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Review

Third Molar Germectomy in Children and Adolescents: An Update

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Abstract

Background/Objectives: Germectomy is the surgical removal of a developing third molar, usually before one-third of its root has formed. In children and adolescents, it is performed mainly for orthodontic reasons, without an established advantage over retention or later removal. This review summarizes clinical studies published in 2016–2026. Methods: English-language studies from PubMed, Scopus and Web of Science were synthesized narratively, graded with the Strength of Recommendation Taxonomy (SORT) and assessed for risk of bias. Results: Of the 77 records, 14 studies with 654 germectomies were included, and four of them were randomized trials; none reached SORT level 1, and no comparative study was at low risk of bias. The definitions and the staging criteria varied; five studies did not report the developmental stage. The indications were mostly orthodontic, but in the only randomized comparison with retention, germectomy did not shorten the uprighting of impacted second molars. Delayed-onset infection, the most frequent complication, followed 9.2% of 218 germectomies in the largest series and appeared 2–8 weeks after surgery, when seven studies had ended follow-up. Three other studies reported complications after 3.6–4.5% of germectomies; where specified, none was a nerve injury. Pain and oral health-related quality of life were assessed only in the first postoperative week, when pain peaked in the first days. Two maxillary case reports described germ displacement and late partial tooth formation. Conclusions: Germectomy rarely causes serious complications, but its orthodontic benefit is unproven. Families should expect pain in the first days and possible infection weeks later. Prospective comparisons of germectomy and monitoring of the germ, with standardized staging and follow-up of at least one year, should test the orthodontic indication.

Keywords: germectomy; third molar; tooth germ; tooth extraction; impacted tooth; postoperative complications; child; adolescent

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1. Introduction

The third molar is the last tooth of the permanent dentition to form, with calcification beginning at a mean age of about 10 years and closure of the root apex at about 22 years [1]. Its development therefore extends from late childhood to early adulthood, and for most of adolescence the tooth exists as a germ, with a crown in formation and little or no

root. Germectomy is the surgical removal of the third molar at this stage, and most authors reserve the term for a tooth that has formed no more than one-third of its root [2]. The procedure has also been defined by the age of the patient, as the removal performed between 9 and 16 years, in contrast with the delayed removal of the tooth in older patients [3]. The presence and the position of the third molar vary widely between individuals. Third molar agenesis has an estimated worldwide prevalence of 22.6% [4]. Impaction is even more frequent, since 36.9% of individuals have at least one impacted third molar, most often in the mandible [5]. This condition is not always permanent, as one-third of the third molars that are impacted at 18 years erupt fully by the age of 26 [6]. The third molar is also a frequent source of disease. Among the permanent teeth, it has the highest incidence of pericoronitis and odontogenic space infections [7]. An impacted mandibular third molar increases the risk of caries on the distal surface of the adjacent second molar, especially when it is mesioangular or horizontal [8]. Cysts and odontogenic tumors can develop around impacted mandibular third molars, although they are rare and become more frequent with age [9].

Germectomy aims to remove the teeth before these conditions appear and at an age when surgery is better tolerated. Recovery after third molar surgery is slower in patients aged 21 years or older than in younger patients [10]. Increasing age is also a risk factor for injury to the inferior alveolar and lingual nerves [11]. In a mandibular germ, the root has barely begun to form and contact with the mandibular canal is less frequent at 12–13 years and before root formation begins [12]. The indications reported for germectomy are mainly orthodontic, infective or cariogenic, and prophylactic, but none of them is yet supported by sufficient evidence in patients of developmental age [13]. The uncertainty about germectomy reflects a wider uncertainty about the management of third molars. For asymptomatic, disease-free impacted third molars, the available evidence is insufficient to choose between removal and retention, and the decision rests on clinical judgment and on the preferences of the patient [14]. The comparison between germectomy and delayed removal is based on few heterogeneous studies, which do not show a clear benefit of preventive removal [15]. Early removal is not supported either as a way to preserve the stability of orthodontic treatment, since no clear association has been found between mandibular third molars and the relapse of incisor crowding [16]. Even the definition of germectomy is not uniform, because criteria based on root development and on age are used in different studies. The decision to remove a germ is taken at an age when its future eruption cannot be predicted, whereas an impacted third molar may still erupt in early adulthood.

Earlier reviews answered narrower questions. The systematic review of germectomy and delayed removal cited above included four articles, and the review of the clinical indications for germectomy included eight studies, with searches closed in 2019 and 2021, respectively. A systematic review published in 2026, limited to mandibular third molars, pooled comparative observational studies and found a lower risk of inferior alveolar nerve injury and of overall complications after germectomy than after delayed extraction, with limited certainty of evidence [17]. None of these reviews included case reports or case series, which describe how germs are staged and removed in practice and report rare adverse events that small comparative studies cannot detect.

The aim of this narrative review was to summarize the published clinical studies on third molar germectomy in the last ten years, with three objectives: to describe how germectomy is defined and at which developmental stage and age it is performed; to summarize indications, surgical management, postoperative outcomes and complications in children and adolescents; and to identify gaps in the evidence that future studies in growing patients should address.

2. Materials and Methods

2.1. Literature Search

This review is based on a structured search of PubMed, Scopus and Web of Science. The last search was run on 25 September 2026, and the only filter applied was the publication year, limited to 2016–2026. This ten-year window was chosen to describe current practice and to cover the studies published after the searches of the earlier reviews. The PubMed query was as follows:
(germectomy OR ((Early tooth extraction OR prophylactic tooth germ removal) AND (tooth germ OR tooth bud))) AND ("third molar" OR "wisdom tooth" OR "wisdom teeth")

In Scopus, the same string was applied to titles, abstracts and keywords (TITLE-ABS-KEY), and, in Web of Science, to the topic field (TS).

2.2. Eligibility Criteria

Studies were eligible if they reported on germectomy of third molars in human patients and had been published in English between 2016 and 2026 with the full text available. For inclusion, germectomy was defined as the surgical removal of a developing third molar, with incomplete root formation, that the authors identified as a germ or bud. The staging criterion of each study was recorded as reported, and when a study also included teeth at later stages of development, only teeth classified as germs were counted as germectomies, and other teeth were used only as comparison groups. Case reports, case series, randomized clinical trials and observational studies (cross-sectional, case–control and cohort) were accepted. Exclusion criteria were in vitro or non-human studies; languages other than English; secondary studies, reviews and meta-analyses; conference abstracts and preprints; unavailable full text; and articles not pertinent to the topic or with insufficient information on germectomy. Information was considered insufficient when the removed teeth could not be identified as germs or when no patient data or outcome could be attributed to germectomy.

2.3. Study Selection

After removal of duplicate records, Z.H.H. and D.L. screened titles and abstracts independently. Records were excluded when both reviewers judged them ineligible; when the reviewers disagreed, S.C. made the decision. The full texts of the remaining records were then checked against the eligibility criteria by A.B. and G.C.; disagreements were resolved by a third author, S.C. The selection process is summarized in a flow diagram adapted from PRISMA 2020 [18] (Figure 1).

2.4. Data Extraction and Risk of Bias

The recorded data of each study were as follows: patients, age, sex, arch, developmental stage, indication, anesthesia, surgical technique, perioperative drugs, outcomes, instruments, follow-up, main results and limitations. For the randomized trials, the non-randomized comparisons and the cohorts, the design features related to internal validity were also recorded: generation and concealment of the allocation sequence, blinding, sample size calculation, completeness of follow-up and exclusion after enrolment. Data were extracted manually by two authors (A.B. and Z.H.H.). Each study was assigned a level of evidence according to the Strength of Recommendation Taxonomy (SORT) [19]. Level 1 requires good-quality patient-oriented evidence, such as a randomized trial with concealed allocation, blinding where possible, intention-to-treat analysis, adequate statistical power and follow-up of more than 80% of patients. Lower-quality trials, cohort studies and case–control studies are level 2. Case series and studies

limited to disease-oriented outcomes are level 3, the level also assigned to case reports. Single-arm cohorts that reported patient-oriented outcomes were graded as cohort studies, and the histological series as a case series.

Risk of bias was assessed independently by two authors (Z.H.H. and A.B.), and disagreements were resolved by a third author (S.C.). The randomized trials were assessed with the revised Cochrane tool (RoB 2) [20] and the non-randomized comparative studies with the Risk Of Bias In Non-Randomized Studies of Interventions tool (ROBINS-I) [21], each for its main outcomes. The single-arm cohorts and the histological series had no comparison group and were appraised with the JBI checklist for case series [22]; the case reports were appraised with the JBI checklist for case reports [23]. For the JBI checklists, the number of items met is reported, without an overall score.

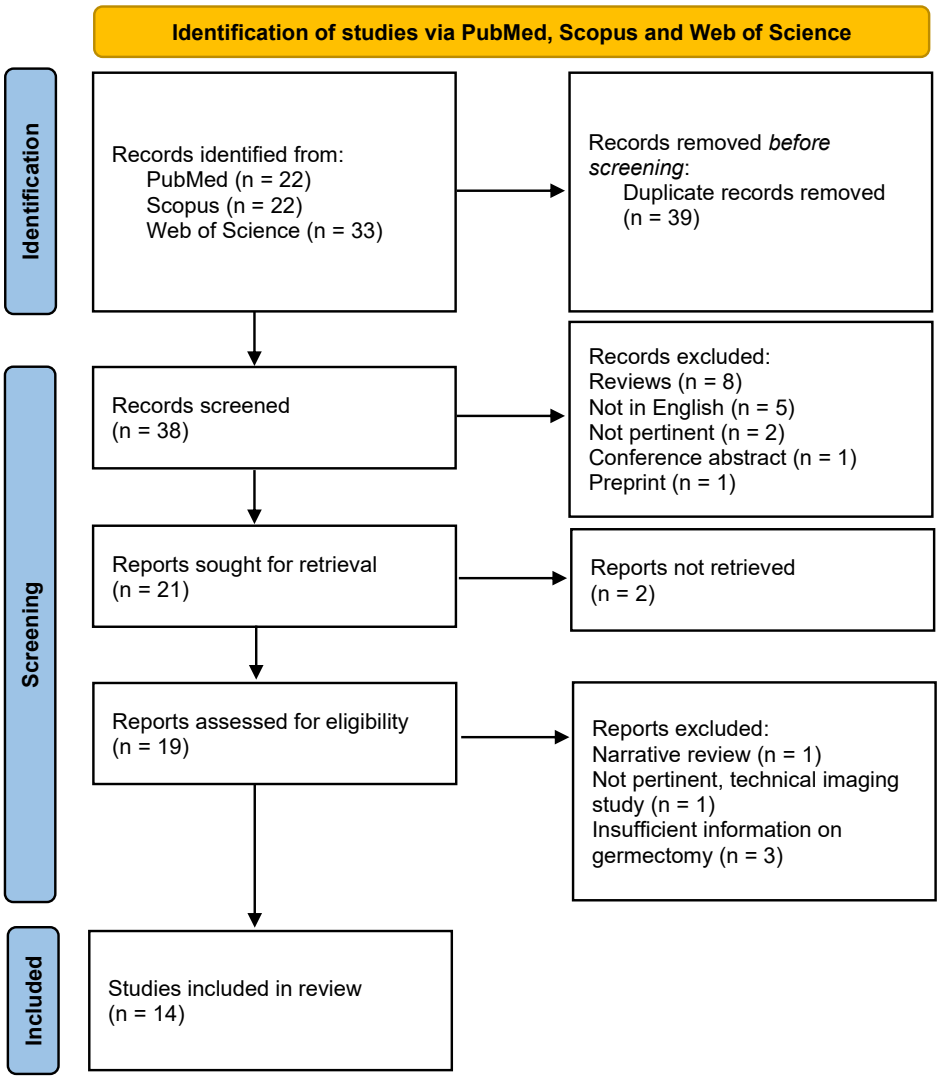


Figure 1. Flow diagram of the study selection (adapted from PRISMA 2020).

2.5. Synthesis

The findings were grouped by theme: definition of germectomy and developmental stage at surgery; indications, age and timing; anesthesia, sedation and surgical technique; postoperative course and patient-reported outcomes; complications; and histology of the dental follicle. The synthesis is narrative. Event frequencies are reported for each study, with numerator, denominator and unit of analysis (tooth or patient), and summarized as ranges across studies without pooling. Germectomies were summed across studies,

excluding comparison groups, only to describe the amount and distribution of available data. No meta-analysis was carried out.

3. Results

3.1. Study Selection

The search returned 77 records: 22 from PubMed, 22 from Scopus and 33 from Web of Science. After removal of 39 duplicates, 38 records were screened and 17 were excluded on title and abstract: eight reviews, five articles not in English, two not pertinent, one conference abstract and one preprint. Two of the 21 reports sought in full text could not be retrieved. Of the 19 full texts assessed, five were excluded: a narrative review, a technical study of automated image segmentation without germectomy data, and three articles with insufficient information on germectomy. Fourteen studies were included (Figure 1).

3.2. Characteristics of the Included Studies

The 14 studies were published between 2017 and 2026 (Table 1). Four were randomized: a pilot trial with allocation per tooth [24], two split-mouth trials [25,26] and a parallel-group trial [27]. Two were non-randomized comparative studies [28,29], three were single-arm cohorts, one retrospective [30] and two prospective [31,32], one was a case series with histological outcomes [33], and four were case reports [34–37] (Figure 2). Eight studies came from Italy and one each from Malaysia, Tajikistan, Morocco, Austria and France; one case report did not state the country. Where reported, the age at surgery ranged from 9 to 20 years. Nine studies were graded SORT level 2 and five level 3. None of the four trials met the SORT criteria for a high-quality trial: none reported how the allocation sequence was concealed or how the sample size was calculated (Table 2). Among the cohorts, only D'Angeli et al. calculated the sample size, and Monaco et al. analyzed only the patients who completed all follow-up visits. Follow-up ended at one week in seven studies; two cohorts followed patients for at least one year.

Two of the four trials were at high risk of bias for every outcome assessed, and the other two raised some concerns for their main outcome (Table 3). In both split-mouth trials, patients rated their own pain after procedures they could tell apart, and one protocol planned to exclude from the analysis the patients whose anesthesia was inadequate. In the pilot trial of germectomy versus retention, the time to uprighting raised some concerns, but oral health-related quality of life, reported by patients who knew whether the germ had been removed, was at high risk of bias. The two non-randomized comparisons were at serious and critical risk of bias, mainly because the patients who underwent germectomy were younger than those in the comparison groups and no adjustment was made. The three cohorts and the histological series met five to eight of the ten items of the JBI checklist for case series. None of them included patients both consecutively and completely, and all four analyzed teeth of the same patient as independent observations. The four case reports met five to seven of the eight items for case reports; three did not present the history as a timeline.

The 14 studies reported 654 germectomies. This total describes the available data, not distinct patients: four studies from the same university, with overlapping or unreported recruitment periods, contributed 184 germectomies and may share patients. In the eight studies other than case reports that gave the number of operated patients, samples ranged from 10 to 134 patients. In the six trials, comparative studies and cohorts that reported the sex of the patients who underwent germectomy, 152 of 305 patients (49.8%) were female (Figure 3a). The mean age at surgery, where reported, ranged from 12 to 16.1 years (Figure 3b). All germs were mandibular, except two maxillary germs, and the 74 germs of

Yunusov and Sultanov, who did not separate the arches (Figure 4a). Only 275 germectomies (42.0%) were followed for at least one month, while 291 (44.5%) were followed for one week (Figure 4b).

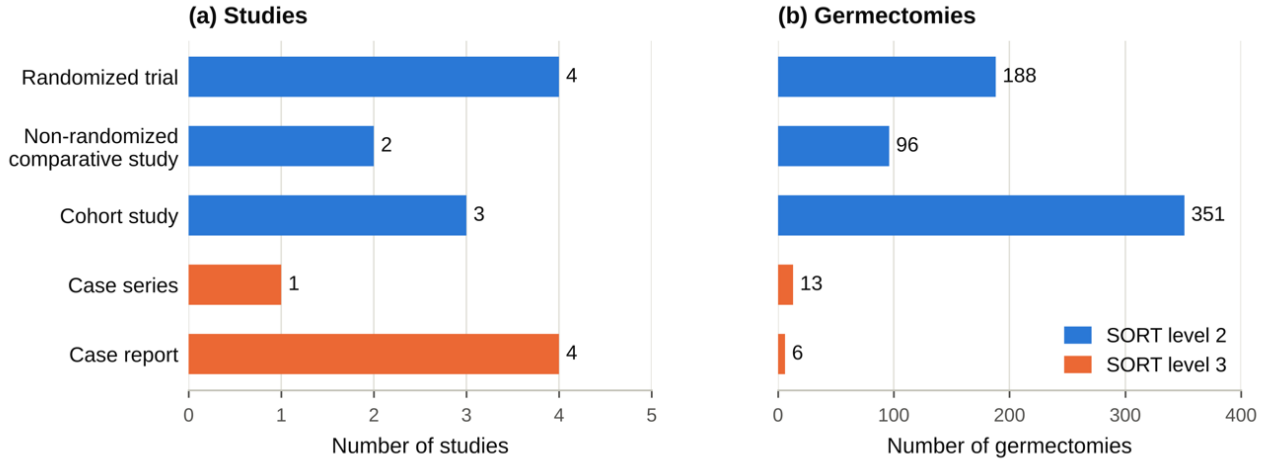


Figure 2. Design of the included studies. (**a**) Number of studies by design. (**b**) Number of germectomies by design. The color of the bars shows the level of evidence according to the Strength of Recommendation Taxonomy (SORT).

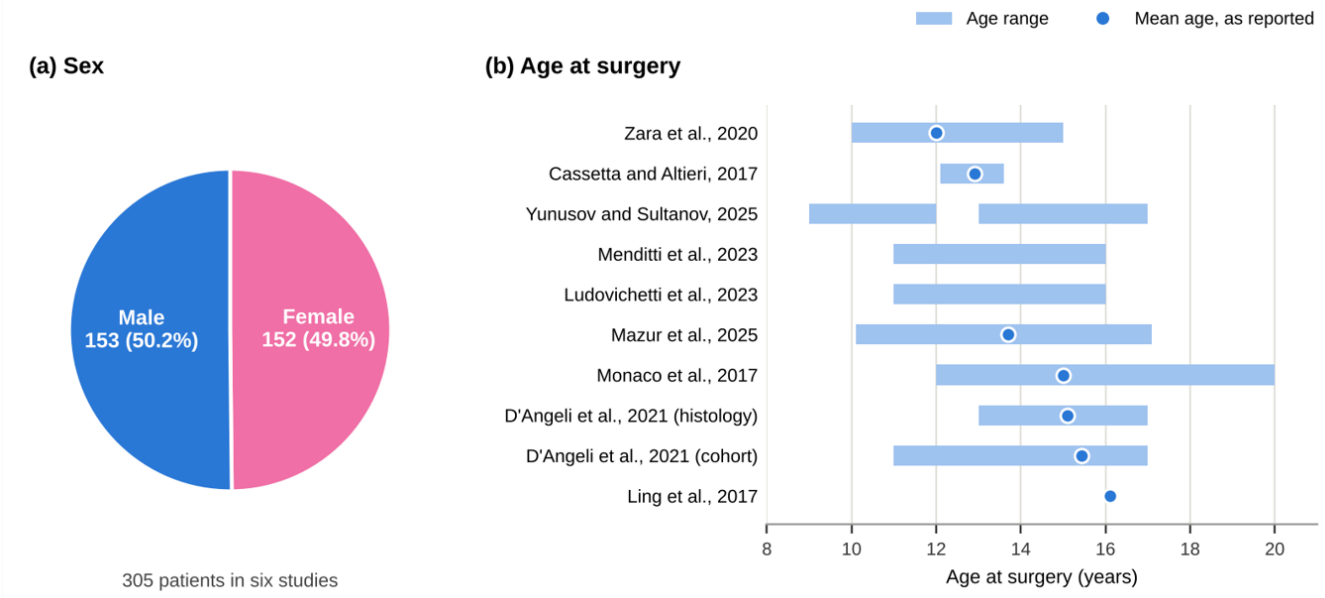


Figure 3. Sex (**a**) and age at surgery (**b**). (**a**) Patients who underwent germectomy in the six trials, comparative studies and cohorts that reported their sex; three of these studies come from the same university with overlapping or unreported recruitment periods, so some patients may be counted more than once. (**b**) Reported age range (bars) and mean age (dots) in the ten studies that were not case reports [24–33].

Table 1. Characteristics of the included studies.

Ref.	Study, Country	Design (SORT Level)	Patients (F/M); Germs (Arch)	Age (Years)	Stage at Surgery (Criterion)	Indication	Intervention and Comparison	Main Findings
[24]	Cassetta and Altieri, 2017, Italy	Randomized pilot trial, allocation per tooth (2)	14 (5F/9M); 20 impacted M2, 10 with germectomy (mandible)	12.1–13.6 (germectomy group mean 12.9)	NR	Uprighting of the impacted M2	Brass wire uprighting with vs. without germectomy	Time to uprighting 170.9 vs. 174.4 days (p = 0.440); OHIP-14 score worse with germectomy at 3 days (p = 0.017) and 7 days (p = 0.002)
[25]	Zara et al., 2020, Italy	Randomized split-mouth trial (2)	19 (8F/11M); 38 (bilateral, mandible)	10–15 (mean 12)	NR	Orthodontic	Piezoelectric vs. rotary-bur ostectomy	Piezoelectric ostectomy 7.5 min longer on average; no significant difference in mouth opening, swelling or pain; 1 alveolar osteitis (rotary side)
[26]	Menditti et al., 2023, Italy	Split-mouth trial, randomized side (2)	50 (NR); 100 (bilateral, mandible)	11–16	Definition: at least one-third of the root in formation, periodontal ligament visible (panoramic radiograph)	Orthodontic (posterior crowding, altered M2 eruption, non-extraction approach)	4% articaine by buccal infiltration vs. 2% mepivacaine by inferior alveolar nerve block	Supplementary injection on 21/50 vs. 40/50 sides; no intraoperative pain on 45/50 vs. 10/50 sides; no complications
[27]	Ludovichetti et al., 2023, Italy	Randomized parallel-group trial (2)	40 (22F/18M); 40 (mandible)	11–16	NR	Prophylactic and orthodontic	Para-marginal vs. marginal flap	At 1 week: bleeding on probing 6/20 vs. 19/20; swelling 9/20 vs. 20/20; pain (VAS) 2.95 ± 1.93 vs. 5.75 ± 1.37 (p = 0.000005)
[28]	Ling et al., 2017, Malaysia	Prospective non-randomized comparative study (2)	44 (33F/11M); 88 teeth: 22 germectomies, 30 with partially and 36 with fully formed roots (mandible)	Germectomy group 16.1 ± 1.48 (inclusion 14–23)	"Roots not formed" (panoramic radiograph)	Orthodontic	Germectomy vs. removal at later stages, all under general anesthesia	Operating time 14.8 ± 3.89 vs. 19.8 ± 8.36 min with fully formed roots (p = 0.024); infection after 1/22 germectomies; inferior alveolar nerve deficit only after removal of a fully formed tooth (1/36)
[29]	Yunusov and Sultanov, 2025, Tajikistan	Non-randomized comparative study (2)	36 (15F/21M); 28 + 46 germs in two age groups (both arches) vs. 32 adults, 54 fully formed teeth	9–12 and 13–17 (controls ≥ 18)	NR	Prophylactic, orthodontic; predicted impaction (Turley method)	Germectomy vs. extraction of fully formed teeth in adults	Complications after 1/28 (3.6%) and 2/46 (4.3%) germectomies vs. 7/54 (13.0%) extractions (p > 0.05)
[30]	Monaco et al., 2017, Italy	Retrospective cohort (2)	134 (66F/68M); 218 (mandible)	12–20 (mean 15)	Root less than one-third of total length	Orthodontic (lack of distal space	Germectomy with triangular flap and	Delayed-onset infection after 20/218 germectomies (9.2%), in 18/134 patients

					(panoramic radiograph)	and/or need for molar distalization)	sectioning; no comparison	(13.4%); early infection after 2/218 (0.9%); lower Ganss ratio with delayed infection (p = 0.004)
[31]	D'Angeli et al., 2021, Italy	Prospective single-arm cohort (2)	25 (10F/15M); 46 (mandible)	11–17 (mean 15.44 ± 2.06)	Nolla stages 5–8	Orthodontic or surgical	Germectomy with combined suture; no comparison	Complications after 2/46 germectomies (4.3%): one delayed infection, one bleeding; no further complications up to 2 years
[32]	Mazur et al., 2025, Italy	Prospective single-arm cohort (2)	51 (31F/20M); 87 (mandible)	10.11–17.1 at surgery (mean 13.69 ± 1.83 at the first intervention)	Demirjian stages B–D	NR	Germectomy; no comparison	Pain (VAS) 5.95 ± 3.23 on the day of surgery (n = 39) and 0.54 ± 1.17 on day 7 after the first intervention
[33]	D'Angeli et al., 2021, Italy	Case series, CBCT and histology (3)	10 (5F/5M); 13 (mandible)	13–17 (mean 15.1 ± 1.66)	Nolla stages 5–7 (CBCT)	Orthodontic (e.g., distal movement of M2)	Germectomy; follicle examined on CBCT and by histology	Follicles normal on CBCT: odontogenic remnants in 9/13, none with ameloblastic differentiation; squamous metaplasia in 5/13
[34]	Ouaabbou et al., 2024, Morocco	Case report (3)	1 (F); 2 (mandible)	17	Incomplete root formation (panoramic radiograph)	NR (referred by her orthodontist)	Germectomy in two sessions under local anesthesia	Uneventful healing at 1 week
[35]	Grün et al., 2024, Austria	Case report (3)	1 (M); 1 (maxilla)	14	Demirjian stage D	Germ obstructing M2 eruption	Germectomy, germ removed in one piece	Partial tooth formation (residual root) found on CBCT in 2024, after surgery in 2016
[36]	López et al., 2024, NR	Case report (3)	1 (F); 2 (mandible)	12	Two-thirds and one-third of the crown formed (CBCT)	Enlarged germ with apparent gemination; space for orthodontic treatment	Germectomy under intravenous conscious sedation	Bur fracture during sectioning; trismus at 7 days; histology consistent with odontogenic myxoma
[37]	Bos Diraison et al., 2026, France	Case report (3)	1 (F); 1 (maxilla)	13	NR	NR	Attempted germectomy by a general dentist; retrieval of the displaced germ	Germ displaced into the buccal soft tissues; retrieved intraorally; healed at 2 weeks

Stages and indications are reported in the wording of the authors. CBCT, cone-beam computed tomography; F/M, female/male; M2, second molar; NR, not reported; OHIP-14, Oral Health Impact Profile-14; SORT, Strength of Recommendation Taxonomy; VAS, visual analog scale.

Table 2. Design features related to internal validity in the nine studies graded SORT level 2. NR, not reported; SORT, Strength of Recommendation Taxonomy.

Study (Design)	Allocation Sequence and Concealment	Blinding	Sample Size Calculation	Follow-Up and Losses	Other Limitations
Cassetta and Altieri, 2017 (randomized pilot trial) [24]	Computer-generated sequence; concealment NR	NR	NR	Until uprighting; no exclusions	Allocation by tooth; 6 of 14 patients contributed through two teeth
Zara et al., 2020 (split-mouth trial) [25]	Computer algorithm; concealment NR	Described as blind; masked person not specified	NR	7 days; losses NR	No numerical results for mouth opening, swelling or pain
Menditti et al., 2023 (split-mouth trial) [26]	Computerized randomization program; concealment NR	NR	NR	7 days (main outcomes intraoperative); 50 recruited, results reported for 50 per side	Planned exclusion from the analysis of patients with excessive anxiety or inadequate anesthesia; drug and injection technique varied together
Ludovichetti et al., 2023 (parallel-group trial) [27]	Computer-generated sequence; concealment NR	Patients and parents unaware of the flap; blinded researcher for baseline measurement; assessor at one week not stated	NR	1 week; no dropouts	Stage of the germs not reported; no statistical test for bleeding on probing and swelling
Ling et al., 2017 (non-randomized comparative study) [28]	Not randomized; groups formed by root development	NR	NR	1 week; losses NR	Groups differed in age without adjustment; tooth as unit of analysis
Yunusov and Sultanov, 2025 (non-randomized comparative study) [29]	Not randomized; groups formed by age	NR	NR	NR	Germectomy at 9–17 years compared with removal of fully formed teeth in adults, without adjustment; source of the adult group not described
Monaco et al., 2017 (retrospective cohort) [30]	Not applicable	NR	NR	At least 1 year; 134 of 188 patients in the records	Complete periodontal healing at three months required for

				analyzed (inclusion criteria met and all visits completed)	inclusion; one surgeon in one private practice
D'Angeli et al., 2021 (prospective cohort) [31]	Not applicable	NR	Yes (at least 44 extractions)	2 years; losses NR	Distribution by Nolla stage given for 33 of 46 germs
Mazur et al., 2025 (prospective cohort) [32]	Not applicable	NR	Convenience sample of 50	1 week; 3 of 54 enrolled patients lost; pain on the day of surgery missing for 12 of 51	Patients unable to cooperate not enrolled

Table 3. Risk of bias of the included studies: (a) randomized trials, assessed with RoB 2; (b) non-randomized comparative studies, assessed with ROBINS-I; (c) studies without a comparison group, appraised with the JBI checklists.

(a) Randomized trials, RoB 2

Study (Outcome)	Randomization Process	Deviations from Intended Interventions	Missing Outcome Data	Measurement of the Outcome	Selection of the Reported Result	Overall
Cassetta and Altieri, 2017 (time to uprighting) [24]	Some concerns	Low	Low	Some concerns	Some concerns	Some concerns
Cassetta and Altieri, 2017 (OHIP-14) [24]	Some concerns	Low	Low	High	Some concerns	High
Zara et al., 2020 (postoperative pain) [25]	Some concerns	Some concerns	Some concerns	High	Some concerns	High
Menditti et al., 2023 (supplementary injection, intraoperative pain) [26]	Some concerns	High	Low	High	Some concerns	High
Ludovichetti et al., 2023 (pain) [27]	Some concerns	Low	Low	Low	Some concerns	Some concerns
Ludovichetti et al., 2023 (bleeding on probing) [27]	Some concerns	Low	Low	Some concerns	Some concerns	Some concerns

(b) Non-randomized comparative studies, ROBINS-I

Study (Outcome)	Confounding	Selection of Participants	Classification of Interventions	Deviations from Intended Interventions	Missing Data	Measurement of Outcomes	Selection of the Reported Result	Overall
Ling et al., 2017 (operating time) [28]	Serious	Low	Moderate	Low	Low	Low	Moderate	Serious

Ling et al., 2017 (complications) [28]	Serious	Low	Moderate	Low	Low	Moderate	Moderate	Serious
Yunusov and Sultanov, 2025 (complications) [29]	Critical	No information	Moderate	No information	No information	Serious	Serious	Critical

(c) Studies without a comparison group, JBI checklists

Checklist for case series	**Monaco et al., 2017 [30]**	**D'Angeli et al., 2021 (cohort) [31]**	**Mazur et al., 2025 [32]**	**D'Angeli et al., 2021 (histology) [33]**
Clear criteria for inclusion	Yes	Yes	Yes	Yes
Condition measured in a standard, reliable way	Yes	Unclear	Unclear	Yes
Valid methods to identify the condition	Yes	Yes	Yes	Yes
Consecutive inclusion of participants	Unclear	Unclear	No	Yes
Complete inclusion of participants	No	Unclear	No	Unclear
Demographics clearly reported	Yes	Yes	Yes	Yes
Clinical information clearly reported	Yes	No	No	Yes
Outcomes or follow-up clearly reported	Yes	Yes	Yes	Yes
Clinic and setting clearly reported	Yes	Yes	Yes	Yes
Appropriate statistical analysis	No	No	No	No
Items met	7 of 10	5 of 10	5 of 10	8 of 10
Checklist for case reports	**Ouaabbou et al., 2024 [34]**	**Grün et al., 2024 [35]**	**López et al., 2024 [36]**	**Bos Diraison et al., 2026 [37]**
Demographics clearly described	Yes	No	Yes	Yes
History presented as a timeline	No	Yes	No	No
Condition on presentation described	Yes	No	Yes	Yes
Diagnostic tests and results described	Yes	Yes	Yes	Yes
Intervention described	Yes	No	Yes	Yes
Post-intervention condition described	Yes	Yes	No	Yes
Adverse or unanticipated events described	Yes	Yes	Yes	Yes
Takeaway lessons provided	Yes	Yes	Yes	Yes
Items met	7 of 8	5 of 8	6 of 8	7 of 8

In (a) and (b), each row gives the judgments for the outcome in parentheses: RoB 2 judgments refer to the effect of assignment to the intervention, and ROBINS-I judgments to germectomy versus removal at later stages of development. In (c), each cell answers one item of the JBI checklist; these checklists give no overall judgment. OHIP-14, Oral Health Impact Profile-14.

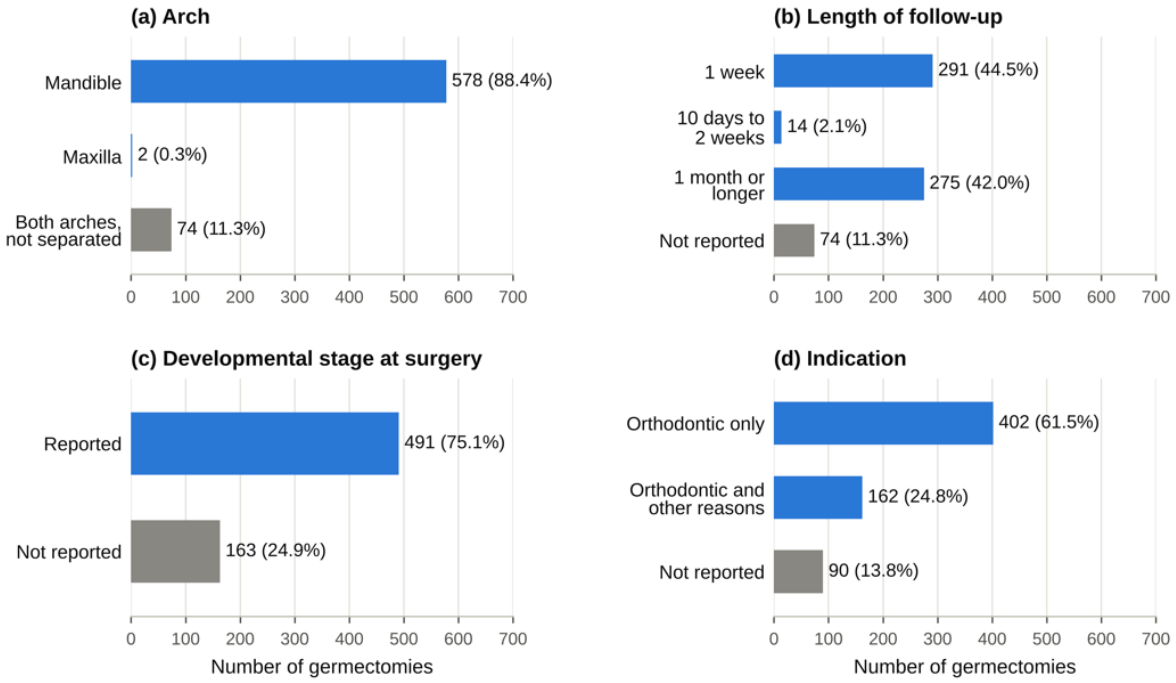


Figure 4. Distribution of the 654 germectomies reported by the included studies by (**a**) arch, (**b**) length of follow-up, (**c**) reporting of the developmental stage and (**d**) indication. Percentages refer to all 654 germectomies.

3.3. Definition of Germectomy and Developmental Stage at Surgery

The studies did not share a definition. Ouaabbou et al. described germectomy as the removal of germs "while they are still developing", and the prospective cohort of D'Angeli et al. as extraction before crown and root development is complete. Others set a threshold on root formation, in opposite directions: at most one-third of the root (Ling et al.; López et al., who also included crown-only germs), or "at least a third of its root in formation" with a periodontal ligament visible on the panoramic radiograph (Menditti et al.).

Staging criteria were equally varied. The two studies by D'Angeli et al. used Nolla's classification, with stages 5 to 8 in the cohort and stages 5 to 7 on cone-beam computed tomography (CBCT) in the histological series. The cohort of Mazur et al. included Demirjian stages B to D without reporting their distribution, and the maxillary germ of Grün et al. was at Demirjian stage D, with no root formation. Monaco et al. required root development of less than one-third of the total root length. In their analysis, however, Ling et al. called germectomy only the removal of teeth with "roots not formed" and classed teeth with partially formed roots as early removal. Five studies, with 163 of the 654 germectomies (24.9%), did not report the stage (Table 1; Figure 4c), and the "late germectomy" of Ludovichetti et al. was not defined.

3.4. Indications, Age and Timing

Orthodontic reasons prevailed, such as lack of distal space, the need for distalization, posterior crowding or an obstructed eruption of the second molar (Table 1). An orthodontic reason was given, alone or with other indications, for 564 of the 654 germectomies (86.2%), and no indication for 90 (13.8%; Figure 4d). Two studies combined orthodontic and prophylactic indications and one orthodontic and surgical indications, without a breakdown. López et al. removed an enlarged germ with apparent gemination

close to the mandibular canal, together with the contralateral germ, to gain space for orthodontic treatment. The indication was not stated in the cohort of Mazur et al. or in the cases of Bos Diraison et al. and Ouaabbou et al., although the latter patient had been referred by her orthodontist.

Two studies selected patients with a space analysis. Monaco et al. removed germs when the ratio of retromolar space to mesiodistal crown width on the panoramic radiograph (Ganss ratio) was below 1, and Yunusov and Sultanov screened 300 adolescents with the Turley method and identified 36 candidates. The orthodontic benefit was tested in one randomized trial: in 20 impacted mandibular second molars of patients aged 12.1 to 13.6 years treated with a brass wire ligature, germectomy did not shorten the time to uprighting (170.9 versus 174.4 days, 10 teeth per group, $p = 0.440$; Cassetta and Altieri). Two case reports suggested postponing maxillary germectomy: Grün et al. recommended waiting until Demirjian stage E, and Bos Diraison et al. suggested considering postponement, in the absence of pathology or a clearly justified indication, until a more advanced stage of root formation and eruption.

3.5. Anesthesia, Sedation and Surgical Technique

Most procedures were performed under local anesthesia, usually with inferior alveolar and buccal nerve blocks. In the split-mouth trial of Menditti et al. (50 patients aged 11 to 16 years, germs with at least one-third of the root in formation), 4% articaine by buccal infiltration was compared with 2% mepivacaine by inferior alveolar nerve block: a supplementary intraosseous injection was needed on 21 and 40 of 50 sides, respectively, and intraoperative pain was absent on 45 and 10 sides; drug and technique were not varied independently. Ling et al. operated under general anesthesia, and López et al. used intravenous sedation with midazolam, fentanyl and propofol in a 12-year-old girl.

In the trial of Ludovichetti et al. (20 patients per group), a para-marginal flap was followed by less bleeding on probing of the second molar at one week than a marginal flap (6 of 20 versus 19 of 20 patients), less swelling (9 of 20 versus 20 of 20) and lower pain on a visual analog scale (VAS; 2.95 ± 1.93 versus 5.75 ± 1.37, $p = 0.000005$). In the 19 children of Zara et al., piezoelectric ostectomy took on average 7.5 min longer than rotary ostectomy, with no significant difference in mouth opening, swelling or pain (no numerical values reported). Ling et al. recorded an operating time of 14.8 ± 3.89 min for germs without roots and 19.8 ± 8.36 min for teeth with fully formed roots ($p = 0.024$). Eight studies prescribed systemic antibiotics, mostly amoxicillin with or without clavulanic acid.

3.6. Postoperative Course and Patient-Reported Outcomes

In the cohort of Mazur et al. (51 patients, 87 germectomies), pain was highest on the day of surgery and had almost resolved by day 7: after the first intervention the mean VAS score fell from 5.95 ± 3.23 (rated by 39 patients) to 0.54 ± 1.17 (Figure 5a). The other 12 patients did not rate their pain on the day of surgery, which the authors attributed to the stress of the procedure. Patients with more pain in the first days reported greater limitations of activities at home and at school in the Short Form-12 questionnaire completed at one week. In the 36 patients operated on both sides, pain rated immediately after the local anesthetic injection did not differ significantly between the first and the second intervention (VAS 4.32 ± 1.98 versus 4.63 ± 2.42, $p = 0.560$). One week after surgery, pain was still moderate after a marginal flap in the trial of Ludovichetti et al. (VAS 5.75 ± 1.37). Oral health-related quality of life was measured only by Cassetta and Altieri, whose patients all underwent flap surgery with exposure and luxation of the second molar: the Oral Health Impact Profile-14 (OHIP-14) score three days after surgery was 24.86 ± 12.84 with germectomy and 10.86 ± 3.58 without ($p = 0.017$), and 9.57 ± 4.16 versus 2.71 ± 1.89 at

seven days (p = 0.002). Ling et al. found no trismus or facial swelling at one week; oral intake was tolerated after 20 of 22 germectomies, against 18 of 30 removals of teeth with partially formed roots and 21 of 36 with fully formed roots (p = 0.023; tooth as the unit of analysis).

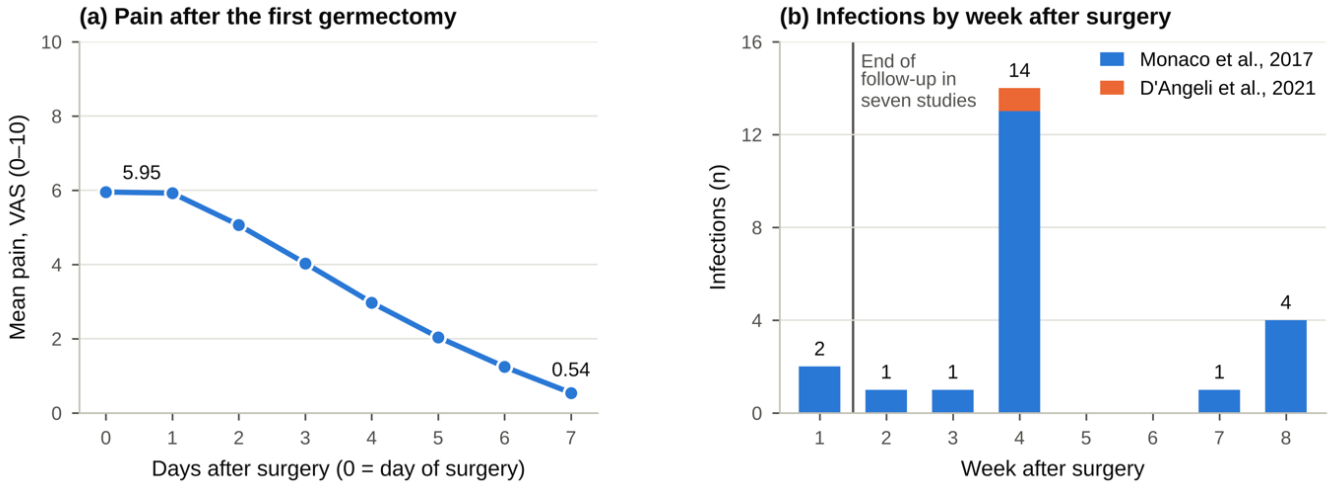


Figure 5. Postoperative course after germectomy. (**a**) Mean pain on a visual analog scale (VAS) after the first germectomy in the cohort of Mazur et al. (51 patients; 39 rated pain on the day of surgery) [32]. (**b**) Infections by week after surgery in the two cohorts followed for more than one month: Monaco et al. (218 germectomies; the two infections of the first week were found at suture removal) [30] and D'Angeli et al. (46 germectomies) [31]. The vertical line marks the end of follow-up in seven of the included studies.

3.7. Complications

Infection was the most frequent complication. Monaco et al. observed delayed-onset infection, defined as swelling or purulent drainage appearing between 15 days and 2 months after surgery, after 20 of 218 germectomies (9.2%) in 18 of 134 patients (13.4%), mostly four weeks or more after surgery (Figure 5b). The Ganss ratio was lower in germectomies followed by delayed infection (0.40 ± 0.20 versus 0.53 ± 0.21, p = 0.004). Two further infections (0.9%) were found at suture removal one week after surgery. In the cohort of D'Angeli et al., two complications followed 46 germectomies (4.3%), a delayed infection at one month and an immediate bleeding, and no further complication was recorded during the two-year follow-up. Ling et al. reported one infection in 22 germectomies (4.5%) and none at later stages; the only inferior alveolar nerve deficit followed removal of a tooth with fully formed roots (1 of 36). Yunusov and Sultanov observed complications after 1 of 28 germectomies (3.6%) at 9 to 12 years, 2 of 46 (4.3%) at 13 to 17 years and 7 of 54 extractions (13.0%) of fully formed teeth in adults (p > 0.05). In the two split-mouth trials, with one week of follow-up, Menditti et al. recorded no complications (50 patients) and Zara et al. one alveolar osteitis on a rotary side (19 patients). In the five studies that recorded early complications, infection within the first week ranged from none (Menditti et al., 100 germectomies) to 4.5% (Ling et al., 1 of 22). Delayed-onset infection followed 1 of 46 germectomies (2.2%) in the cohort of D'Angeli et al. and 20 of 218 (9.2%) in that of Monaco et al., the two cohorts that followed patients beyond one month. The four studies that listed every complication, with 22 to 100 germectomies each, recorded no nerve injury.

Three case reports described uncommon events. Grün et al. found partial tooth formation, in the form of a residual root, at the site of a maxillary germ removed at Demirjian stage D in a 14-year-old patient, diagnosed on CBCT in March 2024 after

surgery in October 2016. Bos Diraison et al. described a maxillary germ displaced into the buccal soft tissues, probably along the buccal fat pad, during an attempted germectomy by a general dentist in a 13-year-old girl; it was retrieved intraorally under local anesthesia. In the patient of López et al., a bur fractured during sectioning, and mouth opening was reduced at the seven-day control.

3.8. Histology of the Dental Follicle

In the histological series of D'Angeli et al., 13 radiographically normal follicles of germs at Nolla stages 5 to 7 contained odontogenic remnants in 9 cases, none with features of ameloblastic differentiation, and focal squamous metaplasia in 5. Follicle width on CBCT was not correlated with any histological finding. Mild myxoid degeneration was present in 8 of the 13 follicles. In the case of López et al., histology of the enlarged germ was reported as consistent with odontogenic myxoma, although CBCT showed only a follicular radiolucency.

4. Discussion

The studies published since 2016 describe germectomy as a procedure performed mainly on mandibular germs, for orthodontic reasons, in children and adolescents, with few serious complications in the short term. The evidence behind this picture is thin: no study reached SORT level 1, the largest series included 134 patients, and only one small trial compared germectomy with retention of the germ, for an orthodontic outcome. The main findings, with suggestions for practice and research, are summarized in Table 4.

Table 4. Summary of the findings of the included studies, with suggestions for practice and research.

Aspect	Findings of the Included Studies	Suggestion
Definition and stage	Criteria varied: Nolla stages 5–8, Demirjian stages B–D, root formation at most or at least one-third, or qualitative descriptions; five of 14 studies did not report the stage.	Record the stage of each germ with a named classification on the preoperative radiograph.
Indication	Mostly orthodontic (lack of distal space, distalization, eruption of the second molar).	Decide together with the orthodontist; no evidence supports routine removal of asymptomatic germs.
Age and timing	Reported ages at surgery 9–20 years; in the maxilla, removal of a germ at the crown stage was followed by late partial tooth formation, and another germ was displaced into the cheek during an attempted germectomy.	Postponing maxillary germectomy until root formation begins is a hypothesis for future studies.
Preoperative assessment	Space analysis on panoramic radiographs (Ganss ratio, Turley method) was used to select patients; a lower Ganss ratio was associated with delayed-onset infection.	A small distal space may identify patients at higher risk of delayed-onset infection.
Anesthesia and sedation	Local anesthesia in most studies; articaine infiltration required fewer supplementary injections than mepivacaine block, with drug and technique confounded; intravenous sedation and general anesthesia in single studies.	Choose the approach according to cooperation and anxiety; apply pediatric sedation standards when sedation is used.
Surgical technique	Para-marginal flap: less bleeding on probing, swelling and pain than a marginal flap in one trial; piezoelectric ostectomy took longer without	Flap design may affect the periodontal condition of the second molar; piezoelectric surgery adds time.

	measurable clinical benefit; operating time was shorter than for fully formed teeth.	
Postoperative course	Pain highest on the day of surgery and almost resolved by day 7 in one cohort, still moderate one week after a marginal flap in one trial; oral health-related quality of life worse at 3 and 7 days when germectomy was added to surgical exposure of an impacted second molar.	Plan analgesia for the first days after surgery and tell the family what course to expect.
Complications	Delayed-onset infection after 9.2% of germectomies in the largest series, 2–8 weeks after surgery; complications after 3.6–4.5% of germectomies in three other studies, and none or one event in two one-week trials; no nerve injury where the type of complication was reported.	Follow-up extended to at least 8 weeks after surgery would capture delayed-onset infection.
Follow-up and reporting	Follow-up ended at one week in seven studies; anxiety was not measured, and no study described how the young patient's assent was obtained.	Report stage, denominators (patients and teeth) and follow-up of at least two months.

The Table summarizes Section 3 and Tables 1–3. Evidence for each row comes from studies at SORT level 2 or 3, and the suggestions are not graded recommendations.

4.1. Definition and Developmental Stage

The studies included did not agree on what counts as a germ. Limits based on root formation, descriptions of the crown and two classification systems were used, and five studies gave no stage. The results obtained with different criteria cannot be compared directly, and studies without a stage cannot be placed on the developmental timeline. This matters most for outcomes that change with root development, such as operating time and nerve injury. In the study of Ling et al., operating time was longer for teeth with fully formed roots than for germs without roots, and the four studies that recorded no nerve injury operated on teeth ranging from germs without roots to Nolla stage 8, so their safety data cannot be assigned to one stage. The two maxillary cases describe partial tooth formation years after removal of a germ at the crown stage and displacement of a germ into the cheek. Accidental displacement of third molars is rare, and displaced maxillary third molars most often reach the infratemporal fossa [38]. Both groups of authors suggested postponing maxillary germectomy, a hypothesis that none of the included studies tested.

4.2. Indication and Prediction of Impaction

Most germectomies were performed for orthodontic reasons, but the included studies pursued different aims under this heading. Some removed the germ to ease the eruption or uprighting of the second molar, others to gain space for molar distalization or for treatment without extractions, and Grün et al. cited the prevention of anterior crowding as a common but controversial purpose. Only one of these aims was tested in a comparative study. In the only randomized comparison with retention of the germ, germectomy did not shorten the time needed to upright an impacted second molar, in a pilot sample of 10 teeth per group without a sample size calculation. No included study measured whether removal of the germ made distalization faster or the orthodontic result more stable, so the orthodontic benefit of germectomy rests on clinical reasoning rather than on outcome data.

The orthodontic indication also rests on predicting which germs will remain impacted. In a cohort followed for 7 years, more third molars erupted when the space/width ratio on panoramic radiographs was 1 or greater [39], the threshold used by

Monaco et al. to select germs for removal. In 771 patients radiographed at 8 to 15 years and again at 16 to 23 years, however, only 13.9% of the teeth reached full eruption and no predictive model for eruption could be obtained [40].

The role of third molars in late incisor crowding has long been debated. In a randomized trial, removal of the third molars after orthodontic retention did not significantly reduce the late increase in lower incisor irregularity (mean increase 2.1 mm with retained third molars, reduced by 1.1 mm after extraction; $p = 0.15$) [41]. Later systematic reviews disagreed: one found no clear connection between third molars and crowding relapse after orthodontic treatment [42], and a meta-analysis of observational studies concluded that lower third molars may contribute to mandibular crowding [43]. Clinical guidance in England does not support removal for this purpose. In 2000, the National Institute for Clinical Excellence advised that the prophylactic removal of pathology-free impacted third molars be discontinued and that surgery be limited to patients with evidence of pathology, without listing orthodontic reasons among the indications [44]. The parameters of care of the Royal College of Surgeons of England describe crowding as multifactorial, find studies both for and against a contribution of third molars, and conclude that routine removal of third molars to encourage orthodontic stability cannot be justified, with an open recommendation, the weakest of their three grades [45]. None of the included studies measured crowding after germectomy.

Histology does not settle the question of prophylactic removal either. A meta-analysis of asymptomatic impacted third molars with a normal pericoronal space estimated cystic changes in 26.7% of follicles, with very high heterogeneity, and concluded that these findings alone do not support prophylactic extraction [46]; in the series of D'Angeli et al., none of the nine follicles with odontogenic remnants showed features of ameloblastic differentiation.

Removing a germ also gives up its possible use as a donor for autotransplantation. Yunusov and Sultanov listed the possible transplantation of the third molar into the socket of a removed second molar among the factors to weigh before germectomy. Third molar autotransplantation can replace a missing tooth, and its prognosis is better when the donor root is incompletely formed [47]. In children and adolescents, immature donors with one-half to three-quarters of the root formed survived in about 94% of cases in three retrospective studies of transplanted premolars, with low certainty of evidence [48]. When a first or second molar has a doubtful prognosis, monitoring the germ until its root reaches this stage may keep the option open.

4.3. Morbidity and Complications Compared with Later Removal

None of the studies that specified the type of complication reported a nerve injury after germectomy, and in the study of Ling et al. the only inferior alveolar nerve deficit followed removal of a fully formed tooth. These studies included 22 to 100 germectomies each, too few to exclude an uncommon risk. The lower risk of inferior alveolar nerve injury after germectomy than after delayed extraction, reported by the systematic review cited in the Introduction, rests on two retrospective studies. In an earlier retrospective study, complications followed 2.48% of extractions of lower third molars with immature roots in patients aged 23 years or younger and 10% of extractions of mature teeth in older patients [49]; age and root maturity cannot be separated in that comparison.

Most of the morbidity reported after germectomy appears in the first weeks. Delayed-onset infection, the most frequent complication, appeared between 2 and 8 weeks after surgery. In the two cohorts with longer follow-up, delayed infections outnumbered those of the first week, 20 to 2 in the larger and 1 to none in the smaller. A case–control study of lower third molar surgery found this complication only in patients younger than 26 years, about 29.5 days after surgery, and associated it with lower Nolla stage, full bone

coverage and less distal space [50]. These features match the association with a low Ganss ratio reported by Monaco et al., and a one-week follow-up, as in seven included studies (Figure 5b), cannot detect this event. Eight studies gave antibiotics to every patient. A Cochrane review found low-certainty evidence that prophylactic antibiotics may reduce infection and dry socket after third molar extraction and advised deciding for each patient according to clinical condition and risk of infection [51]; none of the included studies compared germectomy with and without antibiotic prophylaxis.

Differences in follow-up limit any comparison of complication rates between studies. The seven studies that ended follow-up at one week could not record delayed-onset infection, so their rates are minimum values and cannot be set against those of the cohorts followed for one or two years. The selection of the analyzed patients adds uncertainty: Monaco et al. analyzed 134 of the 188 patients found in their records, those who met the inclusion criteria and completed all follow-up visits, and complete periodontal healing at three months was itself an inclusion criterion, which may have excluded patients with a complicated course. Events that take longer to appear fell outside almost every follow-up. The partial tooth formation reported by Grün et al. was diagnosed more than seven years after surgery. The periodontal condition of the second molar was assessed only at one week and at three months, and the orthodontic result only until the end of active uprighting.

Quality of life showed the same short-term burden. After third molar removal under local anesthesia, a meta-analysis of six studies found the OHIP-14 score on the first postoperative day 17.57 points higher than before surgery, with very high heterogeneity [52]. In the trial of Cassetta and Altieri, where germectomy was added to exposure and luxation of the second molar, the score had risen by 20.9 points three days after surgery with germectomy and by 8.0 points without.

4.4. Anesthesia and Surgical Technique

In a meta-analysis of randomized trials of mandibular third molar extraction, 4% articaine required fewer reinjections than 2% lidocaine and acted longer than 2% mepivacaine [53]; in the trial of Menditti et al., mepivacaine was given by a different technique, so the findings are not directly comparable. In children receiving routine dental treatment, articaine and lidocaine, administered by infiltration or inferior alveolar nerve block, gave similar pain during treatment and less pain afterwards with articaine, with low-quality evidence [54]. A meta-analysis of impacted lower third molar surgery found strong evidence of longer operating time and low evidence of less pain and trismus with piezoelectric instruments [55]; Zara et al. confirmed only the longer operating time. Envelope and triangular flaps did not differ in pain, edema or trismus in another meta-analysis [56]; the para-marginal flap of Ludovichetti et al. is a different comparison, tested in a single trial.

4.5. Aspects Specific to Children and Adolescents

Dental anxiety affects 23.9% of children and adolescents, with a lower prevalence in adolescents (13.3%) than in younger children [57]. No included study measured it, and two studies had exclusion rules for anxious or uncooperative patients. Menditti et al. planned to exclude from the analysis the patients who became excessively anxious, Mazur et al. did not enroll patients unable to cooperate, and López et al. used intravenous sedation to control anxiety in a 12-year-old girl. The results therefore apply to cooperative adolescents more than to younger or anxious children, in whom limited cooperation also makes the assessment of the development and position of the germ less accurate, as Yunusov and Sultanov noted for patients aged 7 to 12 years. Pediatric sedation guidelines require, among other measures, presedation evaluation, staff trained in airway rescue,

monitoring during and after the procedure, and recovery to the presedation level of consciousness before discharge [58].

Germectomy also places demands on the patient after surgery. Bilateral cases were often treated in two sessions, 15 or 30 days apart in the split-mouth trials, and in the cohort of Mazur et al. pain at the anesthetic injection did not decrease at the second session. In the same cohort, almost a quarter of the patients did not rate their pain on the day of surgery, which the authors attributed to stress, and more pain in the first days was associated with greater limitations of activities at home and at school. At this age, postoperative care is shared with the family. Mazur et al. explained the pain scale and the questionnaire to both patients and parents and contacted each patient by telephone every day of the first week, and D'Angeli et al. prescribed a liquid diet for three days and attributed their low complication rate partly to compliance with the postoperative instructions. Analgesia, oral hygiene, diet and the signs of a late infection need to be explained to the parents as well as to the patient.

Germectomy is often elective. In pediatric practice, parental permission and the assent of the child form an active process, and the opinion of the child and later of the adolescent is increasingly included in decisions as they mature [59]; none of the included studies described how the assent of the young patient was sought.

4.6. Limitations

Only 14 studies met the criteria. Their samples were small and mostly from single centers, and eight of them came from Italy. None of the four trials met the SORT criteria for a high-quality trial, and none was at low risk of bias. The two non-randomized comparisons set germectomy in adolescents against the removal of fully formed teeth in older patients, so age and stage cannot be separated, and their risk of bias was serious or critical (Tables 2 and 3). Five studies were conducted at the same university, three of them with overlapping recruitment periods and one without a reported period, so some patients may appear in more than one study. The studies defined germectomy in different ways, operated on germs from the crown stage to Nolla stage 8, and five did not report the developmental stage, so their results cannot be attributed to a single stage. Designs and outcome measures also differed, and follow-up ended after one week in half of the studies. Apart from one study that did not report results by arch, the data on maxillary germs come from two case reports of adverse events, which cannot show how often such events occur. The search covered three databases with a query built mainly on the term germectomy and was limited to articles in English, without the screening of reference lists or the gray literature. Studies that described the procedure with other terms, such as tooth bud removal or enucleation, may therefore have been missed. The synthesis is narrative, and the JBI checklists used for the eight studies without a comparison group rate each item separately, without an overall judgment of risk of bias.

4.7. Future Directions

Whether a child with a defined orthodontic indication does better with germectomy or with monitoring of the germ has been addressed by a single pilot trial limited to the uprighting of second molars. Prospective comparative studies, randomized where the indication allows it, should allocate patients to these two strategies and follow them for at least one year. They should record the developmental stage of every operated tooth with a named classification, report data separately per patient and per tooth, and schedule a visit at least two months after surgery, when delayed-onset infection is still appearing. A core set of outcomes would make studies comparable: nerve injury, infection, pain, oral health-related quality of life measured with age-appropriate instruments, anxiety, days of school missed, periodontal condition of the second molar and the orthodontic result.

Trials of local anesthesia should separate the effect of the drug from that of the injection technique, and the need for routine antibiotic prophylaxis in healthy adolescents should be tested. Maxillary germectomy needs dedicated series with long-term radiographic control. Studies should also report how the parents and the patients were informed and how the young patient's assent was obtained. A public CBCT dataset and a deep-learning network for segmenting pediatric mandibular third molars are now available [60] and could support a reproducible description of germ position in the mandible.

5. Conclusions

Germectomy of third molars in children and adolescents rests on limited evidence. The 14 studies published since 2016, with 654 germectomies in total, had small samples, mostly from single centers, and none reached SORT level 1. None of the six comparative studies was at low risk of bias. The studies also defined the germ with different criteria, and five of them did not report the developmental stage of the operated teeth, so their results can be compared only in part. Within these limits, the procedure caused little morbidity in the short term. Pain and oral health-related quality of life were assessed only in the first postoperative week, when pain peaked in the first days. No nerve injury was reported in the studies that specified the type of complication. Delayed-onset infection is the complication that a short follow-up misses: it appeared 2 to 8 weeks after surgery and was associated with a small space distal to the second molar.

The orthodontic indication, which motivated most procedures, is not supported by the comparative evidence. In the only randomized comparison with retention of the germ, germectomy did not shorten the uprighting of impacted second molars. Nor can the eruption of a germ be predicted reliably at the age when the decision is taken. Germectomy should therefore be proposed for a defined clinical reason rather than as routine prevention. The decision should be shared with the orthodontist, the patient and the parents, who need to weigh the early discomfort and the risk of late infection against an uncertain benefit. In the maxilla, two case reports described the displacement of the germ and late partial tooth formation; whether postponing removal until root formation has begun prevents these events should be tested before it is recommended.

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