Superficial hymen notches present in both groups. Hymen measurements lack sensitivity and specificity. Only a hymen thickness of <1 mm is confined to abused girls, but is so rare it misses most abused children.	
TOTAL	USA only		1120, exc double counting (197) but including 659 referred to a center for evaluation owing to concern about findings						

\*\*These 'controls' are likely to be the same children recruited from the same clinic during the same time interval using the same methods.

**Table 3.** Data on Healing of Hymenal Injuries

Authors, Year	Country	No. of hymen injuries	Age Range	Injuries and Healing
Berkowitz et al, 1987 <sup>35</sup>	USA	1	5	tears, scars and distortion of hymen and perineal laceration
Finkel, 1989 <sup>36</sup>	USA	1*	Prepubertal	
McCann, 1992 <sup>37</sup>	USA	3*	4 months 4 years 9 years	All rapid healing, but different in all 3 cases. Infant: irreg narrow rim to shallow concavity 4yo: hymen orifice enlarged as torn edges folded back 9yo: injury disappeared into folds of hymen with changes of puberty
Boos, 1999 <sup>38</sup>	USA	1	7 years	Labial and fossa navicularis abrasions healed within 3 days. Petechiae healed quickly. Partial 8 o'clock tear healed with angular notch
Heppenstal -Heger et al, 2002 <sup>39</sup>	USA	37*	Range not given. Mean 69.7 mo includes postpubertal cases	12 hymen abrasions or hematomas—11 healed completely, 1 healed with slight angularity. All trauma to labia healed without residua. Perihymenal laceration healed with vascular changes.
McCann et al, 2007 <sup>40</sup>	USA	113*	113 prepubertal girls	Healed rapidly – timescale for various injuries documented

\*These papers contained more cases, but only the prepubertal girls with genital injury are considered here.

By 7 months there was scar tissue with no orifice, so simulating an imperforate hymen  
Hymen transection did not heal  
2 transections did not heal  
Transection at 6 o'clock did not heal  
17 transections did not heal, except 2 out of 6 that underwent surgical repair.  
Except for deeper lacerations, left no evidence of trauma. Final 'width' of hymen rim dependent on initial depth of laceration

documented healing of 37 hymen injuries, 47 posterior fourchette injuries, 39 perihymenal injuries, and 17 labial injuries but did not differentiate between prepubertal and pubertal girls.<sup>39</sup> The latest paper adds data on 239 hymenal injuries, of which 126 were prepubertal cases.<sup>40</sup>

All longitudinal studies reported that genital injuries may heal quickly. Complete transection through the full thickness of the hymen leaves a permanent defect or gap in the hymen, unless repaired surgically.<sup>39,40</sup> Abrasions and hematomas heal completely. Partial thickness tears of the hymen may heal completely or may leave a partial notch. However, superficial notches on the posterior part of the hymen also occur naturally and it is not clear these can be differentiated from a partial notch at the site of healed trauma. To date, deep or full thickness notches (transections) have only been observed following injury, which may be accidental or deliberate abuse.

There are many papers reporting acute injury to the genitalia without follow-up data. One study worthy of note in regard to causation detailed 4 children run over by a motor vehicle who sustained lacerations to the hymen/vagina or anus that could be mistaken for sexual abuse.<sup>41</sup> The authors postulated that compression of the abdomen forcing the genitalia down and outward, or shear/torque forces, had produced injuries that were previously believed to be pathognomonic of penetrating trauma.

## Discussion

Although Paul was one of the first practitioners to publish data on the newly recognized problem of sexual abuse,<sup>42</sup> no study from the UK has contributed normative data. This may reflect the extreme difficulty of doing research in this in this area. Within the UK it is particularly difficult to get ethical approval to include children in studies involving any intrusive procedure that is not medically indicated or of direct benefit to the child. There may also have been an assumption by both medical and non-medical professionals that doctors know what is normal from routine child examinations. In reality, medical examination of children does not normally include visualization of the genital anatomy. To see the hymen in most children requires special techniques of separation and traction on the labia. In some cases examination in knee-chest position is necessary. These procedures are intrusive and uncomfortable to the child. Unsurprisingly they have only been employed where the child had a genital symptom or there was a suspicion of sexual abuse, in which case there is risk the findings will be assumed to reflect the presenting concern. In this context it becomes understandable

that what is seen is then likely to be assumed abnormal. This may explain many of the papers where high rates of abnormal findings were reported.

Considering the very small size of the evidence base, if a spontaneously arising normal variant has a low frequency (say 1 in 2000–5000 children) there is a possibility it may not have been documented among the normative evidence base. Small numbers always demand cautious interpretation and an understanding that outliers in the normal population will be in grave danger of being labeled ‘abnormal.’

Overwhelmingly, the data is from the USA, so strong attention should be directed to the North American consensus on interpretation of findings which states “...Medical professionals must take great care to interpret physical findings using research-derived knowledge concerning the variations of normal and the particular conditions that may be mistaken as abuse.”<sup>5</sup> Without knowledge of the USA data, many common normal variations may be mistaken as post-traumatic changes.

The term *child sexual abuse* refers to a range of activities which exploit the child for sexual gratification of the abuser. Many of these do not cause physical injury and the physical findings will be normal. This is understandable if non-discovery and continued access is important to the abusive relationship. Injuring the child carries high risk of discovery and loss of access to the child. Historically, these concepts were not understood.

There was a tendency to conceptualize sexual abuse of girls in adult terms of penile vaginal penetration. There was therefore an expectation that there would likely be findings. There has been universal agreement that statements made by the child are potentially the most important information. This may have led some doctors to conclude that penile penetration of the prepubertal vagina may not result in any trauma or abnormal findings. There is need here to consider what the vagina is to a prepubertal child. She has no frame of reference to understand that penetration between the labia is not the same as vaginal penetration. Penetration of a blunt object between the labia will not likely result in tissue trauma.

As we have learned more, findings such as hymen orifice diameters have been excluded from classification systems and irregularities of the hymen rim have become acknowledged as non-specific. The commonly used term “attenuation” implies tissue which was there has been lost. This implies more tissue was documented at a previous examination, but in most cases there has been no prior examination so this terminology is inappropriate. If one considers the relatively estrogenized hymen of the newborn against the hymen in mid childhood (before the onset of puberty) it seems likely that all hymens go through

a process of natural attenuation, particularly in the first year.<sup>15,16</sup>

Hymen measurements have generally been unhelpful to the diagnosis of child sexual abuse. In the author's experience, hymen measurements are too small to be reliably estimated with the naked eye. With magnified photography, which must include a grid or measure, it is possible to obtain accurate measurement to the nearest millimeter. Visual estimates of the hymen orifice made without magnified photography tend to be overestimates (unpublished data). Also, distinguishing where the fossa navicularis ends and the hymen starts can best be clarified by the light reflex on a photographic image.

### Conclusion

The history of the medical diagnosis of child sexual abuse is short, and reveals a process where opinion came first, before the evidence base. Wide differences of opinion have existed on the rates of abnormal genital findings in children believed to have been abused, particularly between series reported from the UK and USA. This review clarifies considerable limitations to the knowledge base about 'normal' genital findings, and confirms that it is based almost exclusively on American research. This knowledge is essential for any doctor performing a forensic genital examination. A posterior rim of hymen is always present and measures at least 1 mm unless there has been trauma. However, a narrow posterior rim (1–2 mm) has been reported in around 1 in 5 normal prepubertal examinations. Accurate measurements in this range require photodocumentation. There is such a wide range of normal hymen orifice size that measurements are generally unhelpful. Genital injuries generally heal rapidly. Injuries to labia heal completely. Injuries to the posterior fourchette may heal completely or may leave scarring or vascular changes. Perihymenal injury may heal completely or may leave vascular changes. Hymen healing does not leave scarring, and except for deeper lacerations leaves no evidence of trauma. Transection through the full thickness of the posterior hymen has not been observed to occur naturally and does not heal without surgical repair.<sup>39</sup>

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