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Pediatric Gynecological and Breast Surgical Lesions from Fetal Life to Early Adulthood: A Comprehensive Review

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Abstract

Objectives: To synthesise current evidence on congenital, developmental, infectious, neoplastic, and traumatic gynecological and breast lesions requiring surgical evaluation or intervention in girls from fetal life to 21 years, highlighting diagnostic pathways, operative indications, outcomes, and gaps in knowledge.

Design: Narrative review of published literature, clinical guidelines, and surgical series across pediatric gynecology, pediatric surgery, and adolescent medicine.

Data Sources: MEDLINE, Embase, Cochrane Library, and major pediatric surgical and gynecologic society guidelines.

Eligibility Criteria: Studies describing structural, functional, or neoplastic lesions of the female genital tract or breast in patients from fetal life to 21 years, with emphasis on conditions requiring surgical assessment or intervention.

Results: Lesions span five domains: congenital anomalies (e.g., Müllerian anomalies, ovarian cysts, cloacal malformations), developmental disorders (e.g., labial adhesions, breast asymmetry), infectious/inflammatory conditions (e.g., vulvar abscess, hidradenitis suppurativa), neoplastic lesions (benign and malignant ovarian, vulvar, vaginal, and breast tumours), and traumatic/iatrogenic injuries. Advances in fetal imaging, minimally invasive surgery, and fertility-preserving techniques have improved outcomes, yet diagnostic delays and fragmentation of care persist.

Conclusions: Pediatric gynecological and breast surgical lesions require age-specific diagnostic frameworks, multidisciplinary care, and long-term follow-up. Evidence remains limited for rare lesions, optimal timing of surgery, and long-term reproductive and psychosocial outcomes.

Keywords: Pediatric Gynecology; Breast Surgery; Congenital Anomalies; Ovarian Cysts; Müllerian Anomalies; Adolescent Health; Minimally Invasive Surgery

Summary Box

What is already known on this topic

- Pediatric gynecological and breast lesions span a wide developmental spectrum, from fetal ovarian cysts and congenital anomalies to adolescent breast masses and ovarian neoplasms.
- Most lesions in children and adolescents are benign, yet a subset requires timely surgical evaluation to prevent complications such as torsion, obstruction, infertility, or malignancy.
- Diagnostic pathways are often fragmented across pediatric surgery, gynecology, radiology, endocrinology, and oncology, contributing to delays in recognition and variability in management.
- Minimally invasive and fertility-preserving surgical techniques have become standard practice, but evidence guiding optimal timing and long-term outcomes remains limited.

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- Rare congenital and neoplastic lesions lack robust prospective data, and long-term reproductive, endocrine, and psychosocial outcomes are poorly documented.

What this review adds

- Provides the first fully integrated, age-stratified synthesis of all surgically relevant pediatric gynecological and breast lesions from fetal life through 21 years, bridging evidence across pediatric surgery, gynecology, radiology, oncology, and adolescent medicine.
- Maps the full developmental trajectory of lesions - congenital, developmental, infectious, neoplastic, and traumatic - highlighting how presentation, diagnostic pathways, and surgical indications evolve across childhood and adolescence.
- Clarifies contemporary surgical principles, including ovarian-sparing techniques, minimally invasive approaches, and fertility-preserving strategies, and identifies where practice variation persists.
- Identifies critical gaps in long-term reproductive, endocrine, oncologic, and psychosocial outcomes, providing a roadmap for future research and standardised outcome reporting.
- Offers practical diagnostic algorithms, risk-stratification frameworks, and management tables that can support clinicians in improving early recognition and coordinated multidisciplinary care.

Strengths and Limitations of this Study

Strengths

- Provides a comprehensive, age-stratified synthesis of gynecological and breast lesions requiring surgical evaluation from fetal life to early adulthood.
- Integrates evidence from pediatric surgery, gynecology, radiology, oncology, and adolescent medicine.
- Highlights diagnostic pitfalls, operative indications, and long-term considerations including fertility and psychosocial health.

Limitations

- Evidence base is limited for rare congenital and neoplastic lesions.
- Heterogeneity in study design and outcome reporting restricts meta-analysis.
- Long-term reproductive and quality-of-life outcomes remain poorly documented.

Introduction

This manuscript provides the first fully integrated, age-stratified synthesis of all surgically relevant gynecological and breast lesions in girls from fetal life through 21 years. It brings together evidence from pediatric surgery, pediatric and adolescent gynecology, radiology, oncology, and adolescent medicine to create a unified framework for understanding congenital, developmental, infectious, neoplastic, and traumatic lesions across the entire pediatric-adolescent continuum [1-22].

Pediatric gynecological and breast lesions encompass a wide spectrum of congenital, developmental, infectious, neoplastic, and traumatic conditions. Although many are benign, a subset requires timely surgical evaluation to prevent complications such as torsion, obstruction, infertility, or malignancy. The clinical presentation varies across developmental stages - from fetal detection of ovarian cysts to adolescent breast masses - necessitating age-specific diagnostic and therapeutic approaches [7, 8, 21].

Despite increasing recognition of pediatric gynecology as a subspecialty, care remains fragmented across pediatric surgery, gynecology, radiology, endocrinology, and oncology [12, 15, 16]. This review synthesises current knowledge on surgically relevant lesions from fetal life to age 21, emphasising diagnostic pathways, operative indications, outcomes, and research gaps.

Methods

Search Strategy

A narrative review approach was used. MEDLINE, Embase, and Cochrane Library were searched using terms related to pediatric gynecology, breast lesions, congenital anomalies, ovarian cysts, Müllerian anomalies, vulvar disease, and pediatric breast masses.

Inclusion Criteria

- Female patients from fetal life to 21 years
- Lesions requiring surgical evaluation or intervention
- English-language publications
- Clinical studies, case series, guidelines, and systematic reviews

Exclusion Criteria

- Purely medical (non-surgical) conditions
- Adult-only populations
- Non-clinical reports

Data Extraction

Data were grouped into five domains: congenital, developmental, infectious/inflammatory, neoplastic, and traumatic/iatrogenic lesions.

Results

Fetal and Neonatal Lesions

Gynecological issues can manifest as early as birth-neonatal mastitis, often driven by maternal hormone withdrawal. Temporary breast budding and nipple discharge in newborns are common due to maternal estrogen and typically require no surgery.

Fetal Ovarian Cysts:

- Most common antenatally detected gynecologic lesion.
- Simple cysts <40 mm often regress; complex or >50-60 mm risk torsion.
- Surgical options: postnatal laparoscopy, cyst aspiration, or cystectomy.

Ambiguous Genitalia / Disorders of Sex Development (DSD):

- Surgical intervention is increasingly deferred unless medically necessary.
- Requires multidisciplinary evaluation.

Cloacal and Urogenital Sinus Malformations:

- Complex anomalies requiring staged reconstruction.

Table 1. Congenital Gynecological Lesions in Girls: Presentation, Diagnosis, and Surgical Management

Condition	Typical Age	Key Clinical Features	Diagnostic Tools	Surgical Indications	Surgical Options
Fetal ovarian cysts	Fetal–neonatal	Abdominal mass, torsion risk	Prenatal US, postnatal US/MRI	Complex cyst, >50–60 mm, torsion	Laparoscopic cystectomy, aspiration
Imperforate hymen	Neonatal–adolescence	Hydrocolpos, cyclic pain, amenorrhea	Pelvic US, MRI	Obstruction, infection	Hymenotomy/ hymenectomy
Transverse vaginal septum	Childhood–adolescence	Cyclic pain, hematocolpos	MRI, exam under anesthesia	Obstruction	Septum resection
Müllerian agenesis (MRKH)	Adolescence	Primary amenorrhea, absent vagina	MRI, karyotype	Functional vaginal creation	Non-surgical dilation, vaginoplasty
Cloacal malformations	Neonatal	Single perineal opening, obstruction	US, MRI, cystoscopy	Universal	Staged reconstruction

Table 1: Congenital Gynecological Lesions in Girls: Presentation, Diagnostic Pathways, and Surgical Management. This table summarises the major congenital gynecological anomalies encountered from fetal life through adolescence, outlining typical age of presentation, key clinical features, recommended diagnostic imaging, and indications for surgical intervention. It highlights conditions such as fetal ovarian cysts, imperforate hymen, transverse vaginal septum, Müllerian agenesis, and cloacal malformations.

Table 2. Pediatric Breast Lesions: Differential Diagnosis and Surgical Approach

Lesion Type	Age Range	Key Features	Imaging	Indications for Surgery	Surgical Approach
Fibroadenoma	10–21 yrs	Mobile, firm mass	US	Rapid growth, >5 cm, deformity	Excision, enucleation
Juvenile hypertrophy	Early adolescence	Rapid unilateral/ bilateral enlargement	US/ MRI	Functional/ psychosocial impairment	Reduction mammoplasty
Breast cysts	Adolescence	Fluctuating mass	US	Persistent, symptomatic	Aspiration or excision
Phyllodes tumour	Adolescence	Rapid growth, lobulated mass	US/ MRI	All suspected cases	Wide local excision
Secretory carcinoma	Childhood–adolescence	Rare malignant tumour	US/ MRI	Universal	Breast-conserving surgery ± axillary staging

Table 2: Pediatric Breast Lesions: Differential Diagnosis, Imaging Characteristics, and Surgical Approach. This table provides an overview of common benign and rare malignant breast lesions in children and adolescents. It includes age distribution, characteristic clinical and imaging findings, and criteria for surgical management, with emphasis on fibroadenomas, juvenile hypertrophy, cysts, phyllodes tumours, and secretory carcinoma.

- Early imaging essential for surgical planning.

Congenital and Developmental Lesions

Müllerian Anomalies:

- Imperforate hymen, transverse vaginal septum, vaginal agenesis, uterine anomalies.
- Present with hydrocolpos, cyclic pain, or primary amenorrhea.
- Surgical correction aims to relieve obstruction and preserve

Table 3. Ovarian Masses in Children and Adolescents: Risk Stratification

Category	Examples	Tumour Markers	Imaging Features	Surgical Strategy
Benign	Dermoid cyst, simple cyst	Normal	Unilocular, avascular	Ovarian-sparing cystectomy
Intermediate	Borderline tumours	± CA-125	Papillary projections	Fertility-sparing resection
Malignant	Germ cell tumours, sex-cord stromal tumours	↑ AFP, β-hCG, LDH	Solid, vascular, ascites	Staging surgery, fertility-sparing when safe

Table 3: Ovarian Masses in Children and Adolescents: Risk Stratification and Surgical Strategy. This table categorises ovarian masses into benign, intermediate-risk, and malignant groups, summarising associated tumour markers, imaging features, and recommended surgical approaches. It emphasises ovarian-sparing techniques for benign lesions and fertility-preserving principles in malignant disease when oncologically appropriate.

Figure 1. Developmental Timeline of Pediatric Gynecological and Breast Lesions

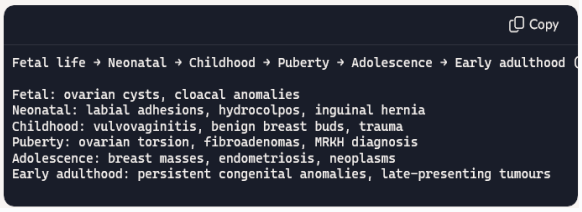

Figure 1: Developmental Timeline of Pediatric Gynecological and Breast Lesions from Fetal Life to Early Adulthood. This schematic illustrates the age-related distribution of key gynecological and breast lesions, mapping how congenital, developmental, infectious, neoplastic, and traumatic conditions emerge across fetal life, childhood, puberty, adolescence, and early adulthood.

Figure 2. Algorithm for Evaluation of an Adnexal Mass in Girls

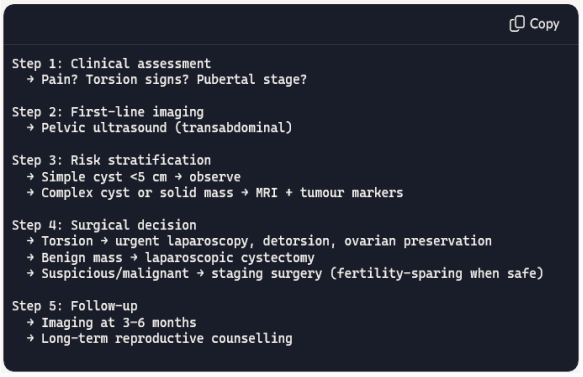

Figure 2: Diagnostic and Surgical Algorithm for Evaluation of an Adnexal Mass in Girls. This figure presents a stepwise clinical algorithm for evaluating adnexal masses in pediatric and adolescent patients, incorporating clinical assessment, first-line imaging, tumour marker evaluation, risk stratification, and indications for ovarian-sparing versus staging surgery.

fertility.

Ovarian and Adnexal Lesions:

- Functional cysts, torsion, benign tumours (dermoids).
- Ovarian-sparing surgery is standard when feasible.

Labial Adhesions:

- Usually managed medically; surgery reserved for refractory cases.

Inguinal Hernias and Canal of Nuck Cysts:

- More common in premature infants, one third resolve spontaneously so delayed repair
- Surgical repair recommended due to risk of incarceration.

Infectious and Inflammatory Lesions

Vulvar Abscesses and Bartholin-like Lesions:

- Bartholin glands are typically inactive prepubertally; abscesses often due to skin flora.
- Incision and drainage or marsupialisation may be required.

Hidradenitis Suppurativa:

- Rare before puberty but may require surgical excision in severe cases.

Lichen Sclerosus with Scarring:

- Surgery reserved for complications such as introital stenosis.

Neoplastic Lesions

Ovarian Tumours:

- 70-80% benign in children (e.g., teratomas).
- Malignant tumours include germ cell tumours and sex-cord stromal tumours.
- Fertility-sparing surgery is standard when oncologically safe.

Vaginal and Vulvar Tumours:

- Rhabdomyosarcoma is the most common malignant tumour.
- Management combines surgery with chemotherapy.

Breast Lesions:

- **Benign:** Premature thelarche, fibroadenomas, juvenile hypertrophy, cysts. Fibroadenomas: The most frequent breast mass in adolescents; surgical excision is reserved for large (>5 cm), rapidly growing, or symptomatic masses. Other Benign Conditions: Include phyllodes tumors (often benign in this age group but requiring complete resection), intraductal papillomas, and abscesses requiring incision and drainage. Endometriosis: Increasingly recognized in adolescents with chronic pelvic pain; surgical management emphasizes laparoscopic excision to improve quality of life.
- **Malignant:** Rare; includes secretory carcinoma and phyllodes tumours. Extremely Rare: Primary breast cancer is very rare (<0.02% of pediatric breast masses); other malignancies include sarcomas and metastatic disease.
- High-Risk Populations: Adolescents with a history of chest radiation for other cancers (e.g., Hodgkin lymphoma) have a significantly increased risk of early-onset breast cancer.
- Surgical indications include rapid growth, pain, deformity, or suspicion of malignancy.

Flowchart 1. Approach to Pediatric Vulvar and Vaginal Lesions

```
Presentation → (pain, discharge, mass, bleeding)
        ↓
Initial evaluation
  - History (trauma, infection, hygiene)
  - External exam only (non-invasive)
  - Consider safeguarding if indicated
        ↓
Is there infection?
  - Yes → treat medically
  - No → proceed to imaging
        ↓
Ultrasound findings
  - Cystic lesion → consider Bartholin-like cyst, Gartner duct cyst
  - Solid lesion → consider tumour (rare)
        ↓
Surgical indications
  - Abscess → incision & drainage
  - Obstruction → surgical correction
  - Tumour → biopsy/excision
```

Flowchart 1: Clinical Approach to Pediatric Vulvar and Vaginal Lesions. This flowchart outlines a structured approach to evaluating vulvar and vaginal complaints in children and adolescents, including initial assessment, safeguarding considerations, imaging pathways, and indications for surgical intervention in cystic, infectious, obstructive, or neoplastic lesions.

Flowchart 2. Evaluation of Breast Masses in Children and Adolescents

```
Breast mass detected
        ↓
Clinical exam
  - Size, mobility, tenderness
  - Pubertal stage
        ↓
Ultrasound (first-line)
  - Cystic → aspiration if symptomatic
  - Solid → characterize margins, vascularity
        ↓
Risk assessment
  - Typical fibroadenoma → observe or excise if >5 cm
  - Rapid growth → excision
  - Suspicious features → core biopsy
        ↓
Management
  - Benign → excision or observation
  - Phyllodes → wide local excision
  - Malignant → multidisciplinary oncology pathway
```

Flowchart 2: Evaluation and Management Pathway for Breast Masses in Children and Adolescents. This flowchart summarises the recommended diagnostic pathway for pediatric breast masses, including clinical examination, ultrasound-based risk stratification, criteria for observation versus biopsy, and surgical indications for benign, borderline, and malignant lesions.

Traumatic and Iatrogenic Lesions

Genital Trauma:

- Accidental injuries, straddle trauma, and lacerations.
- Surgical repair required for deep or bleeding injuries.

Sexual Assault-Related Injuries:

- Surgical intervention is rare but may be required for severe lacerations.
- Forensic and safeguarding pathways essential.

Iatrogenic Lesions:

- Post-operative adhesions, scarring, or complications from prior surgery.

Discussion

Pediatric gynecological and breast surgical lesions encompass a wide spectrum of conditions, ranging from congenital anomalies detected in fetal life to neoplasms in early adulthood [7, 8, 14, 16]. While most lesions in this population are benign, surgical intervention often focuses on organ preservation to safeguard future fertility and development [1, 4, 12].

The review offers several unique contributions:

- A developmental timeline mapping how lesion types and presentations evolve from fetal life to early adulthood [7, 8, 21].
- Practical diagnostic algorithms, risk-stratification tables, and management flowcharts to support clinical decision-making [1, 12, 13].
- A synthesis of contemporary surgical principles, including minimally invasive and fertility-preserving approaches [4, 12, 18].
- Identification of critical gaps in long-term reproductive, endocrine, oncologic, and psychosocial outcomes, highlighting priorities for future research [10, 11, 14].

This review highlights the breadth of pediatric gynecological and breast lesions requiring surgical evaluation. Several themes emerge:

Age-Specific Presentation

Lesions vary dramatically across developmental stages, necessitating tailored diagnostic frameworks [7, 8, 16, 21].

Importance of Imaging

Ultrasound remains first-line; MRI is increasingly used for Müllerian anomalies and complex masses [1, 7, 10, 11].

Fertility Preservation

A central principle in ovarian and Müllerian surgery, supported by minimally invasive techniques [4, 12, 13].

Psychosocial Considerations

Body image, sexual development, and trauma-related distress require integrated psychological support [15, 16, 18].

Evidence Gaps

- Long-term reproductive outcomes after pediatric gynecologic surgery [10, 11].
- Optimal timing of surgery for congenital anomalies [7, 8, 20].
- Standardised reporting of outcomes in rare tumours [14, 15].

This review underscores the need for age-specific diagnostic frameworks, multidisciplinary collaboration, and integrated models of care that address both medical and psychosocial dimensions [12, 15, 16, 22]. Future research should prioritise prospective studies, standardised outcome reporting, and long-term follow-up into adulthood to better understand reproductive, endocrine, oncologic, and quality-of-life trajectories [10, 11, 14]. Strengthening education and awareness among clinicians, caregivers, and adolescents will be essential to improving early recognition and ensuring equitable access to specialised pediatric gynecologic and breast care [12, 15, 22].

Key Surgical Principles

- Tissue Preservation: Surgery must prioritize preserving the developing breast bud and the "shared ovary" to maintain endocrine function and future fertility [1, 4, 12, 16].
- Minimally Invasive Approaches: Laparoscopy is the standard for gynecological procedures to reduce recovery time and scarring [4, 12].
- Multidisciplinary Care: Management of complex anomalies or rare malignancies requires a team approach involving pediatric surgeons, gynecologists, oncologists, and specialists in fertility preservation [10, 11, 14, 20].

Pediatric gynecological and breast surgical lesions span a broad continuum from fetal life through early adulthood, encompassing congenital anomalies, developmental conditions, infectious and inflammatory disorders, neoplastic processes, and traumatic injuries [7, 8, 14, 16, 19]. Although many lesions are benign, a significant proportion require timely surgical evaluation to prevent long-term morbidity, preserve reproductive potential, and support healthy physical and psychosocial development [1, 4, 12, 15]. Advances in fetal imaging, minimally invasive surgery, and fertility-preserving techniques have transformed management [7, 12, 18], yet persistent challenges remain - including diagnostic delays, variability in care pathways, and limited long-term outcome data [10, 11, 14, 22].

Conclusion

Pediatric gynecological and breast lesions encompass a diverse range of congenital, developmental, infectious, neoplastic, and traumatic conditions. Early recognition, multidisciplinary care, and fertility-preserving surgical principles are essential. Future research should prioritise long-term outcomes, patient-centred measures, and standardised surgical reporting to improve care across this age spectrum.

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