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Morphological Spectrum of Hymenal Types Across Age Groups: An Autopsy-Based Cross-Sectional Study at a Tertiary Care Centre

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ABSTRACT

Background: The hymen exhibits wide physiologic variation across the life course, and its appearance is frequently over-interpreted in medico-legal contexts. **Objectives:** To describe age-wise patterns in hymenal configuration, hymenal integrity, and tear characteristics in female medicolegal autopsy cases. **Methods:** A cross-sectional study was conducted in the mortuary wing of the Department of Forensic Medicine, Government Medical College, Thiruvananthapuram, Kerala, India (May 2021–November 2022). Ninety female bodies subjected to medicolegal autopsy were examined. Hymenal morphology was classified as annular, fimbriate, crescentic, or infantile; cases with extensive disruption were recorded as not classifiable. Tears were documented by number, nature (fresh/healed), and clock-face position. **Results:** Young adults aged 21–30 years formed the largest group (26.7%). Overall, the hymen was torn in 78.9% and intact in 21.1%; all cases aged ≤10 years had an intact hymen. Fimbriate (31.1%) and annular (22.2%) patterns were the most frequent recognizable configurations, while 31.1% were not classifiable due to extensive tearing or residual tissue only. Among torn hymens, multiple tears predominated (88.7%) and healed tears were overwhelmingly common (98.6%). Tears most often involved multiple sites, followed by the 3–6 o'clock and 5–7 o'clock positions. **Conclusion:** Hymenal morphology shows clear age-related differences, and healed multi-site tears are common beyond childhood. Findings support cautious, age-contextual interpretation and precise descriptive documentation in forensic practice.

Keywords: Hymen; forensic medicine; autopsy; hymenal tears; morphology; age groups.

INTRODUCTION

The hymen is a thin mucosal fold at the vaginal introitus whose configuration reflects developmental anatomy and the surrounding hormonal environment. Across infancy, childhood, and reproductive years, the hymenal rim can be annular, crescentic, or fimbriated, and it can show normal variants such as tags, mounds, and shallow notches. In medico-legal settings, hymenal appearance is sometimes overused as a proxy marker of "virginity" or prior penetration. Contemporary evidence shows that this approach is unsound because a structurally "intact" hymen can coexist with prior sexual activity, while many non-assault mechanisms can produce tears or scars [1-4]. Misinterpretation can contribute to stigma, wrongful conclusions, and inconsistent court testimony [1-3].

An evidence-based interpretation of hymenal findings therefore requires a clear understanding of normal morphology at different ages. Studies in newborns and prepubertal girls have documented substantial physiologic variability, including configurations and minor variants that can be mistaken for trauma by inexperienced examiners [5,6]. Longitudinal observations during early childhood show that hymenal morphology changes with growth and estrogenization, and that infant configurations can evolve toward different patterns through later childhood [7,8]. These data underscore the need to interpret hymenal configuration and rim irregularities within age-appropriate norms rather than as isolated "signs."

Interpretation is further complicated by the natural healing of genital injuries. Longitudinal studies of anogenital trauma demonstrate that many injuries heal rapidly and that residual signs can be subtle or absent, especially when examinations

are delayed [10,12]. Case-control research also indicates that most genital features overlap between abused and non-abused children, with only specific deep injuries carrying higher diagnostic value [9]. Accordingly, recent interpretive updates stress meticulous description, standardized terminology, and cautious linkage of physical findings to alleged events [13,14]. In adults, obstetric stretching and vaginal delivery can leave healed tears and residual hymenal tissue that are expected rather than exceptional, making population description particularly relevant.

Autopsy examination offers an opportunity to document hymenal morphology under controlled conditions across a broad age spectrum. Medico-legal autopsies include adult women with diverse obstetric histories, allowing characterization of residual hymenal tissue, healed tears, and tear topography that are less frequently described in non-forensic cohorts. However, age-stratified descriptive data from medicolegal autopsy settings remain limited in many regions. The present study aimed to describe the morphological spectrum of hymenal types across age groups in female medicolegal autopsy cases and to document hymenal integrity (intact versus torn) along with the number, nature, and common positions of hymenal tears.

MATERIALS AND METHODS

Study design and setting: A cross-sectional autopsy-based study was conducted in the mortuary wing of the Department of Forensic Medicine, Government Medical College, Thiruvananthapuram, Kerala, India, from May 2021 to November 2022.

Participants and eligibility: All female bodies brought for medicolegal autopsy during the study period were considered for inclusion. Bodies with advanced decomposition, severe charring, or extreme mutilation involving the perineum that prevented reliable visualization of the hymen were excluded. Basic demographic details and available medicolegal history were recorded from the inquest and autopsy requisition documents. The study commenced after institutional ethics committee approval and was conducted in accordance with departmental medicolegal procedures.

Autopsy examination protocol: The external genital examination was performed prior to internal dissection. The body was placed in the supine frog-leg position, and the vulva was examined under adequate overhead illumination. The labia majora and labia minora were gently separated to visualize the vestibule and hymenal ring; traction was minimal to avoid artefactual splits. When required, saline-moistened gauze was used to remove surface contaminants without scraping the mucosa. The hymen was inspected circumferentially, and findings were recorded using standardized descriptive terminology. Tear location was mapped using a clock-face method with 12 o'clock as the anterior midline and 6 o'clock as the posterior midline.

Operational definitions: Hymenal integrity was categorized as intact or torn. Hymenal configuration was classified as annular, crescentic, fimbriate, or infantile based on the dominant rim pattern. When extensive tearing or only remnants of the hymenal rim were present, the configuration was labelled "type not ascertainable." Tears were described by number (single versus multiple, defined as ≥2 tears) and by nature as fresh or healed. Fresh tears were defined by recent mucosal disruption without epithelialization, whereas healed tears were defined by epithelialized clefts or scars with rounded or pale margins.

Data management and statistical analysis: Data were entered into a spreadsheet and checked for completeness and internal consistency. Categorical variables were summarized as frequencies and percentages. Age-wise distributions of hymenal integrity and hymenal configuration were examined using cross-tabulation. The analysis was primarily descriptive, aligned with the study objective of documenting the morphological spectrum; standardized documentation principles described in contemporary interpretive guidance informed reporting [13,14]. Age was grouped into predefined intervals.

Ethical considerations: The study involved medicolegal autopsy cases and was initiated after ethics committee clearance. No personal identifiers were included in the research dataset, and observations were confined to routine external examination and documentation performed during autopsy.

RESULTS

A total of 90 female medicolegal autopsy cases were examined to document age-wise variation in hymenal configuration and tear patterns. The age distribution is summarized in Table 1, with the highest proportion of cases in the 21–30-year group (26.7%).

Table 1. Age Distribution of the Study Population (N = 90)

Age group (years)	n (%)
≤10	5 (5.6)
11–20	18 (20.0)
21–30	24 (26.7)
31–40	14 (15.6)

41–50	14 (15.6)
51–60	9 (10.0)
>60	6 (6.7)
Total	90 (100)

Hymenal integrity varied markedly with age (Table 2). All cases aged ≤10 years had an intact hymen, while tears were common beyond childhood and accounted for 78.9% of the total study population.

Table 2. Status of Hymen by Age Group (N = 90)

Age group (years)	Intact n (%)	Torn n (%)	Total (n)
≤10	5 (100.0)	0 (0.0)	5
11–20	6 (33.3)	12 (66.7)	18
21–30	2 (8.3)	22 (91.7)	24
31–40	2 (14.3)	12 (85.7)	14
41–50	2 (14.3)	12 (85.7)	14
51–60	1 (11.1)	8 (88.9)	9
>60	1 (16.7)	5 (83.3)	6
Total	19 (21.1)	71 (78.9)	90

Overall distribution of hymenal configurations is presented in Table 3. Fimbriate (31.1%) and annular (22.2%) rims were the most frequent recognizable patterns. Crescentic hymen accounted for 13.4%, and infantile configuration was confined to children below 10 years. In 31.1% of cases, configuration could not be ascertained due to extensive disruption or residual tissue only.

Table 3. Distribution of Hymenal Types (N = 90)

Hymen type	n (%)
Annular	20 (22.2)
Fimbriate	28 (31.1)
Crescentic	12 (13.4)
Infantile	2 (2.2)
Type not ascertainable*	28 (31.1)
Total	90 (100)

*Type not ascertainable due to extensive tearing or residual hymenal tissue only.

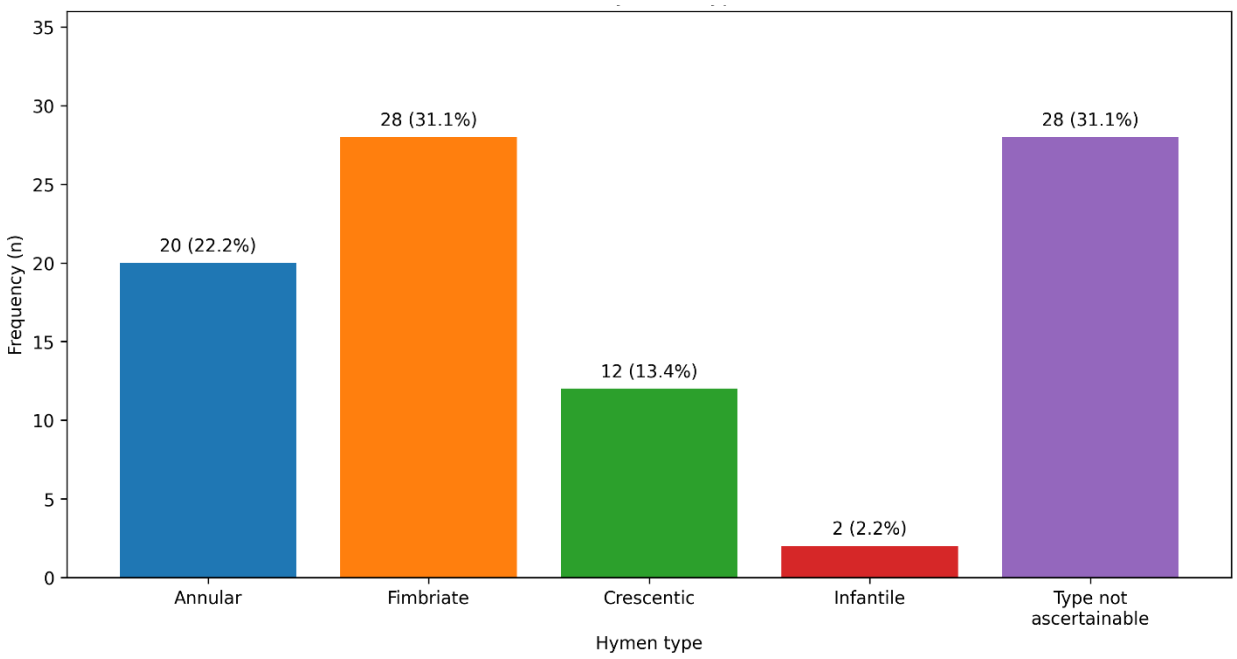

Figure 1: Distribution of Hymenal Types

Tear characteristics among the 71 cases with torn hymen are summarized in Table 4. Multiple tears (≥2) were observed in 88.7% and healed margins in 98.6%. Tears most often involved multiple sites (40.9%), followed by 3–6 o'clock (29.6%) and 5–7 o'clock (22.5%) positions.

Table 4. Characteristics of Hymenal Tears (n = 71)

Parameter	Category	n (%)
Number of tears	Single	8 (11.3)
Number of tears	Multiple (≥2)	63 (88.7)
Nature of tear	Fresh	1 (1.4)
Nature of tear	Healed	70 (98.6)
Position of tear	12–3 o'clock	1 (1.4)
Position of tear	3–6 o'clock	21 (29.6)
Position of tear	5–7 o'clock	16 (22.5)
Position of tear	6–9 o'clock	3 (4.2)
Position of tear	9–12 o'clock	1 (1.4)
Position of tear	Multiple sites	29 (40.9)

DISCUSSION

This autopsy-based cross-sectional study documents age-wise variation in hymenal morphology, integrity, and tear topography in a medicolegal setting. The sample contained a substantial proportion of young adults, which is consistent with the demographic profile of many autopsy caseloads, and it provided an opportunity to describe post-pubertal hymenal patterns that are less frequently captured in community cohorts. In the present series, all children aged ≤10 years had an intact hymen, whereas hymenal tearing predominated beyond childhood. This age gradient is biologically plausible and aligns with the concept that mechanical forces and life events accumulated after puberty progressively shape hymenal integrity.

Hymenal configuration showed a predominance of fimbriate and annular patterns among cases where typing was possible. Paediatric descriptive studies and longitudinal observations highlight that fimbriated and crescentic patterns are both common in normal populations and that configuration can shift with age and estrogenization [6-8]. The high proportion of "type not ascertainable" cases in the present series (approximately one-third) is an important practical finding: in adults, extensive tearing and residual rims frequently obscure a dominant configuration. Therefore, hymenal "type" can be less informative than careful description of remaining tissue and any scars, especially in reproductive age groups. This supports the approach recommended in interpretive updates, in which detailed description of the rim and any residual tissue is prioritized over categorical assumptions [13,14].

Hymenal integrity also requires careful contextualization. An intact hymen does not equate to absence of prior sexual activity, and consensual intercourse can occur without persistent disruption, particularly when penetration is limited or gradual [3,4]. Conversely, healed tears and scars are not synonymous with assault because childbirth, consensual intercourse, and other non-assault mechanisms can contribute to hymenal disruption [1-4]. This principle is reinforced by case-control work showing that most genital features overlap between abused and non-abused children, with only specific deep injuries showing stronger association with penetration [9]. Therefore, medico-legal opinions should integrate history, scene findings, and ancillary evidence rather than rely on hymenal appearance alone.

Tear characteristics in this study were notable for multiple tears in most cases and an overwhelming predominance of healed tears. Longitudinal studies of anogenital injuries demonstrate rapid mucosal healing and variable residual appearances, particularly when examinations occur after the acute window [10,12]. Although the present study is autopsy-based and includes adults, the same biological propensity for mucosal repair helps explain why fresh tears were uncommon. Tear mapping also showed frequent involvement of multiple sites and posterior/inferior sectors (3–6 o'clock and 5–7 o'clock), patterns that are compatible with stretching forces in obstetric events and introitus trauma. Overall, these findings support standardized, age-contextual documentation and cautious interpretation, consistent with contemporary guidance for forensic and clinical evaluators [13,14].

LIMITATIONS

Limitations include the single-centre autopsy population, which limits generalizability to community women. Detailed sexual and obstetric histories were not consistently available from medicolegal records, restricting attribution of tears to specific exposures. Extensive tearing rendered hymenal typing impossible in many adults, and classification relied on gross inspection without histopathology or inter-observer reliability testing. Time since last intercourse or delivery was unknown, constraining interpretation of tear acuity.

CONCLUSION

This autopsy-based cross-sectional study delineated age-related variation in hymenal integrity, configuration, and tear topography. Intact hymen was universal in children aged ≤10 years, whereas hymenal tearing predominated beyond childhood. When configuration remained identifiable, fimbriate and annular patterns were most frequent, with crescentic rims observed mainly in young adults. Among torn hymens, multiple tears and healed margins were the dominant patterns, and tears were commonly distributed across multiple sites or posterior/inferior sectors. These findings reinforce that hymenal morphology is strongly age- and life-event–dependent and should be interpreted cautiously, using standardized descriptive documentation and appropriate clinical–forensic context. Age-contextual autopsy data can support training, reduce misinterpretation, and improve the quality of medico-legal opinions.

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