The American Journal of Forensic Medicine and Pathology 17(4):289–298, 1996.

Postmortem Perianal Findings in Children

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The postmortem finding of anal dilation or an exposed pectinate line in children who have died under suspicious circumstances continues to raise the concern of possible sexual abuse. The following multicenter, collaborative study was designed to help address that question. Sixty-five subjects, ranging in age from birth to 17 years, were autopsied at three different sites. A standard protocol along with 35-mm cameras were used to record the results. Thirty-eight (58%) subjects were boys, and 27 (42%) were girls. Forty-two (65%) were white, 10 (15%) African-American, five (8%) Asian, three (5%) white Hispanic, and five (8%) other. Fifty-seven (88%) were in Tanner stage I of secondary sexual development. Thirty-four (52%) died of natural causes, 26 (40%) from accidental injuries, three (5%) from other causes, and four (6%) as a result of a homicide. Forty-eight subjects (74%) had some dilation of the anal sphincters. In 21 children (32%), the entire anal canal, including the rectal ampulla, could be visualized. In another 21 (32%) subjects, the pectinate line was exposed. Only the outer portion of the anal canal opened in six children (10%), whereas 17 (26%) had no dilatation of the anus. Anal laxity led to flattened skin folds in 50 (77%), a shallow anal canal in 40 (62%), the exposure of both the pectinate line in 38 (59%), and the anal mucosa in 24 (37%). Venous congestion was present in 14 (22%), venous pooling in three (5%), erythema in six (9%), and increased pigmentation in eight (12%). Funneling was found in two (3%). Blood was present in three (5%), and an abrasion was discovered in one (2%). No fissures, lacerations, hemorrhoids, or scars were found in any of the children. Anal orifice size varied with the age of the child, the amount of traction applied to the buttocks, and a history of a CNS injury at the time of death. It is suggested, finally, that anal dilatation alone cannot be used as a marker for prior sexual abuse and that exposure of the pectinate line should not be confused with tears or fissures of the anal verge. Further studies of children known to have been sodomized prior to death are required.

Key Words: Sexual abuse—Child abuse—Anal dilation—Postmortem findings.

Received April 10, 1995; accepted July 17, 1995.

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On occasions, a postmortem perianal finding in a child will raise the issue of possible sexual abuse. Two of the more common reasons for this concern are a dilated anus and the exposure of the pectinate line. The latter finding can look like a series of deep clefts in the rim of the anus and may be confused with fissures. In an article dealing with sexual abuse of English boys and girls, Hobbs and Wynne (1) suggest that postmortem evidence of "gross anal dilatation" along with an "irregular anal margin, and smooth perianal skin" was evidence of sexual abuse. A contrary opinion is expressed in a recently published text on forensic pathology that states "a widely-open, patulous anus is often seen postmortem, due to flaccidity of the sphincter" (2). Unfortunately, in this latter publication, no references were cited. The only other reference found in the medical literature of postmortem anal dilatation is a report of one case in which the author attributed the finding to a "variation of normal" (3). Although these disparate opinions have provided a basis for argument, none have adequately answered the question about whether anal dilation or other physical findings discovered during an autopsy are signs of sexual abuse or variations of normal.

Until recently, the evaluation of the living child suspected of having been sexually abused was hampered by a lack of standards of normal. The studies that helped resolve this problem have shown that there is a wide variation in the ano-genital anatomy of children; caution must be exercised in interpreting the findings (4,5). This same situation appears to be operative for medical examiners who are being asked to explain unusual ano-genital findings in the dead child.

The following study is designed to help establish standards of normal for the perianal portion of a child's autopsy. Anal dilation and other soft tissue findings were recorded and analyzed to ascertain the frequency with which they were encountered during the postmortem examinations. This infor-

EXHIBIT "C"

TABLE 1. *Cause of death by age*

Cause of death	0–2 y	2–4 y	5–9 y[a]	TSSDII	TOTAL
Natural					
SIDS	18	0	0	0	18 (28%)
Congenital anomaly	7	1	0	0	8 (12%)
Infectious	3	0	1	0	4 (6%)
Malignancy	1	1	0	0	2 (3%)
Accidental					
Drowning	1	6	2	1	10 (15%)
CHI/CNS	1	1	4	5	11 (17%)
Asphyxia	1	1	1	3	6 (9%)
Crushed	0	0	1	0	1 (2%)
Homicidal	3	1	0	0	4 (6%)
Total (%)	36 (55%)	11 (17%)	9 (14%)	9 (14%)	65 (100%)

[a]One child aged 9 still in Tanner Stage I.

TSSDII, Tanner stage of secondary sexual development of ≥ II; CHI/CNS, closed head injury/CNS injury.

mation is being presented to help the pathologist determine if a finding should be considered a normal variant or an indicator of sexual abuse.

METHODS

The cases for this Human Subjects Review Committee–approved research project were obtained from three sites over a period of 2 years. The postmortem examinations were performed by a pathologist at Children's Hospital and Medical Center of Seattle, Washington (J.S.), by the Medical Examiner of King County, Washington (D.R.), and by the Medical Examiner of San Francisco County, California (B.S.). The examinations for this convenience sample study were obtained sequentially by the participating pathologists when they were on duty.

A standardized questionnaire was used to record all available demographic, historical, and medical data. In cases in which the child was pronounced dead in the field, information regarding the circumstances of the death was obtained from police reports. When the child was declared dead in a hospital, the attending physician's discharge summary and other available reports were used to gather data. Reports of prior investigations of the family by the Children's Protective Services (CPS) or law enforcement agencies for possible child abuse or neglect were sought.

The historical information in the project's protocol included questions regarding the cause of death, the organ system(s) involved in the child's death, unusual circumstances surrounding the death, significant past medical history, family history, social history, resuscitation efforts, and all forms of anal penetration by medical personnel prior to death. A review of systems included questions about constipation, chronic diarrhea, rectal bleeding, encopresis, use of enemas, use of suppositories, and/or any preceding neurological disorders.

The medical examination portion of the questionnaire incorporated the time from death to refrigeration, the time from refrigeration to autopsy, the body temperature, the state of rigor mortis, the examination method, the outcome of the autopsy, and the results of any relevant studies such as cultures or toxicology screens.

Most of the infants were examined in a supine position, whereas the older subjects were studied in a prone position. The examiners agreed to use only enough traction to separate the gluteal fold to expose the anus and the surrounding tissues. The pathologist's interpretations of the physical findings were transcribed at the time of the autopsy, and 35-mm cameras with macrolenses were used to record the findings. All anal orifice and other soft tissue measurements were obtained from the photographs.

To ensure the accuracy of the assessment, a metric scale was included in all photographs as a guide for determining sizes. Midline measurements were used to record anterior-posterior (A-P) diameters. The "external" lateral anal orifice diameters were obtained by using a point on the anal verge that was on the same plane as that used to record the "external" A-P measurement. The distal portion of the "saw-toothed" pectinate line was employed as the point of reference for measuring the "internal" A-P and lateral anal orifice diameters. When "complete dilation" was present and the interior of the rectal ampulla was visible, the measurements were obtained from the inner walls of the anal canal/ampulla.

Because the muscle fibers of the external and internal anal sphincters are interdigitated at their junction, no attempt was made to define which sphincter, if either, was dilated. For purposes of consistency, "external" anal dilation was considered present when the edges of the anal verge were separated without the pectinate line being visible. "Internal" anal dilatation was defined as present when the edges of the anal verge were separated and the pectinate line was visible. "Complete" anal dilation was deemed to be present when the entire anal canal was dilated and the rectal ampulla was visible.

Most of the soft tissue findings were obvious in the photographs. However, if there was a difference in the interpretation of a finding between the examiner and the photograph, the examiner's conclu-

TABLE 2. *Postmortem perianal soft tissue findings*

Findings	Yes		No		UTD	
	n	Percentage	n	Percentage	n	Percentage
Blood present	3	5%	62	95%	—	—
Rigormortis	56	86%	8	12%	1	2%
Fecal soiling	26	40%	39	60%	—	—
Livormortis	45	70%	20	31%	—	—
Venous congestion	14	22%	47	72%	4	6%
Venous pooling	3	5%	58	89%	4	6%
Hemorrhoids	0	0%	61	94%	4	6%
Erythema	6	9%	55	85%	4	6%
Erythema, mild	5	83%	—	—	—	—
Erythema, moderate	1	17%	—	—	—	—
Increased pigmentation	8	12%	—	—	—	—
Rash	2	3%	59	91%	4	6%
Lichenification	0	0%	61	94%	4	6%
Diasatsis ani (smooth)	2	3%	58	89%	5	8%
Diastasis ani (dimple)	3	5%	57	88%	5	8%
Fissure	0	0%	60	92%	5	8%
Abrasions	1	2%	59	91%	5	8%
Lacerations	0	0%	60	92%	5	8%
Scars	0	0%	60	92%	5	8%
Tags, anterior	5	8%	55	85%	5	8%
Tags, posterior	1	2%	64	98%	—	—
Skin folds, well defined	14	22%	48	74%	3	5%
Skin folds, flattened	50	77%	12	19%	3	5%
Skin folds, thickened	7	11%	55	85%	3	5%
Skin folds, irregular	12	19%	50	77%	3	5%
Funnel shaped	2	3%	62	95%	1	2%
Shallow anal canal	40	62%	24	37%	1	2%
Exposed pectinate line	38	59%	24	37%	3	5%
Prominent anal mucosa	24	37%	40	62%	1	2%

sions were used. Venous congestion and engorgement were two such examples. The pathologist recorded venous congestion as present when there was a purplish discoloration but no distortion of the perianal tissues. Venous pooling (engorgement) was defined as a bulging of the tissues secondary to underlying venous distention. As with venous congestion, venous pooling created a deep purple hue appearance in the tissues.

When more than one photograph had been taken during an autopsy, the anal orifice measurements from each were compared to determine if there was a significant variation in size. The measurements from the largest and smallest orifices were then compared to determine if the examination technique had an effect upon the results. Only the photographs with the smaller diameter orifices were used to generate the data in this report.

The data were analyzed using the Center for Disease Control's EPI INFO computer data analysis package and the SPSS PC+ statistical package (6,7). Descriptive univariate statistics were generated for all variables. Cross tabulations, using the χ^2 method, were employed to explore the bivariate relationships between categorical variables. Both *t* tests and correlation statistics were used for continuous variables.

RESULTS

Demographic Data

Sixty-five subjects were included in this postmortem study conducted between April 1990 and July 1992. Thirty-one cases were obtained from the King County Medical Examiner's office, 25 cases from the Children's Hospital and Medical Center in Seattle, Washington, and nine cases from the Medical Examiner's office in San Francisco. Thirty-eight (59%) were boys, and 27 (41%) were girls. There were 42 (65%) whites, 10 (15%) African- Americans, five (8%) Asians, three (5%) white Hispanics, and five (8%) other races. The age of the subjects ranged from stillborn to 17½ years. Fifty-seven (88%) subjects were in Tanner stage I of secondary sexual development, one (1%) in Tanner stage II, two (3%) in Tanner stage III, three (5%) in Tanner stage IV, and two (3%) in Tanner stage V.

Cause and Location of Death

Thirty-three (51%) of the subjects died of natural causes, 28 (43%) because of accidental injuries, and four (6%) as a result of homicidal injuries (Table 1). One death, not considered homicidal, was investigated for possible neglect. There were no su-

TABLE 3. *Anal orifice size by age (mean diameter and range)*

Anal orifice	0–2 y	2–5 y	5–9 y	TSSD ≥ II
A-P diameter (A-P range)	9.4 mm (5–20 mm)	14.4 mm (7–20 mm)	16.7 mm (8–23 mm)	18.2 mm (9–23 mm)
AV diameter (AV range)	4.8 mm (2–12 mm)	8.0 mm (2–17 mm)	10.2 mm (6–18 mm)	11.3 mm (5–22 mm)
PL diameter (PL range)	2.2 mm (0–10 mm)	4.5 mm (0–15 mm)	5.8 mm (0–11 mm)	7.1 mm (0–15 mm)

A-P, anterior-posterior; AV, anal verge; PL, pectinate line; TSSD, Tanner stage of sexual development.

icide victims. Although the majority of the infants died of natural causes, most of the older children died because of accidental injuries.

Thirty children (46%) died in the hospital. Seventeen subjects (26%) were in the hospital for <24 h, four (6%) were hospitalized for 24–48 h, two (3%) for 48–168 h, and seven (11%) lived a week or longer.

Historical Information

Although complete historical data was not available for all subjects, the information collected was analyzed to determine if relationships existed that would explain a subject's physical finding. From the available information, the review of systems revealed that only two (4%) out of 45 children had a history of constipation, none had chronic diarrhea or encopresis and only one of the 50 (2%) had rectal bleeding. None of these subjects had a history of chronic use of suppositories or enemas.

Resuscitation was attempted in 47 (72%) of the children. Thirty-eight of the 47 children (80%) were intubated, 20 (43%) were given stimulants, eight (17%) were administered narcotics, seven (15%) were given anticonvulsants, six (13%) had muscle relaxants, and four (9%) were dispensed sedatives. Of the 47 children in whom resuscitation was attempted, 39 (83%) received intravenous fluids. No association was discovered between this information and the children's physical findings.

Anal penetration was documented in 27 (42%) of the subjects <24 h prior to death. This consisted of the use of rectal temperature thermometers in 15 (56%), digital examination in eight (30%), antemortem anal manipulation in three (11%), and the use of suppositories in two (7%). No association was discovered between this information and the children's physical findings.

Autopsy Findings

The majority of the 26 (40%) children who were 2 months of age or younger were examined in a supine position, whereas the older children were examined in a prone position. Traction, as determined from the photographs, was applied to the buttocks of 46 (71%) of the subjects, whereas 19 (29%) were examined by observation only. The soft tissue findings of the autopsies are recorded in Table 2.

The most common soft tissue findings were flattened skin folds (77%), a shallow anal canal (62%), and an exposed pectinate line (59%). Because mild perianal erythema (6%) was indistinguishable from livormortis (70%) on the photographs, the determination of this finding was left to the pathologist who performed the autopsy.

Upon review of the photographs, 77% (50) of the subjects had some anal dilation. The entire anal canal, including the rectal ampulla, was visible in 32% (21) of the children. In a similar number of subjects (21), the pectinate line was exposed but the anal canal remained closed. There was only "external" dilatation of the anal verge, without visualization of the pectinate line, in 10% (6) of the subjects. No anal dilation was noted in 23% (15) of the children.

With external anal dilation, the orifice was elliptical or oval in shape. Both round and oval anal orifice configurations were noted, with either internal or complete anal dilation. The nondilated anal orifice had a "slit-like" appearance.

Two or more photographs of the subject's perianal area were obtained during 38 (58%) of the 65 autopsies. When the anal orifice measurements from one photograph were compared to another from the same individual, a statistically significant difference between the orifice sizes was discovered. This was true for both the lateral verge and pectinate line measurements but not for the A-P dimension. With traction, the mean diameter for the lateral verge measurement varied from 8.6 to 11.1 mm ($p < 0.0001$), with the range of the discrepancy being 0–7 mm. The mean diameter for the lateral pectinate line measurement changed from 6.0 to 8.7 mm ($p < 0.0001$), with the range of differences being 0–7 mm. There was no significant change in the A-P diameters among the photographs.

TABLE 4. *Summary of postmortem anal findings*

No.	Age	DILAT	A-P	LAT (V/P)	Event/diagnosis	Anal findings/ comments
1	6 years	Internal	14 mm	10/6 mm	Drowned	Oval, mucosa
2	16 years	Internal	16 mm	11/8 mm	Drowned	Oval, mucosa
3	9 years	Internal	21 mm	10/7 mm	Auto accident	Oval, CHI
4	22 months	External	8 mm	6/2 mm	Abused	Slit, CHI
5	7 years	External	8 mm	7/0 mm	Auto/ped	Slit, CHI
6	5 years	External	19 mm	6/2 mm	Drowned	Slit
7	5 years	Internal	18 mm	10/7 mm	Kicked	Oval, CHI
8	10 years	Complete	20 mm	13/10 m	Auto accident	Oval, CHI
9	2 years	Internal	13 mm	5/3 mm	Drowned	Slit, mucosa
10	4 years	Internal	14 mm	7/5 mm	Auto accident	Slit, CHI
11	6 years	Complete	15 mm	8/5 mm	Auto accident	Irregular, CHI
12	12 months	Internal	17 mm	10/6 mm	Drowned	Oval, mucosa
13	2 months	Internal	10 mm	5/2 mm	SIDS	Slit, mucosa
14	2 months	None	9 mm	4/0 mm	SIDS	Slit
15	2 months	None	7 mm	3/0 mm	SIDS	Slit
16	3 years	Internal	18 mm	9/4 mm	SBS	Oval, CHI
17	3 years	Complete	20 mm	12/9 mm	Drowned	Oval, stool
18	2 months	External	7 mm	4/0 mm	SIDS	Slit
19	4 months	Complete	9 mm	9/8 mm	SIDS?	Oval, funnel
20	10 years	External	15 mm	5/0 mm	Auto accident	Slit, CHI
21	15 months	Internal	10 mm	5/2 mm	Oven door	Slit
22	22 months	Internal	20 mm	8/5 mm	Auto accident	Oval, mucosa
23	17 months	Internal	14 mm	8/2 mm	SBS	Oval
24	4 years	Internal	20 mm	8/3 mm	Drowned	Slit
25	4 years	Internal	20 mm	17/15 m	Smoke inhalation	Oval, smooth canal
26	7 years	Complete	23 mm	12/8 mm	Crushed	Oval, empty ampulla
27	11 years	Complete	21 mm	8/7 mm	CO	Oval, stool
28	14 years	Internal	9 mm	10/6 mm	Suffocation	Irregular
29	5 years	Complete	22 mm	18/11 m	CP/infection	Round, asphyxia
30	17 years	Internal	19 mm	15/7 mm	Auto accident	Oval, CHI
31	14 years	Complete	23 mm	22/15 m	Brk neck	Round, stool
32	2 years	None	10 mm	5/0 mm	Drowned	Slit
33	6 years	Complete	20 mm	13/8 mm	Suffocation	Round, retarded
34	9 years	Internal	20 mm	8/4 mm	Auto accident	Slit, CHI
35	2 years	Internal	8 mm	8/2 mm	Drowned	Elliptical
36	1 month	None	9 mm	4/0 mm	Burn	Slit, fissure
37	8 years	Complete	11 mm	8/5 mm	Crushed	Round, CHI
38	2 years	Complete	16 mm	12/6 mm	Drowned	Irregular
39	2 months	None	15 mm	4/0 mm	SIDS	Slit
40	21 months	Complete	9 mm	7/4 mm	Unknown	Oval, hyperthermia
41	4 months	Complete	10 mm	4/2 mm	SIDS	V-shaped
42	1 month	Complete	8 mm	5/5 mm	SIDS	Round
43	4 months	Complete	6 mm	3/2 mm	SIDS	Irregular
44	10 months	None	10 mm	2/0 mm	Cancer	Slit
45	4 years	Internal	7 mm	3/2 mm	CHD	Slit
46	20 months	Complete	10 mm	5/4 mm	CHD	Round
47	4 months	None	8 mm	3/0 mm	SIDS	Slit
48	2 months	Complete	5 mm	5/5 mm	SIDS	Round
49	1 month	None	7 mm	3/0 mm	SIDS	Slit
50	4 months	Complete	10 mm	4/2 mm	SIDS	Oval, emptamp
51	17 months	Complete	10 mm	5/3 mm	Cong mal	Oval, stool
52	1 month	Internal	8 mm	5/4 mm	Cong anl	Oval, mucosa
53	14 days	None	7 mm	2/0 mm	Cong anl	Slit
54	3 years	None	12 mm	2/0 mm	Brain tumor	Slit
55	3 months	None	5 mm	4/1 mm	SIDS	Slit
56	1 day	Internal	10 mm	4/2 mm	Cong mal	Oval, meconium
57	1 month	None	11 mm	5/0 mm	SIDS	Slit
58	12 days	None	5 mm	3/0 mm	Cong mal	Slit
59	Birth	Complete	10 mm	12/10 m	Cong mal	Round, meconium
60	19 months	None	10 mm	2/0 mm	Infection	Slit
61	8 months	None	11 mm	2/0 mm	Infection	Slit
62	1 month	None	8 mm	3/0 mm	SIDS	Slit
63	2 months	External	11 mm	6/2 mm	SIDS	Slit
64	Birth	None	7 mm	3/0 mm	Cong mal	Slit
65	2 months	Complete	8 mm	6/6 mm	SIDS	Irregular, funnel

DILAT, dilation of external and/or internal anal sphincter; A-P, anterior/posterior diameter; LAT V/P, lateral verge/pectinate line diameters; CHI, closed head injury; CHD, congenital heart disease; CP, cerebral palsy; Cong anl, congenital anomaly; Cong mal, congenital malformation.

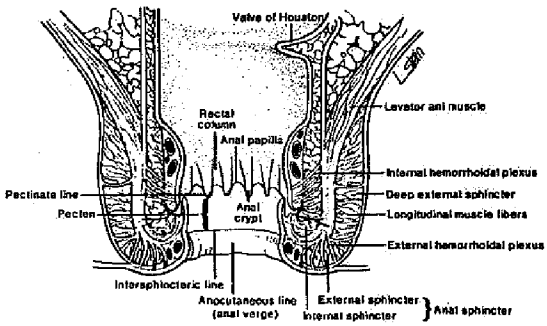

FIG. 1. Cross-section of rectosigmoid and anal structures. (From ref. 27, with permission.) All photographs (Figs. 1–9) were taken with the subject in a prone position; A-P diameters are listed first, followed by lateral anal orifice measurements, and magnification varies.

Of the 21 children with complete anal dilatation, the A-P diameter was 10–14 mm in 15 (71%), 15–19 mm in seven (33%), and ≥20 mm in six (29%). No stool was present in 11 (52%). The anal orifice size and range by age may be found in Table 3.

To determine if any associations could be detected between soft tissue findings and historical information, statistical bivariate analysis was performed. This analysis was limited to those variables in which there were sufficient numbers and variation in the findings. Significant relationships discovered included an increase in the diameters of the anal orifice with increasing age of the child ($p < 0.0001$), an increase in the lateral diameter of the anal orifice with traction ($p < 0.001$), and an increased likelihood of anal dilation with a CNS injury at the time of death ($p < 0.02$). A history of a neurologic disorder prior to death also appeared to increase the possibility that anal dilatation would be present at the time of the child's death. However, the number of subjects was too small to determine the statistical significance of this association. A summary of the postmortem anal findings may be found in Table 4.

DISCUSSION

As the medical community's awareness of childhood sexual abuse has grown, so has the concern over postmortem perianal findings discovered at autopsy (Fig. 1) (1–3). This has been particularly true when anal dilatation is encountered. Although a patulous anus has been documented immediately following a sexual assault, the question of whether or not anal dilatation is a marker for ongoing abuse has remained unanswered (8).

In the living child, a large number of perianal findings have been associated with ongoing sexual abuse. These include erythema, hyperpigmentation, dilated veins, localized venous pooling, loss of normal skin folds, thickening of the perianal tissues, shortened anal canal, funneling, swelling of perianal tissues, fissures, hematomas, skin tags, scars, and anal dilation (9–25). Although the significance of many of these findings is still being debated, the unanswered question is whether or not any of these same findings, when discovered during an autopsy, are indicative of sexual abuse.

This study was designed to explore the type and frequency of perianal findings that might be encountered by pathologists performing autopsies on children. Although it is necessary to view this as a preliminary study due to its methodological limitations, the intent of this report was to help establish a baseline of normal findings for the postmortem examination of a child.

Most of the children appeared to have died because of accidental injuries or other natural causes. Although four children died as a result of homicidal violence, a review of the available information identified only one subject for whom the possibility of sexual abuse arose. In that subject, it was the autopsy finding of a patulous anus that led to the suspicion of possible sexual abuse (Fig. 2). This

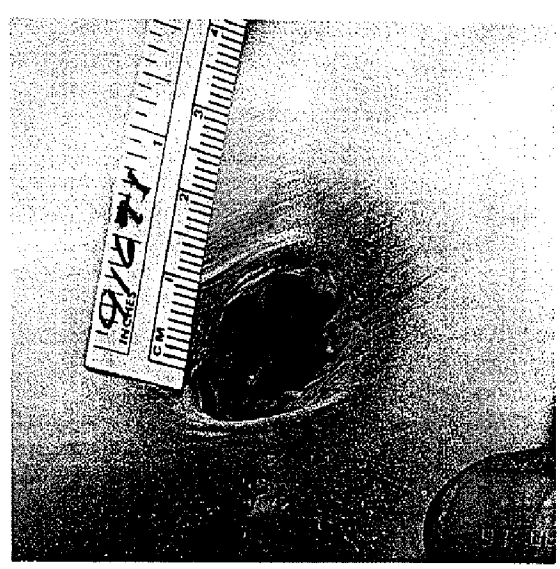

FIG. 2. A 5-year-old white girl kicked in the head by a horse. The possibility of sexual abuse was investigated due to patulous anus. No documentation of evidence was contained in the medical record. Note smooth perianal tissues with faint bluish discoloration (venous congestion). Shallow anal canal. Prominent pectinate line with anal canal columns visible. External anal verge diameter: 21 × 16 mm. Internal pectinate line diameter: 20 × 15 mm. Ampulla opening: 10 × 2 mm.

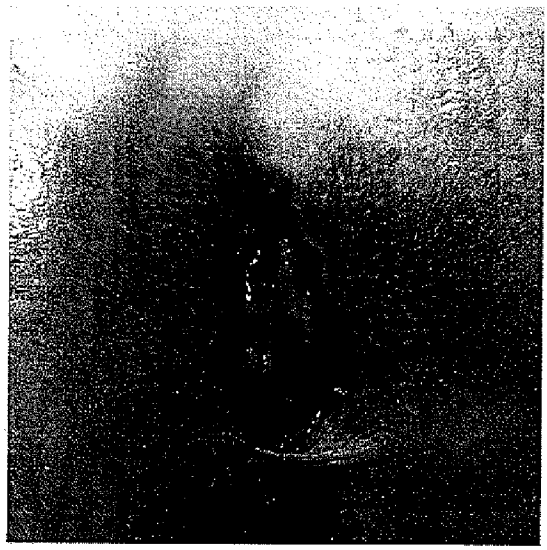

FIG. 3. A 9-year-old white girl died in an automobile accident. Massive closed head injury. Fractured skull, broken ribs, and multiple contusions. Note smooth perianal tissues, localized venous engorgement at 3 o'clock, and generalized venous congestion. Pectinate line and prominent anal mucosa visible. Had digital rectal examination just prior to death. External anal verge diameter: 20 × 8 mm. Internal pectinate line diameter: 18 × 4 mm.

FIG. 5. A 6-year-old girl with hypomelenosis of Ito died of suffocation. Found in her body cast wedged upside down between bed and wall. Child severely developmentally delayed. Note generalized perianal livermortis. Smooth perianal skin folds, shallow anal canal with pectinate line, and anal mucosa visible. External anal verge diameter: 24 × 15 mm. Internal pectinate line diameter: 20 × 13 mm. Ampulla opening: 15 × 8 mm.

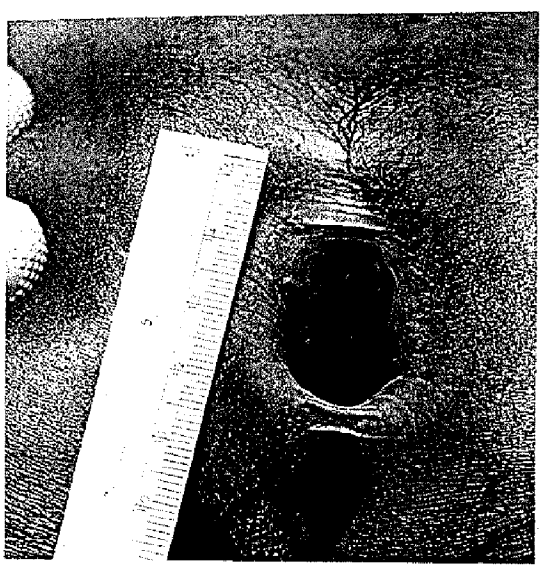

FIG. 4. A 5-year-old African-American girl died in her sleep. Severely developmentally delayed secondary to neonatal asphyxia. Smooth perianal tissues with venous congestion between 1 and 6 o'clock positions. Shallow anal canal with prominent pectinate line and anal canal. Rectal ampulla visible. External anal verge diameter: 24 × 20 mm. Internal pectinate line diameter: 20 × 18 mm. Ampulla opening: 16 × 10 mm.

FIG. 6. A 6-year-old white girl thrown from car and sustained fractures of skull, pelvis, and humerus. In intensive care unit 2 weeks prior to death. Perianal tissues wrinkled. Prominent folds of pectinate line give orifice an irregular appearance. External anal verge diameter: 15 × 8 mm. Internal pectinate line diameter: 13 × 7 mm. Ampulla opening: 10 × 5 mm.

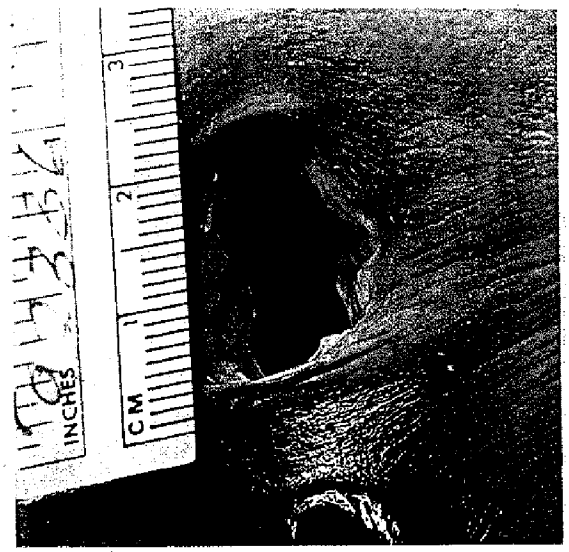

FIG. 7. A 7-year-old Asian girl crushed by a pickup truck. Died of a closed head injury. Smooth perianal skin folds, shallow anal canal, pectinate line, anal canal, and empty rectal ampulla visible. External anal verge diameter: 23 × 15 mm. Internal pectinate line diameter: 20 × 12 mm. Ampulla opening: 14 × 7 mm.

child was a 5-year-old girl who was kicked in the head by a horse and died as the result of a severe head injury. Her medical records contained no evidence of sexual abuse and the anal dilation is consistent with her central nervous system injury.

Statistically, there is a possibility that one or more of the children in this study was sexually molested (26). Despite a dilated anus discovered in two of the four physically abused children, both of whom died of closed head injuries, there was no evidence of sexual abuse in any of the subjects.

As expected, the A-P dimension of the anal orifice did increase with the age of the child. This relationship existed even if there was anal dilatation (Figs. 3 and 4). The lateral anal orifice size varied within the same age group, primarily because of dilatation of the anus in some subjects (Table 4).

Lateral or horizontal anal orifice diameters proved difficult to record from the photographs. The identification of an anatomical plane that could be used to measure both the A-P and the lateral dimensions was tedious. Even when there was no true dilation of the anus, the lateral edges of the anal verge were slightly separated when the above plane was used to transcribe measurements.

The amount of traction applied to the buttocks and perianal tissues did influence the lateral dimensions of the anal orifice. Even without consciously attempting to open the anal canal, the examiners inadvertently applied varying amounts of traction, which caused a significant difference in the lateral diameters of the orifice. This was most evident in the older child, in whom it was necessary to spread the buttocks in order to visualize the anus.

Children who died of a CNS injury (Figs. 2, 4, 7, and 8) had an increased likelihood of having a dilated anus. The children who were severely brain damaged (Figs. 5 and 6) also were more likely to have a dilated anus at the time of their death. However, not all children who had sustained a CNS injury or who had a history of significant developmental delay had a dilated anal orifice. Similarly, there were subjects whose anus was dilated but had no history of a CNS injury (Figs. 3 and 9). Except for age, there were no other combinations of historical or physical findings that were of statistical significance when matched with the finding of anal dilation.

The findings in the 40 (62%) subjects with shallow anal canals and the 24 (37%) with exposure of the mucosa (Figs. 2 and 4), were consistent with the statement in Knight's textbook *Forensic Pathology*: "The inner mucosa is often visible . . . in the postmortem examination of the child" (1). The laxity of the sphincter muscles was also responsible for a smooth anal verge (77%) (Figs. 2–7) and the exposure of the pectinate line (59%) (Figs. 2–9).

FIG. 8. A 4-year-old white girl died of smoke inhalation in a house fire. Perianal tissues smooth with anterior perianal skin tag at 6 o'clock position. Pectinate line and anal canal columns visible. External anal verge diameter: 20 × 15 mm. Internal pectinate line diameter: 18 × 8 mm. Ampulla closed.

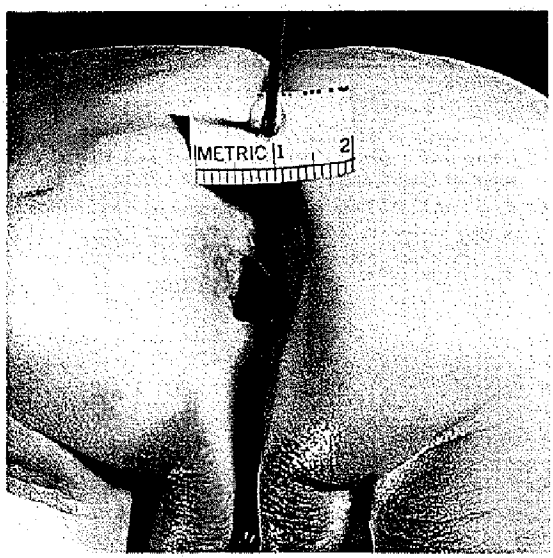

FIG. 9. A 2-month-old white girl died of sudden infant death syndrome (SIDS). Anal canal and rectal ampulla dilated. Smooth perianal area with funnel-like appearance. Shallow anal canal with pectinate (Z) line and anal canal mucosa visible. External anal verge diameter: 10 × 8 mm. Internal pectinate line diameter: 8 × 6 mm. Rectal ampulla opening: 8 × 6 mm.

Irregular (19%) and thickened (11%) folds were relatively uncommon (Fig. 7 and Table 2).

No true hemorrhoids, fissures, or scars were identified in any of the children. Two subjects had blood in their anal canals, and one had a perianal abrasion. All three were in accidents involving automobiles. Three other subjects had a peculiar V-shaped cleft in their anal verge at the 4 o'clock position. Despite this appearance in the photographs, the pathologists did not identify them as fissures. The only skin tags (9%) detected were in the midline (Fig. 9). A funnel-shaped appearance of the perianal tissues was discovered in one infant (Fig. 3) and in one older child. In neither case was there evidence of abuse.

CONCLUSION

Anal dilation was a common postmortem finding in these dead children. The anal sphincter muscle laxity, which produced the smooth perianal skin folds, was also responsible for a shallow anal canal. This led to the exposure of the pectinate line and the mucosa of the anal canal. At times, the irregularity of the pectinate line created an appearance similar to perianal fissures. Other common findings included fecal soiling, venous congestion, and increased pigmentation of the perianal tissues. In contrast, hemorrhoids, lacerations, fissures, and scars were not found in this population of subjects.

Although there are limitations of this study due to its methodology, it is suggested that anal dilatation alone cannot be used as a marker for prior sexual abuse. In addition, exposure of the pectinate line should not be confused with tears or fissures of the anal verge.

A study dealing specifically with the autopsy findings of children known to have been sodomized prior to death is needed to help identify the soft tissue changes that occur as a result of sexual abuse. However, based upon the results of this preliminary report, it is suggested that postmortem perianal findings must be interpreted with caution. Standards of normal are not yet firmly established.

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