PCH Cheung 張志雄
CH Ko 高震雄
HYM Lee 李綺雯
LMC Ho 何慕清
WWK To 杜榮基
PLS Ip 葉麗嫦

Correlation of colposcopic anogenital findings and overall assessment of child sexual abuse: prospective study

以陰道鏡檢查肛門生殖器的結果與兒童性侵犯整體評估的相關性：前瞻性研究

Objective. To examine the relationship between colposcopic anogenital findings and overall assessment of sexual abuse.
Design. Prospective study.
Setting. Regional hospital, Hong Kong.
Patients. Seventy-seven children (mean age, 6.5 years; range, 6 months-16 years) referred consecutively for sexual abuse evaluation between July 1999 and June 2002 were included.
Main outcome measures. Colposcopic anogenital findings (categorised as normal, non-specific, concerning for abuse, or clearly abnormal) were correlated with the overall assessment of likelihood of abuse (classified as no evidence of abuse, possible abuse, probable abuse, or definite abuse). The sensitivity and specificity of clearly abnormal findings in detecting definite abuse were computed, and the diagnostic impact of colposcopy findings were expressed as likelihood ratios.
Results. Anogenital findings were normal in 45% of patients, non-specific in 29%, concerning for abuse in 13%, and clearly abnormal in 13%. Seven of the 16 confirmed cases of sexual abuse had normal or non-specific findings. Overall assessment showed that 46% of all patients had no evidence of abuse, 20% had cases of possible abuse, 13% had cases of probable abuse, and 21% had cases of definite abuse. The sensitivity and specificity of abnormal anogenital findings in detecting definite abuse were 56.3% and 98.4%, respectively. Colposcopy showed a fair correlation with the overall assessment of abuse (weighted kappa, 0.245). The diagnostic impact of normal, non-specific, concerning, and clearly abnormal findings in terms of likelihood ratios were 0.23, 1.12, 0.00, and 34.30, respectively.
Conclusions. Anogenital findings are often normal or non-specific in sexual abuse. In general, colposcopy examination findings do not directly reflect the final diagnosis. A category-4 finding on colposcopy is very helpful in confirming definite abuse, whereas other findings do not rule out the diagnosis.

Key words:
Anus/injuries;
Child abuse, sexual;
Genitalia, female;
Colposcopy

關鍵詞：
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陰道鏡

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United Christian Hospital, 130 Hip Wo Street, Kwun Tong, Hong Kong:
Department of Paediatrics and Adolescent Medicine
PCH Cheung, FRNZCGP, FHKAM (Paediatrics)
LMC Ho, MRCPCH, FHKAM (Paediatrics)
PLS Ip, FRCP, FHKAM (Paediatrics)
Department of Obstetrics and Gynaecology
HYM Lee, MRCOG, FHKAM (Obstetrics and Gynaecology)
WWK To, FRCOG, FHKAM (Obstetrics and Gynaecology)
Department of Paediatrics and Adolescent Medicine, Caritas Medical Centre, 111 Wing Hong Street, Shamshuipo, Kowloon, Hong Kong
CH Ko, MRCP, FHKAM (Paediatrics)

Correspondence to: Dr PCH Cheung (e-mail: cheungp8@netvigator.com)

目的：檢視以陰道鏡檢查肛門生殖器的結果與性侵犯整體評估的關係。
設計：前瞻性研究。
安排：分區醫院，香港。
病者：在1999年7月至2002年6月，轉介接受性侵犯評估的77位兒童，平均年齡為6.5歲，分佈域為6個月至16歲。
主要結果測量：計算以陰道鏡檢查肛門生殖器的結果(劃分為正常、未見異常、涉及侵犯和確定不正常)，與受侵犯可能性整體評估(劃分為沒有證據顯示受侵犯、有可能受侵犯、極可能受侵犯、確定受侵犯)之間的相關程度。以「確定不正常」的結果，計算其敏感度及特異性。陰道鏡檢查結果對診斷的影響，以似然比值表示。
結果：肛門生殖器檢查結果顯示，病童中有45%為正常、29%為未見異常、13%為涉及侵犯，以及13%為確定不正常。在16個確定受侵犯個案中，7個個案的檢查結果為正常或未見異常。整體評估顯示，77位病童中，46%屬沒有證據顯示受侵犯、20%屬有可能受侵犯、13%屬極可能受侵犯，以及21%屬確定受侵犯。利用「確定不正常」類別的檢查結果數據來確定兒童是否受侵犯，其敏感度為

56.3%，特異程度為98.4%。陰道檢查鏡結果與受侵犯的整體評估相關度屬一般(加權內部一致性係數值為0.245)。正常、未見異常、涉及侵犯及確定不正常的檢查結果對診斷的影響，以似然比值表示，依次分別為0.23、1.12、0.00及34.30。

結論：在性侵犯案件中，肛門生殖器的檢查結果經常為正常或未見異常。一般而言，陰道鏡檢查結果並不能直接反映最後的診斷結果。陰道鏡第四類檢查結果對確定兒童受侵犯相當有效，其他結果亦不能排除診斷結果的可能性。

Introduction

Clinicians conventionally identify cases of abuse on the basis of physical findings. For example, there are specific patterns of bodily injuries in cases of physical abuse and there are specific growth patterns in cases of child neglect. Not all abnormal physical signs, however, indicate that abuse has occurred. For example, apparent signs of child sexual abuse can actually be because of a congenital condition,[1-3] prepubertal appearance,[4-7] anogenital variation,[8-11] or other anogenital injuries.[4,5,12] Anatomical findings previously reported as abnormal are now considered non-specific, such as an enlarged hymenal diameter, hymenal notches, clefts and bumps, narrowed hymenal width, changes in anal tone, and anal dilatation.[8,13-15]

Photographic documentation, which comes under peer's scrutiny in order to reach a uniform interpretation of anogenital findings, can improve consistency in research and avoid repeated examinations. Furthermore, terminology of anogenital findings[16] and scales used to classify sexual abuse[17,18] are now sophisticated. In this study, we explored the relationship between physical findings and the final assessment of whether sexual abuse had occurred in a group of children referred for suspected sexual abuse. (The term 'children' in this paper refers to individuals younger than 18 years.)

Methods

The Department of Paediatrics and Adolescent Medicine at the United Christian Hospital handles referrals for sexual abuse evaluation and serves a regional population of 700 000. The hospital multidisciplinary team includes social workers, paediatricians, gynaecologists, and nurses, and liaises closely with statutory social workers and the police, who conduct forensic interviews.

In this study, we recruited 77 consecutive patients who were referred for a colposcopy examination between July 1999 and June 2002. These patients accounted for 80% of all suspected sexual abuse cases referred to us during this period. The remaining 20% of cases were those in which consent for colposcopy examination was refused, those examined by forensic pathologists, or those for which there were various reasons that a colposcopy examination was not performed but a general anogenital examination was done instead.

The timing of the colposcopy examination depended on whether abuse was acute or historical (over 72 hours), and whether there were conditions, such as bleeding or infection, that required prompt management. Children were examined immediately if suspected abuse had occurred within 72 hours; an early examination (usually within 24 hours of presentation) was arranged for cases of historical abuse. Written consent for colposcopy examination was obtained for all cases from the guardians. A professional who had been specially trained in playing with children was available for additional support.

Children were examined firstly in a supine, frog-legged position, and then in a crouched, knee-to-chest position. For girls, the hymen was visualised after labial separation and traction. Sedation was administered if children were not able to cooperate, or if the clinical decision necessitated examination for treatment purposes. Specimens, such as blood samples and anogenital swabs, were labelled, signed, and sent to the laboratory with a completed chain-of-evidence form to eliminate errors in specimen handling. Anogenital findings were recorded on 35-mm slide films on which the patient's identifying details (eg medical record number) were encrypted. Digital images could also be captured simultaneously. All anogenital findings were reviewed by the whole team before medical reports were issued.

Anogenital findings were documented according to the glossary of terms for child sexual abuse evidentiary examination defined by the American Professional Society on the Abuse of Children.[16] The findings were then categorised according to the Adams system[18] as (1) normal; (2) non-specific; (3) concerning for abuse or trauma; and (4) clear evidence of blunt force or penetrating trauma (Table 1). For findings belonging to more than one category, the highest category was recorded. For example, a child with signs falling into category 1 (eg periurethral bands) and category 3 (eg acute abrasion) would be recorded as having category-3 findings.

An overall assessment of the likelihood of abuse was made for each child by using the Adams classification scale.[18] This overall assessment was an integration of medical history, behavioural changes, laboratory results, and anogenital findings. Patients were classified as (I) having no indication of abuse; (II) having suffered possible abuse; (III) having suffered probable abuse; and (IV) having suffered definite abuse (Table 2).

Finally, the sensitivity and specificity of category-4 findings in detecting class IV (definite abuse) were calculated. Confidence Interval Analysis version 2.0.0 was used for analysis of diagnostic tests.[19] The general correlation between the two assessments (anogenital findings and

Table 1. Adams classification of anogenital findings[18]

Category 1 *Normal*	Category 2 *Non-specific*	Category 3 *Concerning for abuse or trauma*	Category 4 *Clear, blunt force or penetrating trauma*
Normal (1) Periurethral bands (2) Longitudinal intravaginal ridges (3) Hymenal tags/ bumps/mould (4) Linear vestibularis (5) Anterior hymenal cleft/notch (6) External hymenal ridge *Normal variants* (7) Septate hymen (8) Failure of midline fusion (9) Groove in fossa (10) Diastasis ani (11) Perianal skin tag (12) Increased perianal skin pigmentation (13) Venous congestion in perianal area *Other conditions* (14) Haemangioma (15) Lichen sclerosis (16) Behçet's disease (17) Streptococcal cellulitis of perianal tissue (18) Molluscum contagiosum (19) Verruca vulgaris (common wart) (20) Vaginitis caused by *Streptococcus* or enteric organisms (21) Urethral prolapse (22) Foreign body in vagina	(1) Erythema (2) Increased vascularity (3) Labial adhesion (4) Vaginal discharge (5) Vesicular lesions (6) Wart-like lesions (7) Friability of posterior fourchette (8) Thickened hymen (9) Anal fissures (10) Flattened anal folds (11) Anal dilatation with stool present, or knee-to-chest >30 sec (12) Vaginal bleeding (13) Notch or cleft in posterior hymen <50% width	(1) Marked immediate anal dilatation with no stool visible or palpable (in knee-to-chest position) with no encopresis, constipation, neurological disorder, or sedation (2) Notch or cleft in posterior hymen >50% width (3) Acute abrasion/ laceration/bruising (4) Bite/suction (5) Scar or fresh laceration of posterior fourchette not involving hymen (6) Perianal scar	(1) Hymen laceration, acute (2) Hymen ecchymosis (3) Perianal laceration extending deep to external anal sphincter (4) Hymenal transection, healed (torn to the base/ complete cleft) (5) Hymenal tissue absence confirmed in knee-to-chest position

Table 2. Adams assessment of the likelihood of abuse[18]

Class I *No indication of abuse*	Class II *Possible abuse*	Class III *Probable abuse*	Class IV *Definite abuse*
(1) Normal examination findings, no history, no behavioural changes, no witnessed abuse (2) Category-2 findings with another known or likely explanation and no history, no behavioural changes (3) Child at risk of sexual abuse but no history and non-specific behavioural changes (4) Physical findings consistent with injury history	(1) Category-1 or category-2 findings with abnormal behaviour, no history (2) Herpes type 1; otherwise normal examination findings, no history (3) *Condyloma acuminatum* (genital wart); otherwise normal examination findings, no history (4) Statement from child, but not sufficiently detailed or consistent	(1) Consistent history with or without abnormal physical findings (2) Positive *Chlamydia trachomatis* culture in prepubertal child (not via rapid antigen test) (3) Positive herpes simplex virus 2 culture (4) Trichomoniasis	(1) Category-4 findings, no accident history (2) Sperm or seminal fluid found (3) Pregnancy (4) Positive *Neisseria gonorrhoea* culture (5) Postnatal syphilis (6) Photographs or videotapes showing abuse (7) HIV infection, not perinatally acquired, via needle or blood

overall assessment of likelihood of abuse) was deduced from the weighted kappa, which is a measure of agreement between categorical variables.[20] The diagnostic impact of each category of colposcopy finding was expressed as the likelihood ratio (LR).[21]

Results

Eighty-eight examinations were performed on 77 patients—all female, whose mean age was 6 years and 6 months (range, 6 months-16 years). Eight patients were post-pubertal. Sedation was required for only four patients. Ten (13%) patients had category-4 findings; three of these were postpubertal. Five had hymenal transection, two had hymenal laceration, and three lacked hymenal tissue up to the base of hymen in the posterior rim (Table 3). The girl with clear evidence of trauma but no definite signs of abuse was a 4-year-old who sustained a hymenal transection in

Table 3. Examination findings versus overall classification of likelihood of abuse

Examination finding category	Overall classification of likelihood of abuse				Total
	I No abuse	II Possible	III Probable	IV Definite	
1 (Normal)	18	10	5	2	35 (45%)
2 (Non-specific)	9	4	4	5	22 (29%)
3 (Concerning for abuse)	8	1	1	0	10 (13%)
4 (Clear evidence)	1	0	0	9	10 (13%)
Total	36 (47%)	15 (19%)	10 (13%)	16 (21%)	77

Table 4. Patients with clear evidence of abnormal anogenital findings or definite abuse

Patient No.	Age (years)	Puberty	Anogenital category	Overall classification	Description
1	2	Prepubertal	2	IV	Cleft posterior hymen <50% width, gonorrhoea
2	3	Prepubertal	2	IV	Erythema, gonorrhoea
3	9	Prepubertal	4	IV	Posterior hymenal tissue absence confirmed in knee-to-chest position
4	5	Prepubertal	4	IV	Hymen ecchymosis/acute laceration
5	11	Prepubertal	4	IV	Posterior hymenal tissue absence confirmed in knee-to-chest position
6	7	Prepubertal	2	IV	Erythema, gonorrhoea
7	12	Prepubertal	4	IV	Hymen ecchymosis/acute laceration
8	7	Prepubertal	2	IV	Erythema, gonorrhoea
9	6	Prepubertal	2	IV	Cleft posterior hymen <50% width, gonorrhoea
10	2	Prepubertal	1	IV	Confession
11	3	Prepubertal	1	IV	Postnatal syphilis
12	8	Prepubertal	4	IV	Hymenal transection, gonorrhoea
13	9	Prepubertal	4	IV	Posterior hymenal tissue absence confirmed in knee-to-chest position
14	12	Postpubertal	4	IV	Hymenal transection
15	16	Postpubertal	4	IV	Hymenal transection
16	14	Postpubertal	4	IV	Hymenal transection
17	4	Prepubertal	4	I	Hymenal transection

the 3-o'clock position after her 7-year-old sister had accidentally inserted a wand with a sharp-edged plastic star at its tip during play in the bath. This was classified as no abuse but the family was referred to social services for further follow-up.

Category-3 findings were found in 10 (13%) patients, nine of whom had acute abrasions, lacerations, or bruising of the labia, perihymenal tissues, or perineum; or a posterior fourchette tear. Causes included inappropriate nappy and vulva care, straddle injury, alleged gang rape, or alleged digital sexual assault. Even if there was a convincing history of alleged abuse corroborated by category-3 findings, the case was not classified as definite abuse, but as probable abuse (class III).

Category-1 and category-2 findings of normal or non-specific findings were found in 57 (74%) patients. In overall assessments, 50 patients had no indication of definite abuse, and seven patients had normal or non-specific findings but microbiology confirmed gonorrhoea or syphilis; these seven patients were thus classified in the definite abuse group.

Overall, 47% of patients had no evidence of abuse (class I), 19% had a possible abuse (class II), 13% a probable abuse (class III), and 21% a definite abuse (class IV). Of the 16 girls with definite abuse, 13 were prepubertal and three were postpubertal. Definite abnormal findings (category 4) were found in six of the 13 prepubertal and all three postpubertal girls (Table 4). None of the children from classes I, II, or III were re-admitted or brought to our attention because of further abuse, which would then have been classified as definite (class IV). In addition, none of the class-IV patients were re-abused.

Table 5. Sensitivity and specificity of colposcopic examination*

Examination finding categories	Overall classification of likelihood of abuse		Total
	Class IV Definite abuse	Class I-III Not definite abuse	
Category 4 (clear evidence)	9	1	10
Categories 1-3 (no clear evidence)	7	60	67
Total	16	61	77

* Sensitivity=9/16=56.3% (95% CI, 33.2%-76.9%); specificity=60/61=98.4% (95% CI, 91.3%-99.7%)

The association between definite signs of blunt force or penetrating trauma and overall assessment of definite abuse is summarised in Table 5. The sensitivity and

Table 6. Diagnostic impact of anogenital findings

Examination result	Definite abuse No. (%)	Not definite abuse No. (%)	Likelihood ratio*	95% Confidence interval	Diagnostic impact
Category 1	2 (12.5)	33 (54.1)	0.23	0.06-0.69	Intermediate-low
Category 2	5 (31.3)	17 (27.9)	1.12	0.47-2.35	Indeterminate
Category 3	0 (0)	10 (16.4)	0.00	0.00-1.24	Indeterminate
Category 4	9 (56.3)	1 (1.6)	34.30	6.09-200.27	Rule-in diagnosis

* Likelihood ratio=% of definite abuse ÷ % of not definite abuse

specificity of category-4 findings in diagnosing definite abuse were 56.3% (95% confidence interval [CI], 33.2%-76.9%) and 98.4% (91.3%-99.7%), respectively. The low sensitivity (56.3%) and high specificity (98.4%) of colposcopy makes it a useful examination to confirm but not to rule out the diagnosis (definite abuse, class IV) in our setting. The weighted kappa was 0.245, which indicated a fair agreement between anogenital findings and the overall assessment of abuse.

Table 6 summarises the diagnostic impacts of individual anogenital findings of categories 1 to 4. The LRs of each category were as follows: category 4, 34.30 (6.09-200.27); category 3, 0.00 (0.00-1.24); category 2, 1.12 (0.47-2.35); and category 1, 0.23 (0.06-0.69). The LR for category-4 findings results in a large and conclusive change from the pre-test probability of 21% (16/77) to a post-test probability of 90% (9/10). The LR for category-1 findings reduces the probability from 21% to only 5.7% (2/35), which is not low enough to rule out the diagnosis. Moreover, 32 (42%) patients had category-2 or category-3 findings, for which the LRs have indeterminate diagnostic values. In other words, a category-4 finding from colposcopy is very helpful in confirming definite abuse, whereas findings in categories 1 to 3 do not rule out the diagnosis.

Discussion

The paradigm of medical history, examination, and investigation should be followed in that order before a diagnosis is reached. Our findings suggest that colposcopy adds a new dimension to the investigation of child sexual abuse. It provides photographic documentation of medical findings and facilitates the peer review process. Our data show that results of the physical examination are often normal or non-specific regarding sexual abuse. Although colposcopy examination alone generally does not directly reflect the final diagnosis, it is useful in confirming but not excluding definite abuse.

Although the Adams classification[18] is a useful system for clinicians to categorise physical findings and assess the overall likelihood of abuse, it has not undergone vigorous scientific evaluation to make it a 'gold standard'. Despite this drawback, use of the system increases the consistency in interpretation of medical findings and generates the potential for a consensus in the field. Furthermore, a common scale can help both medical colleagues not handling abuse and other non-medical personnel to appreciate better the medical findings and assessment of abuse.

The public generally believe that physical findings have a major role in defining whether sexual abuse has occurred. Because physical findings are included as one of the factors in the overall assessment of the likelihood of abuse, the two are not totally independent of each other. It follows that if the agreement analysis yields a high kappa, one may doubt whether it is biased by the intrinsic association between the two assessment methods. On the contrary, the weighted kappa in our study was only 0.245, which signified only a fair agreement. One can conclude that the correlation between colposcopic findings and overall assessment is genuinely poor, despite a potential bias favouring a higher kappa. Therefore, our findings support the opinion that one should not rely only on normal physical findings to refute sexual abuse.

Normal or non-specific findings were found in 74% (57/77) of patients. The literature shows a wide variation in the number of normal findings. In a review of 21 studies of various numbers of allegedly sexually abused girls (ranging from 86 to 688) who were younger than 18 years, the proportion of girls with normal findings ranged from 26% to 73%.[22] Among the 16 cases of definite abuse in our study, seven (44%) had normal or non-specific findings. In a blinded retrospective photographic review of subjects whose perpetrators were convicted for sexual abuse, Adams et al[9] found that 77% of the confirmed sexually abused girls had normal or non-specific anogenital findings.[9]

Abnormal findings were found in 13% (10/77) of patients in our series. Fourteen percent of 213 girls in a paper were found to have abnormal findings.[9] In the study by Heger et al,[23] only 4% of 2384 subjects referred for medical evaluation of sexual abuse were found to have abnormal findings—defined in that study as acute trauma, hymenal transection to the base, scarring, sexually transmitted diseases, and forensic results that were positive for sexual abuse.

Our higher rate of abnormal findings (13%) could be accounted for by a number of factors. Firstly, this study included only individuals who had undergone a colposcopic examination. The 13% of abnormal findings would be reduced to 10% if all suspected cases were taken into consideration. Furthermore, the Hong Kong central regis-

try of child abuse recorded 73 newly established cases of sexual abuse during 6 months,[24] whereas only 45 patients had been evaluated in all hospitals in Hong Kong.[25] This disparity suggests that some 38% of cases of abuse may not have any symptoms or signs that needed hospital evaluation and treatment. These factors need to be considered when one interprets and compares results with other studies. We anticipate that subjects presenting to our tertiary centre would have an increased likelihood of having abnormal findings. However, 74% were found to have normal or non-specific findings. There are other factors affecting the number of children being evaluated. There is no mandatory reporting of abuse in Hong Kong. The process of abuse disclosure suggests that many abused children are yet to be identified.

Conclusions

Sexual abuse takes on all forms of acts that may or may not result in physical injuries. Genital trauma often heals rapidly.[4,5,12] Clinicians are often asked to identify and interpret medical findings of sexual abuse, however, they need to avoid substantiating a false accusation by misinterpreting medical findings, and to avoid excluding sexual abuse on the basis of a normal examination. We have shown that physical examination results are often normal, and that colposcopic examination can aid child sexual abuse evaluation. In general, it does not reflect the final assessment directly and one should not only rely on this approach to conclude on the nature of abuse. It is, however, a useful examination to confirm class-IV definite abuse. Moreover, a category-4 finding on colposcopy is very helpful in confirming definite abuse, whereas findings in categories 1 to 3 do not rule out the diagnosis.

The diagnosis of sexual abuse should stem from a sound analysis of the medical history, behaviour changes, and physical findings. No single factor should be relied on to formulate the final assessment. A normal examination should not be taken as evidence that sexual abuse has not occurred, and an important piece of information in diagnosis is a clear statement from the child. On one hand, clinicians should be vigilant for abuse if positive physical findings were present, but on the other hand they should not reach the conclusion of abuse purely on the basis of trivial anogenital findings.

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