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Robotic-Assisted Surgery for Adnexal and Ovarian Pathologies in Patients Under 18 Years: A Systematic Review and Single-Arm Meta-Analysis

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ADMINISTRATIVE INFORMATION

Support - No support.

Review Stage at time of this submission - Completed but not published.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 26 June 2026 and was last updated on 26 June 2026.

INTRODUCTION

Review question / Objective Objective: To identify and synthesise all available procedure-level outcomes of robotic-assisted adnexal or ovarian surgery in female patients under 18 years, and to determine whether the technique is reliably feasible, whether ovarian preservation is consistently achievable, and whether the current evidence supports broader clinical adoption.

PICOS:

Population: Female patients younger than 18 years with adnexal or ovarian pathology (pure <18 series, or mixed-age series with an independently extractable <18 subgroup).

Intervention: Robotic-assisted laparoscopic adnexal or ovarian surgery on any robotic platform (e.g. da Vinci Si/Xi/SP, Versius, Hugo RAS).

Comparator: None required (single-arm design); where a study compared robotics with conventional laparoscopy, the robotic-arm data were extracted separately.

Outcomes: Conversion to laparotomy; intra- and post-operative complications (Clavien–Dindo); ovarian preservation (ovary-sparing vs oophorectomy/salpingo-oophorectomy/gonadectomy); operative time; operating-room setup/docking time; length of stay; recurrence at last follow-up.

Study designs: Retrospective and prospective case series, retrospective cohorts, and comparative observational studies. Case reports (n<3) and registry abstracts without outcome data were excluded from the synthesis (retained for reference mining only).

Rationale Adnexal and ovarian pathology is the most common gynecologic surgical indication in the pediatric and adolescent population, including functional cysts, mature and immature teratomas, cystadenomas, paratubal/parovarian cysts, ovarian torsion, and gonadal pathology associated with disorders of sex development. Surgical management aims to eradicate pathology while maximising ovarian tissue preservation, given the lifelong fertility and endocrine implications.

Minimally invasive surgery is the default approach, and laparoscopic ovary-sparing cystectomy is recommended for benign masses. Robotic-assisted laparoscopic surgery entered pediatric practice in the early 2000s, offering tremor filtration, three-dimensional magnified visualization, and wristed instrument articulation that may be advantageous in the confined pelvis of younger or smaller patients. Robotic platforms have been progressively adopted for pediatric urology, general surgery, and increasingly pediatric gynecology, but the evidence base remains limited to single-centre series.

To our knowledge, no published aggregate analysis has pooled procedure-level outcomes of robotic-assisted adnexal surgery restricted to patients under 18 years. Existing publications either address pediatric robotic surgery in general or the entire robotic gynecologic portfolio without an age-restricted analysis, and ovarian-preservation proportions have never been quantitatively synthesised in this population. A single-arm meta-analytic approach is validated in adjacent pediatric domains but has not been applied to adolescent gynecologic robotics. This review addresses that gap.

Condition being studied Adnexal and ovarian pathology in female children and adolescents (under 18 years) requiring surgical management. This encompasses benign and malignant ovarian masses – mature and immature cystic teratomas (dermoid cysts), serous and mucinous cystadenomas, functional/physiologic ovarian cysts, and germ-cell tumours – as well as paratubal and parovarian cysts, fallopian-tube lesions, ovarian torsion, and gonadal pathology associated with disorders of sex development (gonadal dysgenesis, ovotestis, Turner syndrome with Y-chromosome material).

In this population the principal therapeutic tension is between complete removal of pathology and preservation of ovarian tissue, because oophorectomy carries lifelong fertility and endocrine consequences. The condition is therefore studied specifically in the context of the surgical approach (robotic-assisted laparoscopy) and its procedure-level outcomes – conversion, complications, ovarian preservation, operative time, length of stay, and recurrence.

METHODS

Search strategy Five bibliographic databases were searched on 21 June 2026 with no date or language restrictions: PubMed/MEDLINE, Embase (Ovid/Emtree), Cochrane CENTRAL, Scopus, and Web of Science Core Collection. Supplementary

sources: CNKI, Google Scholar (first 200 results per query), ClinicalTrials.gov and WHO ICTRP, backward/forward citation chasing of all included studies, conference proceedings (2018–2026), and multilingual gray literature (Spanish, Italian, Portuguese, Chinese, Turkish). Each search combined three concept blocks with AND – (1) robotic surgery, (2) adnexal/ovarian pathology, (3) pediatric/adolescent population – adapted to each database's syntax.

PubMed/MEDLINE string:

("Robotic Surgical Procedures"[Mesh] OR "Robotics"[Mesh] OR robotic*[tiab] OR "robot-assisted"[tiab] OR "da Vinci"[tiab] OR daVinci[tiab] OR RALS[tiab]) AND ("Adnexa Uteri"[Mesh] OR "Ovary"[Mesh] OR "Ovarian Cysts"[Mesh] OR "Ovarian Neoplasms"[Mesh] OR "Fallopian Tubes"[Mesh] OR adnexa*[tiab] OR ovar*[tiab] OR "ovarian cyst*" [tiab] OR "ovarian mass*" [tiab] OR teratoma*[tiab] OR oophorectom*[tiab] OR "salpingo-oophorectomy" [tiab] OR cystectomy[tiab] OR paratubal[tiab] OR "fallopian tube"[tiab] OR salpingectom*[tiab] OR torsion[tiab]) AND ("Child"[Mesh] OR "Adolescent"[Mesh] OR "Pediatrics"[Mesh] OR pediatric*[tiab] OR paediatric*[tiab] OR adolescen*[tiab] OR child*[tiab] OR girl*[tiab] OR teenage*[tiab] OR juvenile[tiab])

Full Embase (Emtree), Scopus/Web of Science (TS-equivalent), and Cochrane CENTRAL strings are provided in Supplementary Appendix S1.

Participant or population Female patients younger than 18 years with adnexal or ovarian pathology requiring surgical management. Eligible pathologies include functional/physiologic ovarian cysts, mature and immature cystic teratomas, serous and mucinous cystadenomas, germ-cell and other ovarian neoplasms, paratubal and parovarian cysts, fallopian-tube lesions, ovarian torsion, and gonadal pathology associated with disorders of sex development (gonadal dysgenesis, ovotestis, Turner syndrome with Y-chromosome material). Both pure under-18 series and mixed-age series with an independently extractable under-18 subgroup are eligible. There is no restriction on country, care setting, or robotic platform.

Intervention Robotic-assisted laparoscopic adnexal or ovarian surgery performed on any robotic platform (e.g. da Vinci Si, Xi, or SP; Versius; Hugo RAS). Eligible procedures include ovarian cystectomy and ovary-sparing tumour excision, oophorectomy, salpingo-oophorectomy, gonadectomy, salpingectomy, and paratubal/parovarian cyst excision. Studies are eligible if at least one procedure-level outcome is reported (conversion to laparotomy, Clavien–Dindo

complications, ovarian preservation versus oophorectomy, operative time, operating-room setup/docking time, length of stay, or recurrence). No restriction is placed on platform model, generation, or surgical indication within the adnexal/ovarian spectrum.

Comparator None required. This is a single-arm review: the primary synthesis pools procedure-level proportions and continuous outcomes from robotic-only data, with no comparator necessary for inclusion. Where a study additionally compared robotic-assisted surgery with conventional laparoscopy (or another approach), the robotic-arm data were extracted separately for the single-arm pool, and the head-to-head comparison was summarised narratively. No meta-analytic robotic-versus-laparoscopic effect estimate was pre-specified, given the small number of comparative studies.

Study designs to be included Retrospective and prospective case series, retrospective cohort studies, and comparative observational studies (robotic versus laparoscopic) reporting robotic-arm data separately. Case reports and series with fewer than three eligible cases, reviews, editorials, guidelines, and trial-registry records without published outcome data are excluded from synthesis (retained for reference mining only). No randomised trials exist in this field.

Eligibility criteria Inclusion: female patients <18 years (pure <18 series or extractable <18 subgroup); adnexal or ovarian pathology; robotic-assisted adnexal/ovarian surgery on any platform; at least one procedure-level outcome reported; full papers or conference abstracts with extractable outcome data.

Exclusion: adult-only series with no extractable <18 subgroup; non-adnexal pediatric robotic surgery (urologic, gastrointestinal, isolated Müllerian/urogenital-sinus reconstruction without adnexal component); non-robotic minimally invasive or open surgery; reviews, editorials, and guidelines without primary data; fewer than three eligible cases; registered trials without published outcomes. No date or language restriction.

Information sources Five bibliographic databases were searched on 21 June 2026 with no date or language restrictions: PubMed/MEDLINE, Embase (Ovid/Emtree), Cochrane CENTRAL, Scopus, and Web of Science Core Collection. Supplementary sources included CNKI; Google Scholar (first 200 results per query); the ClinicalTrials.gov and WHO ICTRP trial registries; backward and forward citation chasing of all included studies; pediatric

surgical and gynecological conference proceedings (2018–2026); and multilingual gray literature in Spanish (SciELO, LILACS, Dialnet), Italian, Portuguese (SciELO Brazil), Chinese (CNKI), and Turkish (Dergipark). A pre-submission update of the search was run in June 2026. Full strings for every database are recorded in the search-strategy appendix.

Main outcome(s) Primary outcomes (procedure-level):

(1) Conversion to laparotomy — proportion of robotic procedures converted to open surgery.

(2) Major postoperative complications — Clavien–Dindo grade IIIa or higher, as a proportion of procedures.

Both are reported as crude pooled proportions with Wilson 95% confidence intervals. Timing: intraoperative (conversion) and the in-hospital/early postoperative period (complications) as defined by each source study. No minimum follow-up was imposed for these outcomes.

Additional outcome(s) (1) Ovarian preservation — ovary-sparing procedures as a proportion of evaluable benign-indication cases; pooled both crude (Wilson 95% CI) and with a random-effects (logit-transformed) model, with I^2 for heterogeneity.

(2) Any complication — Clavien–Dindo grade I or higher, as a pooled proportion.

(3) Operative time — median or mean minutes per study, summarised descriptively (clinical and reporting heterogeneity precluded pooling).

(4) Operating-room setup / docking time — minutes, where reported.

(5) Length of stay — days, descriptively.

(6) Recurrence — at last reported follow-up, as a proportion of evaluable cases.

(7) Robotic versus laparoscopic comparison — narrative synthesis of head-to-head studies (operative time, complications, conversion, ovarian sparing, opioid use).

Pre-specified sensitivity analyses: random-effects models for the binary safety outcomes, a cohort-overlap-excluded re-estimate of ovarian preservation, and assessment for small-study effects.

Data management Records from all sources were imported into a reference manager, de-duplicated, and screened against the eligibility criteria by two independent reviewers at title/abstract and full-text stages, with disagreements resolved by discussion. Data were extracted into a standardised, piloted spreadsheet capturing study identifiers, design, population, platform, procedures, and all pre-specified outcomes. Extracted data and the analysis code are

maintained in a project repository to support reproducibility.

Quality assessment / Risk of bias analysis

Methodological quality was assessed with the Joanna Briggs Institute (JBI) critical-appraisal checklist for case series (10 items), applied at study level by two reviewers independently, with disagreements resolved by discussion. Each item was rated as “yes,” “unclear,” or “no,” and ratings were summarised in a traffic-light figure rather than collapsed into a single numeric score. Because the evidence base comprises small retrospective series, the overall certainty of evidence for each pooled outcome was additionally graded with the GRADE approach, starting at low certainty for observational data and downgraded further for imprecision, indirectness, or risk of bias as appropriate. Publication bias was considered but not formally tested with funnel-plot asymmetry, as the number of studies per outcome was below the threshold at which such tests are interpretable.

Strategy of data synthesis Binary procedure-level outcomes (conversion, major complications, any complication, ovarian preservation, recurrence) were pooled as proportions. The primary synthesis used crude pooled proportions — events summed across studies divided by total procedures — with Wilson 95% confidence intervals, an approach robust to the zero-event and sparse-data structure typical of this literature. For ovarian preservation, which carried sufficient between-study variation, a random-effects meta-analysis of proportions was additionally performed using the logit transformation with DerSimonian–Laird estimation of between-study variance; heterogeneity was quantified with I^2 and τ^2 . The Freeman–Tukey double-arcsine transformation was considered but not used as the primary model because of its known back-transformation instability for sparse and zero-cell data.

Continuous outcomes (operative time, operating-room setup/docking time, length of stay) were summarised descriptively as study-level medians or means, without pooling, because of clinical and reporting heterogeneity (mixed median/mean reporting, variable inclusion of docking time, differing case mix). The two comparative robotic-versus-laparoscopic studies were synthesised narratively. Results are reported in accordance with PRISMA 2020. All proportion calculations and confidence intervals were computed in Python (NumPy/SciPy); analysis code is retained for reproducibility.

Subgroup analysis Formal subgroup meta-analysis was not pre-specified because the

number of studies per outcome is small and would not support statistically meaningful subgroup contrasts. Pre-planned descriptive subgroup considerations, examined narratively where data permitted, were: (1) pure under-18 series versus mixed-age series with an extractable under-18 subgroup; (2) full-text studies versus abstract-only/conference reports (handled through the primary, abstract-confirmed, and sensitivity pool structure); and (3) benign versus malignant or disorder-of-sex-development indications for the ovarian-preservation outcome, since preservation is clinically expected only in benign-indication cases.

Sensitivity analysis Pre-specified sensitivity analyses were: (1) a random-effects (logit-transformed) re-estimate of the binary safety outcomes (major and any complication) to test robustness of the crude primary estimates against a continuity-correction-based model; (2) re-estimation of the ovarian-preservation proportion after excluding studies with potential cohort overlap from the same institutional network, to confirm the pooled estimate is not driven by overlapping patients; and (3) restriction of each outcome to full-text-verified studies, excluding abstract-only contributors, to assess the influence of incompletely reported reports. Small-study effects were assessed qualitatively given that the number of studies per outcome was below the threshold for reliable funnel-plot or Egger testing. Agreement between the primary crude proportions and the random-effects estimates was interpreted as evidence of robustness.

Language restriction No language restriction was applied; records in any language were eligible. Non-English studies were screened and extracted with native-speaker support or professional translation where required.

Country(ies) involved Turkey — all review authors are affiliated with İstinye University, Istanbul, Turkey. The included primary studies originate from multiple countries across Europe and Asia.

Other relevant information This is a single-arm (one-group) systematic review and proportional meta-analysis; no comparator is required for inclusion, and the primary synthesis pools procedure-level proportions of robotic-only data. To handle variable full-text availability transparently, included studies are organised into a primary pool (full-text, completely extractable), abstract-confirmed contributors (peer-reviewed reports with outcome data confirmable from the abstract/record), and a sensitivity pool (small series, $n=3-4$). The overall certainty of evidence is

expected to be low to very low (GRADE) given the retrospective, single-centre nature of the available studies; conclusions will be framed accordingly and will not assert superiority over laparoscopy. Screening and extraction are performed in duplicate by two reviewers, with disagreements resolved by discussion. No external funding was received, and the authors declare no competing interests. The review is intended for submission to a peer-reviewed surgical journal. Any amendment to this protocol after registration will be documented and dated in the final report.

Keywords Robotic surgery; Pediatric; Adolescent; Ovarian cyst; Teratoma; Adnexal mass; Ovarian preservation; Meta-analysis.

Dissemination plans Findings will be submitted for publication in a peer-reviewed journal (target: Journal of Robotic Surgery) and presented at relevant pediatric surgery and gynecologic oncology meetings. The extraction dataset and analysis code will be deposited in an open-access repository to support reproducibility.

Contributions of each author

Author 1 - Serhat Sen - conceived and designed the review, developed the search strategy, performed study screening and data extraction, conducted the statistical analysis, and drafted and revised the manuscript.

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Author 2 - Feyza Gulgel Sen - performed independent duplicate study screening and data extraction, contributed to risk-of-bias assessment, and critically revised the manuscript for important intellectual content.

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