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Systematic Review

The Surgical Approach in the Treatment of the Mesiodens: A Systematic Review of the Literature with Narrative Synthesis

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Abstract

Background. The mesiodens is a supernumerary tooth located at the midline of the maxilla and represents the most common form of hyperdontia. When symptomatic or threatening the eruption or alignment of adjacent permanent incisors, surgical removal is indicated; however, the literature reports a wide array of surgical techniques without an established standard of care. **Objectives**. This review aims to evaluate the surgical techniques reported for mesiodens removal, analyzing their outcomes, complications, and predictability, to provide a reference framework for clinical decision-making. **Methods**. The review followed the PRISMA 2020 guidelines and it was retrospectively registered in PROSPERO (CRD420261462413) on 3 September 2026, after study selection had begun. A systematic search was conducted across PubMed, Scopus, and Web of Science for studies published between 2016 and 2026 the searches being run between January and June 2026 without restriction of language or publication status, with predefined eligibility criteria and methodological quality assessed using the Joanna Briggs Institute (JBI) critical appraisal tools. **Results**. Thirty studies were included, predominantly case reports and case series, with only one randomized controlled trial and one comparative cohort study; consequently, the synthesis remained descriptive. The pooled surgical population comprised 845 patients, mostly pediatric, with a marked male predominance. Cone beam computed tomography (CBCT) was used for three-dimensional localization and surgical planning in 73.3% of studies. Surgical approaches were heterogeneous, including palatal, labial/buccal, nasal floor/transnasal, and endoscopic routes. Extraction was performed freehand in 80.0% of studies and with a surgical guide or dedicated plate in 16.7%. Where reported, outcomes were favorable: adjacent teeth were preserved in all 19 studies documenting this outcome, while intraoperative and postoperative complications were described in two of 20 and in three of 23 studies respectively. **Conclusions**. Surgical removal appears feasible and has been reported with generally favorable outcomes in the published literature; however, the evidence base consists predominantly of case reports and small case series, with important risks of selection and publication bias. The reported complication frequencies should therefore not be interpreted as the true complication rate of mesiodens surgery, and the available evidence is insufficient to formulate an evidence-based clinical guideline. Prospective comparative studies with standardized inclusion criteria and outcome definitions are warranted.

Keywords: mesiodens; supernumerary teeth; impacted mesiodens; dental surgical extraction

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1. Introduction

The mesiodens is a supernumerary tooth located in the midline of the upper jaw, between the two central incisors, and represents the most frequent form of hyperdontia [1]. Hyperdontia refers to an additional tooth in addition to the normal series of 20 deciduous teeth and 32 permanent teeth, with an atypical morphology and abnormal location and not attributable to any element of the physiological series [2]. Supernumerary teeth can appear in any region of the dental arches, although they predominantly affect the upper jaw, particularly the premaxilla [3]. Mesiodens can appear as a single or multiple elements, unilateral or bilateral, and erupted or impacted, and the presence of multiple mesiodens is called "mesiodentes" [4]. Among supernumerary teeth, mesiodens constitutes approximately 80% of all cases [5].

From an epidemiological point of view, the prevalence of mesiodens in the general population is reported to range from 0.15% to 1.9%, with variations related to methodological differences and the populations examined [4]. Some studies report a wider prevalence range, between 0.09% and 2.05% [1]. The prevalence of supernumerary teeth is overall higher in the permanent dentition (approximately 2.1%) than in the deciduous dentition (approximately 0.8%) [6]. Mesiodens shows a clear predilection for the male sex, with a male/female ratio generally estimated to be around 2:1 [5].

The mesiodens is part of the larger category of supernumerary teeth, which can be classified according to multiple criteria [7]:

- Chronological: Supernumerary teeth can be classified as pre-deciduous, permanent, and post-permanent (or complementary) teeth;
- Topographical: Based on their location, they are classified as mesiodens, paramolars, distomolars, and parapremolars;
- Morphological: The most described forms include the conoid type (the most common), the tuberculate type, the supplementary type (eumorphic), and the odontoma;
- Orientation: Mesiodens can be classified as upright (normal), inverted, and transverse.

The etiology of the mesiodens is not yet completely clear; however, several theories have been proposed to explain its formation [8]. The first is the atavistic theory (or phylogenetic reversion theory), according to which the mesiodens would represent a phylogenetic legacy of ancestors with three central incisors; this hypothesis is now largely abandoned by embryologists. The second is the dichotomy theory, according to which the dental bud would be divided into two parts of equal or unequal size, giving rise to two equal teeth or to a normal tooth and a dysmorphic one. The third is the theory of hyperactivity of dental lamina, according to which supernumerary teeth would be derived from a local and independent hyperactivity of the dental lamina, or from remnants of the same induced to develop into an additional dental bud; this is considered the most widely accepted hypothesis [9]. The etiology of this hyperactivity is believed to be multifactorial, attributable to both genetic and environmental factors [10]. The genetic component is supported by the observation of a higher frequency of the anomaly among family members of affected subjects compared to the general population, and an autosomal dominant transmission with incomplete penetrance has been proposed, as well as a possible X-linked transmission pattern that would explain the male predominance [11]. Regarding possible associated correlations, mesiodens can present in otherwise healthy subjects as an isolated anomaly or manifest itself within genetic syndromes. The conditions most associated with an increased prevalence of supernumerary teeth include cleidocranial dysplasia, cleft lip and palate and Gardner's syndrome [12].

The clinical presentation of mesiodens is variable: in a significant proportion of cases the tooth is impacted and asymptomatic and is detected incidentally during a radiographic examination. Clinical signs suggestive of the presence of mesiodens include anomalous

positioning of the permanent upper central incisors, the presence of a midline diastema, and delayed eruption of the upper central incisors [13]. When symptomatic, mesiodens can cause numerous complications affecting adjacent teeth and surrounding structures, including impaction, delayed eruption and ectopic eruption of the permanent incisors, crowding, diastema, axial rotation, root dilaceration, root resorption of adjacent teeth, formation of dentigerous cysts, and, more rarely, eruption of the tooth into the nasal cavity. Delayed eruption and displacement of the permanent maxillary incisors are the most frequent complications, while crowding, diastema, and dilaceration are less common [2].

The diagnosis of mesiodens is based on a combination of clinical examination and radiographic evaluation. Erupted mesiodens is easily diagnosed through clinical examination, while the impacted form requires both clinical and radiographic evaluation. Periapical, occlusal, and maxillary intraoral radiographs, as well as orthopantomography (panoramic radiographs), are commonly used for diagnosis and localization. Two-dimensional radiographic techniques such as the tube-shift technique can be used to precisely determine the bucco-palatal position of the tooth [14]. Cone beam computed tomography (CBCT) allows for an accurate three-dimensional assessment of the position of the mesiodens in the three planes of space and of their relationship with nearby anatomical structures, and its use is recommended in cases where conventional radiographs are insufficient. Any delay in the eruption of a permanent incisor exceeding six months should prompt the clinician to investigate the possible presence of a supernumerary tooth [15].

Regarding treatment options, the management of mesiodens depends on the type and position of the tooth and its effect on adjacent teeth [12]. Treatment options include observation with periodic radiographic monitoring in asymptomatic and uncomplicated cases, and surgical extraction in symptomatic or at-risk cases. Removal of mesiodens is generally indicated in the presence of inhibition or delay of eruption, dislocation of adjacent teeth, interference with orthodontic treatment, presence of associated pathological conditions or spontaneous eruption of the supernumerary tooth. The optimal timing for extraction remains a matter of debate in the literature, with an early approach and a delayed approach being contrasted. The early approach is defined as extraction at the time of diagnosis or, according to some authors, before the eruption of adjacent permanent teeth; the late approach is instead defined as postponing extraction until the eruption of adjacent permanent teeth or the completion of their root development. Proponents of the early approach recommend extraction during the initial mixed dentition period, ideally before the age of seven, in order to promote eruption and correct spontaneous alignment of adjacent teeth and reduce the need for subsequent orthodontic treatment. Proponents of the deferred approach instead propose postponing the procedure until the root development of the permanent incisors is complete, in order to ensure patient cooperation and avoid iatrogenic damage to developing structures during the extraction procedure [16].

The aim of the research is to evaluate the surgical techniques available in the literature on the surgical treatment of mesiodens, and then, if possible, to analyze their outcomes, complications, and predictability. The final goal is to provide a reference framework for clinical decision-making in the surgical treatment of mesiodens.

2. Materials and Methods

2.1. Protocol Development and Eligibility Criteria

This review was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (Tables S3 and S4 in Supplementary Materials include PRISMA checklist and abstract PRISMA checklist), and the study protocol has been registered in PROSPERO (https://www.crd.york.ac.uk/prospero/display_record.

php?ID=CRD420261462413, accessed on 3 September 2026). The registration was completed on 3 September 2026, after the start of study selection.

2.2. Search Strategy

A comprehensive literature search was conducted across three electronic databases: PubMed, Scopus and Web of Science. These databases were selected to provide complementary coverage of the biomedical literature (PubMed), broad multidisciplinary and citation-indexed literature (Scopus), and multidisciplinary citation-indexed literature (Web of Science), while minimizing substantial overlap in the initial retrieval. Given the focused clinical question and the predominantly dental/oral-surgical literature, these three databases were considered the core sources for the review; however, the absence of additional databases such as Embase and the Cochrane Library is acknowledged as a limitation. The search strategy employed advanced search functions available within each database, targeting publications dated between January 2016 and June 2026. Specific keywords were used in combination with predefined inclusion criteria. All retrieved records were manually screened, beginning with titles and abstracts, followed by full-text evaluation. Articles that met the exclusion criteria were discarded (Figure 1). For each eligible study, the data-extraction form recorded patient age, clinical indication for removal, anatomical location, diagnostic imaging modality, surgical approach, operative details, complications, and follow-up outcomes. No age-based effect estimate was planned because age, indication, tooth morphology, and anatomical complexity were too inconsistently reported to support a reliable correlation analysis. The diagnostic imaging modality was recorded whenever reported, including periapical, occlusal, and panoramic/orthopantomographic radiographs, CT, CBCT, and localization techniques.

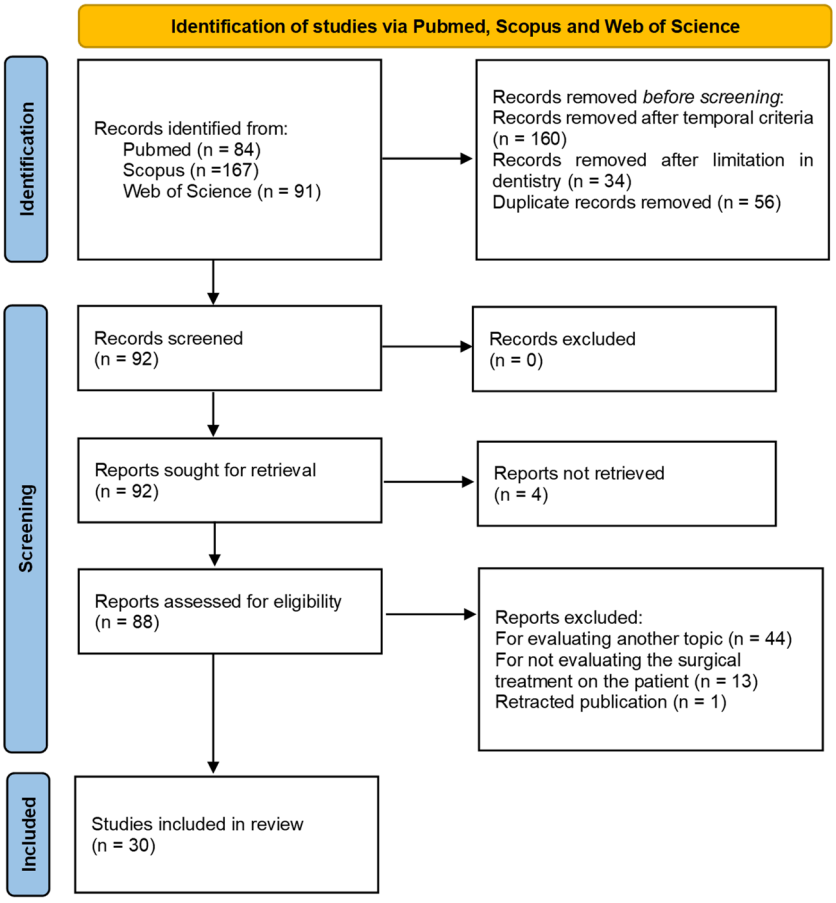


Figure 1. PRISMA flow diagram.

The searches were carried out between January and June 2026; the last search in PubMed, Scopus and Web of Science was run in June 2026. No restriction of language or of publication status was applied, and eligibility was judged based on the content of each record alone. Records were exported and compared manually; no reference-management or screening software and no automation tool were used at any stage of the process.

2.3. Selection Criteria

Inclusion criteria include:

- Human subjects.
- Patients with a mesiodens.
- Patients who underwent oral surgical procedures to treat the mesiodens, including mesiodens located in atypical anatomical sites such as the nasal floor, nasal cavity, nasopalatine canal, or other ectopic locations when surgical treatment was performed.
- Articles that clearly and explicitly described the surgical treatment sufficiently to reconstruct the access route, bone management, and flap or incision design.

Exclusion criteria include:

- Non-human subjects.
- Patients without the mesiodens.
- Reports in which the mesiodens was managed exclusively by observation or radiographic follow-up without surgical intervention.
- Articles that did not describe the surgical treatment sufficiently to reconstruct the operative procedure.

A report was considered to clearly and explicitly describe the surgical procedure if it allowed for the reconstruction of the access route, the management of the overlying bone, and the flap or incision design; reports merely stating that the tooth had been extracted, without these details, were excluded. This criterion was applied independently by three authors (B.A., H.Z.H. and M.C.), with any discrepancies resolved by a fourth (C.S.). For the purpose of synthesis, studies were grouped according to the access route—distinguishing between palatal, labial or vestibular, nasal floor (or transnasal), endoscopic, and combined approaches—and, within each group, according to the use of surgical guides, navigation systems, or piezosurgery; demographic and outcome data were grouped by study design to distinguish the contribution of comparative studies from that of uncontrolled studies.

2.4. Search Terms

The following keywords were applied consistently across all databases to identify relevant studies:

- "Mesiodens", "impacted mesiodens", and "inverted mesiodens" to identify studies focused on the mesiodens, in particular in complex cases.
- "Extraction", "surgical approach", "surgical technique", and "surgical removal" to identify studies focused on the surgical approach.

Keywords were subsequently structured into a Medical Subject Heading (MeSH) query and applied uniformly across all databases:

MeSH terms used in Pubmed:

(mesiodens [Title/Abstract] OR "impacted mesiodens" [Title/Abstract] OR "inverted mesiodens" [Title/Abstract]) AND ("surgical approach" [Title/Abstract] OR "surgical technique" [Title/Abstract] OR extraction [Title/Abstract]).

MeSH terms used in Scopus in article title, abstract, keywords:

(mesiodens OR "impacted mesiodens" OR "inverted mesiodens") AND ("surgical aproach" OR "surgical technique" OR extraction OR "surgical removal").

MeSH terms used in Web of Science in topic:

(mesiodens OR "impacted mesiodens" OR "inverted mesiodens") AND ("surgical aproach" OR "surgical technique" OR extraction OR "surgical removal").

2.5. Screening and Data Extraction Process

Titles, abstracts and the full text were analyzed independently by three authors (B.A., H.Z.H. and M.C.M.N). If they considered a study inappropriate, the study was excluded. A fourth author (C.S.) resolved any disagreements.

Data were extracted independently by three authors (B.A., H.Z.H. and M.C.M.N.) on a common extraction grid corresponding to the items shown in Table 1a–c, and a fourth reviewer (C.S.) checked every extracted record and resolved the disagreements. The same procedure was followed for critical appraisal. The original authors were not contacted for missing or unclear data: items that could not be recovered from the published report were recorded as not reported and appear as such in the tables, and every proportion given in the Results Section is accompanied by the number of studies that actually reported the item, so that the missing data remain visible instead of being absorbed into the denominator.

Two outcomes required an explicit operational definition. Resumption of incisor eruption was recorded as achieved when the report stated that the permanent incisor had erupted spontaneously after removal of the supernumerary, on clinical or radiographic grounds, within the follow-up period described by the authors; no fixed time window could be imposed, because the included studies adopted widely different ones. The need for secondary orthodontics was recorded when the report described an orthodontic appliance applied after the extraction for the purpose of aligning or erupting the permanent incisors and excluded treatment already in progress for unrelated reasons. Preservation of adjacent teeth was recorded as achieved when the report stated that no adjacent teeth had been damaged, devitalized or extracted during or after the procedure. Where a report did not allow the item to be judged, it was recorded as not reported rather than as a negative finding.

Graphs and tables were created using spreadsheet applications Google Sheets and Microsoft Excel.

No effect measures of the outcome were calculated. No records were excluded at the title-and-abstract screening stage. At the full-text assessment stage, 58 reports were excluded for the reasons detailed in the PRISMA flow diagram and Supplementary Table S1.

In PubMed, the MeSH strategy yielded 84 articles, of which 49 met the temporal criteria. Of these articles 23 were excluded due to selection criteria, 7 were excluded because the articles did not analyze the surgical treatment and 1 because it had been retracted. One article could not be retrieved.

In Scopus, the search returned 167 articles, of which 78 met the temporal criteria and 51 were limited to dentistry. Of these articles 23 were duplicates, 10 were excluded due to selection criteria, and 5 were excluded because the articles did not analyze the surgical treatment on their patient. Three articles could not be retrieved.

In Web of Science, the search returned 91 articles, of which 55 met the temporal criteria and 48 were limited to dentistry. Of these articles 33 were duplicates, 11 were excluded due to selection criteria, and 1 was excluded because the article did not analyze the surgical treatment on their patient.

2.6. Quality Assessment

The methodological quality of the 30 included studies was assessed using the Joanna Briggs Institute (JBI) critical appraisal tools, applying the checklist corresponding to each study's design to each study. Consistent with the adopted classification,

one randomized controlled trial (RCT checklist, 13 items), four cohort studies (cohort checklist, 11 items), 12 case series (case series checklist, 10 items), and 13 case reports (case reports checklist, 8 items) were assessed. Responses to each item were coded as "Yes", "No", "Unclear" and "Not applicable". The methodological appraisal of the included studies was conducted using the Joanna Briggs Institute (JBI) critical appraisal checklists corresponding to each study design. The checklists were used to examine the methodological features and completeness of reporting relevant to each design. Responses to individual items were recorded as "Yes", "No", "Unclear" or "Not applicable". In accordance with JBI guidance, no overall summary score was used to classify case reports or case series as having a low, moderate or high risk of bias. The appraisal was performed independently by the reviewers, with disagreements resolved through discussion and review by the designated reviewer.

The appraisal was carried out independently by three authors (B.A., H.Z.H. and M.C.M.N.) and checked by the fourth (C.S.).

3. Results

The review included 30 articles (Figure 2) on the surgical treatment of mesiodens. Data was extracted and summarized in tabular form (Table 1a–c and Table S2). The articles consisted of 13 case reports (43.3%), 12 case series (40.0%), four cohort studies (13.3%), of which three were retrospective and one prospective, and one randomized controlled trial (3.3%). Each report was classified and subsequently appraised, according to the design of the clinical material it contributes, so that reports combining a review of the literature with the authors' own cases were treated as case reports. Since studies with a more robust design were a minority and predominant studies were case reports and small series, not comparable with each other for homogeneous outcomes and lacking matched control groups, the analysis was descriptive.

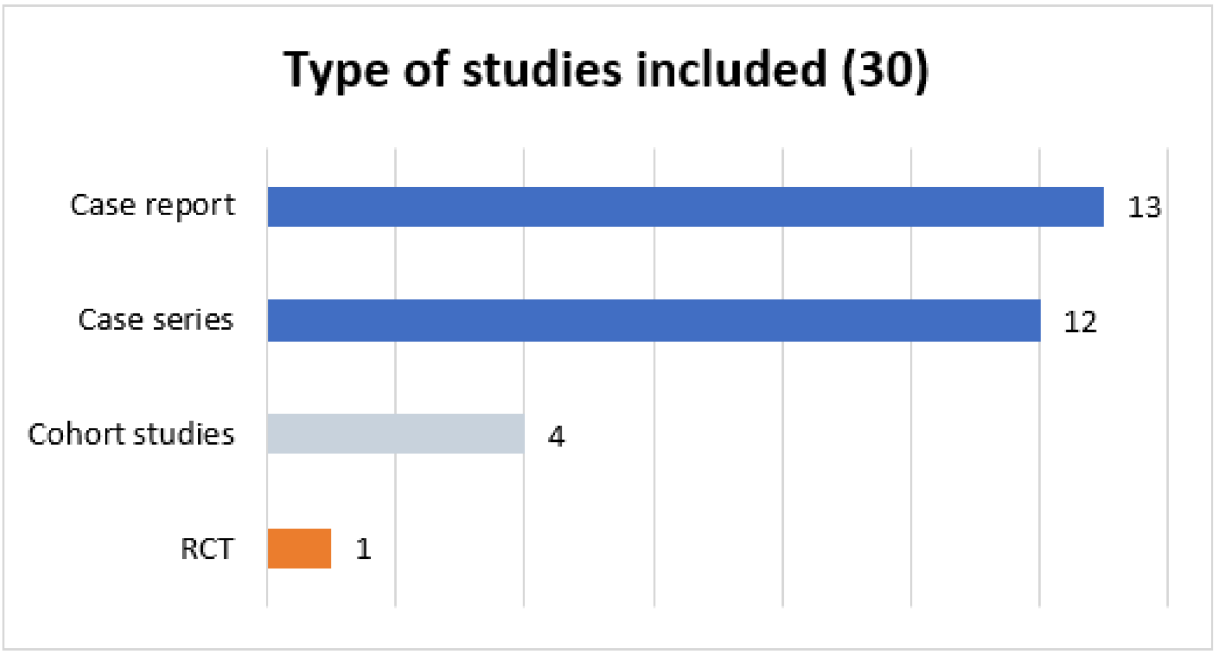


Figure 2. Horizontal bar chart of the 30 studies included. "RCT": Randomized controlled trial.

Table 1. (**a**) The first part of the table presents the research results. The study type, patient information and mesiodens characteristics are described here. "NR": Not reported in the article. (**b**) The second part of the table presents the research results. Descriptions of mesiodens treatment are described here. "NR": Not reported in the article. Surgical approaches reported by Kong et al.; PGMA, palatal gingival margin approach; LPA, local palatal approach; LGMA, labial gingival margin approach; LLA, local labial approach; CLPA, combined labial–palatal approach. (**c**) The third part of the table presents the research results. Descriptions of mesiodens treatment outcome are shown here. "NR": Not reported in the article. "NA": Not applicable.

(**a**)

N	Authors (Year)	Type of Study	Patient/Group	N. Mesiodens	Sex	Age (Years)	Mesiodens Morphology	Mesiodens Orientation	Mesiodens Position
17	Urechescu et al. (2024) [17]	Case series	Case 1	1	F	29	NR	Inverted	Covered by bone; anterior to the nasopalatine canal; nasal axis/floor angle: 85.93°; ANS: 8.98 mm; buccal distance: 4.71 mm; palatal: 6.43 mm
			Case 2	1	M	11	NR	Inverted	Submucosal; anterior to the nasopalatine canal; nasal axis/floor angle: 143.5°; ANS: 8.11 mm; buccal distance: 3.70 mm; palatal: 5.47 mm
			Case 3	1	M	16	NR	Inverted	Covered by bone; anterior to the nasopalatine canal; nasal axis/floor angle: 144.4°; ANS: 13.22 mm; buccal distance: 3.84 mm; palatal: 6.82 mm
18	Yusa et al. (2023) [18]	Retrospective observational study	Group (121)	147 (1 in 96 patients; 2 in 24 patients; 3 in 1 patient)	82 M (67.8%)/39 F (32.2%); M:F 2.1:1	Average: 7.6 ± 3.1 (range: 4–35)	NR	Inverted: 80/147 (54.4%); normal: 43 (29.3%); horizontal: 24 (16.3%)	Sagittal position: Type 1: 16.3%; Type 2: 29.9%; Type 3: 53.7%
19	Koyama et al. (2023) [19]	Case series	Case 1	2	M	9	NR	Inverted (both, palatal)	Palatal; in contact with the root of the permanent tooth for the most part
			Case 2	1	M	11	NR	Inverted	The crown pierced the floor of the nasal fossa
			Case 3	2	M	7	NR	One erupted; one inverted	One erupted between the deciduous central incisors; one inverted between the permanent central incisors
20	Kong et al. (2022) [20]	Retrospective observational study	Group (625)	877 (1 in 371 patients; 2 in 252 patients; ≥3 in 2 patients)	478 M (76.5%)/147 F (23.5%); M:F ≈ 3.25:1	Average: 7.53 ± 2.05 (range: 4.2–16.5)	NR	Included mesiodens (775): inverted: 52.0%; obtuse angle: 18.6%; acute angle: 15.5%; vertical: 13.9%	Eruption status (877): erupted: 11.6%, included: 88.4%. Case types (625): inverted: 43.0%; obtuse: 18.9%; mixed: 14.1%; acute: 13.1%; vertical: 10.9%

Table 1. *Cont.*

(**a**)

N	Authors (Year)	Type of Study	Patient/Group	N. Mesiodens	Sex	Age (Years)	Mesiodens Morphology	Mesiodens Orientation	Mesiodens Position
21	Shetty et al. (2024) [21]	Case series	Case 1	1	F	8	NR	Inverted	Labial
			Case 2	1	M	7.5	NR	Inverted	Near the roots of 11 and 21 (rotated/palatally tilted); distance from the nasopalatine canal: 1.62 mm; less labial bone coverage
22	Ku et al. (2023) [22]	Case series	Case 1	1	M	8	NR	Inverted	Near the roots of the incisors; covered by the cortex of the nasal floor; ANS: 11.89 mm
			Case 2	1	F	7	NR	Inverted	Near the roots of the incisors; covered by cortex; ANS: 10.90 mm
			Case 3	1	M	9	NR	Inverted	Near the roots of the incisors; covered by cortex; ANS: 10.24 mm
23	Iacomino et al. (2024) [23]	Case report	Case 1	1	M	27	Length: 14 mm; short cone-shaped root with apical dilaceration; crown with incisor/canine characters	Inverted	In the nasal septum (rare location); crown at the base of the septum; penetrating into the nasal cavity; displacement of the septum
24	Li et al. (2023) [24]	Prospective single-blind randomized controlled trial	Group IA (intranasal subperiosteal) = 10	10 (1/pz)	5 M/5 F	Average: 10.03 ± 1.92	Type IV according to Liu's classification; length: 6–8 mm, crown diameter: 3–5 mm (inclusion criteria)	Inverted	High; ANS: 9.30 ± 1.49 mm; labial bone distance: 5.00 ± 1.05 mm; palatal: 4.60 ± 0.70 mm
			Group LA (labial) = 10	10 (1/pz)	7 M/3 F			Inverted	High; ANS: 9.90 ± 1.85 mm; labial bone distance: 4.60 ± 0.70 mm; palatal: 4.50 ± 0.71 mm
			Group PA (palatal)—n = 10	10 (1/pz)	6 M/4 F			Inverted	High; ANS: 9.60 ± 2.01 mm; labial bone distance: 4.80 ± 1.03 mm; palatal: 4.70 ± 0.95 mm
25	Yoshizaki et al. (2025) [25]	Case series	Case 1	1	M	6	NR	Inverted	Intraosseous; in contact with the nasal cavity and near the root of the 21
			Case 2	2	M	7		Inverted	First mesiodens in proximity to the nasal cavity; second mesiodens posterior to the median region
			Case 3	1	M	27		Inverted	Labial and intraosseous; root of 1 and mesiodens in contact

Table 1. *Cont.*

(**a**)

N	Authors (Year)	Type of Study	Patient/Group	N. Mesiodens	Sex	Age (Years)	Mesiodens Morphology	Mesiodens Orientation	Mesiodens Position
26	Sharifi et al. (2021) [26]	Case report	Case 1	2	M	9	NR	Inverted	Anterior region of the nasal floor, near the ANS and piriform aperture; on both sides of the septum; crowns covered by a thin layer of nasal floor; near the roots of the incisors
27	Tapia Contreras et al. (2024) [27]	Case series	Case 1	1	M	10	NR	Inverted (80%)/vertical caudal crown (20%)	Non-erupted
			Case 10	1	F	12	NR		
			Case 2	1	M	12	NR		
			Case 3	1	F	10	NR		
			Case 4	1	M	13	NR		
			Case 5	1	F	12	NR		
			Case 6	1	F	11	NR		
			Case 7	1	F	9	NR		
			Case 8	1	M	11	NR		
			Case 9	1	F	10	NR		
28	Yang et al. (2022) [28]	Case series	Case 1	1	M	9	NR	Inverted	Impacted lower than the apical level of the incisor; close to the nasal floor; left deciduous tooth persists
			Case 2	2	M	29	NR	One horizontal (labiopalatal); one vertically inverted	The vertical in contact with the nasal floor, higher than the apical level of the incisor
			Case 3	1	F	19	NR	Inverted	Higher than the apical level of the incisor, crossing the nasal floor

Table 1. *Cont.*

(a)									
N	**Authors (Year)**	**Type of Study**	**Patient/Group**	**N. Mesiodens**	**Sex**	**Age (Years)**	**Mesiodens Morphology**	**Mesiodens Orientation**	**Mesiodens Position**
29	Hauer et al. (2019) [29]	Prospective cohort study	Case 1	1	M	9	Conical	Inverted	At the base of the nasal cavity/septum, ventral to the incisive canal; at the level/dorsal; ANS crown: 19 mm; outside the septum (right)
			Case 2	1	M	11	Conical	Inverted	At the base of the nasal cavity/septum, ventral to the incisive canal; dorsal/ventral; ANS crown: 12 mm; inside the septum
			Case 3	2	M	13	Conical	One inverted; one erupted palatally	At the base of the nasal cavity/septum, ventral to the incisive canal; dorsal/lateral; ANS crown: 9 mm; inside the septum (left)
29	Hauer et al. (2019) [29]	Prospective cohort study	Case 4	1	M	10	Conical	Inverted	At the base of the nasal cavity/septum, ventral to the incisive canal; ventral/dorsal; ANS crown: 13 mm; outside the septum (left)
			Case 5	1	F	16	Conical	Inverted	At the base of the nasal cavity/septum, ventral to the incisive canal; dorsal/dorsal; ANS crown: 12 mm; inside the septum
			Case 6	1	M	10	Tuberculate	Inverted	At the base of the nasal cavity/septum, ventral to the incisive canal; at the level/dorsal; ANS crown: 12 mm; outside the septum (left)
			Case 7	2	M	7	Conical	One inverted; one erupted palatally	At the base of the nasal cavity/septum, ventral to the incisive canal; dorsal/dorsal; ANS crown: 11 mm; outside the septum (left)
			Case 8	1	F	17	Conical	Inverted	At the base of the nasal cavity/septum, ventral to the incisive canal; at the level/dorsal; ANS crown: 16 mm; inside the septum

Table 1. *Cont.*

(a)									
N	**Authors (Year)**	**Type of Study**	**Patient/Group**	**N. Mesiodens**	**Sex**	**Age (Years)**	**Mesiodens Morphology**	**Mesiodens Orientation**	**Mesiodens Position**
29	Hauer et al. (2019) [29]	Prospective cohort study	Case 9	1	M	12	Conical	Inverted	At the base of the nasal cavity/septum, ventral to the incisive canal; dorsal/dorsal; ANS crown: 17 mm; outside the septum (right)
30	Nam et al. (2017) [30]	Case report	Case 1	2	F	9	Conical	Inverted	Vertical in the maxilla, superior to the roots of the incisors; intraosseous
31	Hu et al. (2017) [31]	Retrospective comparative observational study	Group I (with guide)—n = 4	NR (per patient)	6 F/2 M	Average: 19.13 (range: 14–28)	NR	NR	In the premaxilla, high/deep, under the anterior nasal spine (ANS)
			Group II (freehand)—n = 4	NR (per patient)			NR	NR	
32	Pourheidary (2025) [32]	Case report	Case 1	2	F	11	Dens invaginatus in both; anomalous/bulbous corona	NR	Anterior maxillary region, between the roots of the deciduous central incisors, palato-buccal direction; they obstructed the eruption path of the permanent central incisors
33	Šarac et al. (2021) [33]	Case report	Case 1	2	M	17	One fused (incomplete fusion) with the 21st and rotated; the other with a canine-like morphology	NR	The first vestibular/interincisal, attached to the crown and cervical part of the root of 21; the second palatal
34	Jang, Lee, Kim (2025) [34]	Case series	Case 1	1	F	7	NR	Inverted	In the root growth area of the permanent central incisors
			Case 2	1	M	12	NR	Inverted	Deep; not in contact with adjacent teeth; parallel to left anterior teeth; root posterior to 21
			Case 3	2	M	8	NR	One erupted normally; one inverted impacted (horizontal)	The inverted: deep, horizontal, on the palatal side, adjacent to the nasal floor, above the right central incisor
35	Kumar et al. (2024) [35]	Case report	Case 1	3	M	10	NR	Buccally oriented	Buccal; associated with deeply impacted permanent central incisors (complete root)

Table 1. *Cont.*

(a)									
N	**Authors (Year)**	**Type of Study**	**Patient/Group**	**N. Mesiodens**	**Sex**	**Age (Years)**	**Mesiodens Morphology**	**Mesiodens Orientation**	**Mesiodens Position**
36	Gupta et al. (2024) [36]	Case series	Case 1	2	M	13	NR	One inverted; one erupted	Inverted: palatal, above the root of the 21; close relation to the nasopalatine canal; perforating the nasal floor
			Case 2	1	M	12	Conical	Inverted	Palatal to 21; buccal crown, palatal root; crown inclined toward the roots of 11 (proclination)
37	Abdellatif et al. (2023) [37]	Case report	Case 1	2	F	9	Both conical (one palatal conical; one buccal horizontal conical)	One horizontal (buccal); one NR (palatal)	Maxillary arch, frontal area; mesiodens: 1 palatal (cone-shaped crown); mesiodens: 2 buccal, horizontal, at the level of the middle thirds of the central incisors
38	Ullah et al. (2023) [38]	Case report	Case 1	2	M	10	NR	NR	Palpable impaction on the palate near the right central/lateral incisor (palatal); eruption in the anterior maxillary region
39	Uppada et al. (2021) [39]	Case report	Case 1	1	NR	NR	NR	Inverted	Midline, between the two central incisors; intraosseous and labial
40	Sujlana et al. (2017) [40]	Case series	Case 1	2	M	12	Conical (the erupted); the second inverted impacted	One erupted; one inverted impacted	One conical erupted palatally; the second apical between the roots of the permanent central incisors, buccal
			Case 2	2	M	8	Conical	Erupted (in the positions of the central incisors)	Conical teeth erupted in the positions of the central incisors, blocking the eruption of the permanent central incisors
41	Jo et al. (2017) [41]	Case series	Case 1	1	F	12	NR (dilacerated root apex)	NR	Palatal crown; dilacerated apex near the root of 21; reference distances (sagittal: 14.10 mm/62.54°)
			Case 2	1	NR	9	NR	NR	Surrounded by upper left central incisor, lateral incisor and canine; difficult access from both sides

Table 1. *Cont.*

(**a**)

N	Authors (Year)	Type of Study	Patient/Group	N. Mesiodens	Sex	Age (Years)	Mesiodens Morphology	Mesiodens Orientation	Mesiodens Position
42	Rahadian et al. (2017) [42]	Case report	Case 1	1	M	11	Conical	NR	Midline, labiopalatal, between the roots of both central incisors; intraosseous
43	Mulimani et al. (2017) [43]	Case report	Case 1	1	M	22	NR	NR	Between the roots of the two central incisors; impacted, lingual; very close to the roots of 21/22 (no contact/resorption); 3.8 mm from the hyperpneumatized left maxillary sinus
44	Yamamoto et al. (2019) [44]	Case series	Case 1	1	M	11	NR	Inverted	Below the nasal floor bone; between the permanent anterior teeth and the nasopalatine duct; palatal plane/axis angle: 85°; ANS: 11 mm
44	Yamamoto et al. (2019) [44]	Case series	Case 2	1	M	8	NR	Inverted	Below the nasal floor; axis tilted backward; palatal plane/axis angle: 106°; ANS: 13 mm
			Case 3	1	M	8	NR	Inverted	Below the nasal floor; palatal plane/axis angle: 86°; ANS: 10 mm
45	Pallavi et al. (2020) [45]	Case report	Case 1	2	M	11	Tuberculate (incompletely developed roots)	NR	Palatal; slight palpable swelling in relation to 12–22; associated with impaction of the central incisors
46	Abdelemam et al. (2023) [46]	Case report	Case 1	1	M	9	Conical	NR	Right side, blocking the eruption path of the impacted right upper central incisor; labiolingual position

(**b**)

	Authors (year)	Patient/Group	Diagnosis	Use of CBCT	Surgical approach	Guided surgery	Anesthesia	Piezosurgery	Flap
17	Urechescu et al. (2024) [17]	Case 1	Accidental (radiological investigations for orthodontic treatment)	Yes	Intraoral through the nasal floor	No	General + local	No	Canine-to-canine vestibular incision; full-thickness flap up to the ANS/piriform opening; nasal mucosa elevation; 4/0 rapid absorbable suture

Table 1. *Cont.*

(b)									
	Authors (year)	**Patient/Group**	**Diagnosis**	**Use of CBCT**	**Surgical approach**	**Guided surgery**	**Anesthesia**	**Piezosurgery**	**Flap**
17	Urechescu et al. (2024) [17]	Case 2	Accidental (routine radiological investigations)	Yes	Intraoral through the nasal floor	No	General + local	No	Canine-to-canine vestibular incision; full-thickness flap up to the ANS/piriform opening; nasal mucosa elevation; 4/0 rapid absorbable suture
		Case 3	Accidental (radiological investigations for orthodontic treatment)	Yes	Intraoral through the nasal floor	No	General + local	No	Canine-to-canine vestibular incision; full-thickness flap up to the ANS/piriform opening; nasal mucosa elevation; 4/0 rapid absorbable suture
18	Yusa et al. (2023) [18]	Group (121)	Mostly incidental: routine radiography: 65.3%; delayed eruption: 15.7%; eruption: 5.8%; retained deciduous: 3.3%; diastema: 3.3%; malocclusion: 3.3%; swelling: 1.7%; pain: 1.7%	Yes (TC)	Palatal: 110/119 (92.4%); vestibular: 5 (4.2%); modified maxillary vestibular: 4 (3.4%)	No	General	NR	NR
19	Koyama et al. (2023) [19]	Case 1	Symptomatic (malocclusion, reported by the mother)	Yes (TC)	Palatal	Yes, mixed reality (Microsoft HoloLens; CarnaLife Holo software; 3D hologram from CT)	General	No	NR
		Case 2	Symptomatic (malocclusion)	Yes	Labial	Yes, mixed reality (Microsoft HoloLens; CarnaLife Holo software; 3D hologram from CT)	General	No	Gingivobuccal incision; dissection up to the anterior nasal spine and lower margin of the pyriform foramen
		Case 3	Symptomatic (malocclusion)	Yes	Labial	Yes, mixed reality (Microsoft HoloLens; CarnaLife Holo software; 3D hologram from CT)	General	No	Cervical incision

Table 1. *Cont.*

					(b)				
	Authors (year)	**Patient/Group**	**Diagnosis**	**Use of CBCT**	**Surgical approach**	**Guided surgery**	**Anesthesia**	**Piezosurgery**	**Flap**
20	Kong et al. (2022) [20]	Group (625)	NR	Yes	PGMA: 65.4%; CLPA: 16.0%; LPA: 9.4%; LGMA: 6.6%; LLA: 2.6%	No	General suggested for complex/uncooperative cases (otherwise NR)	NR	Variable
21	Shetty et al. (2024) [21]	Case 1	Symptomatic (midline diastema/esthetic)	No	Labial	No	Local	No	Full-thickness flap from distal 11 to 12; bone guttering to expose the apex; extraction without sectioning; interrupted sutures (3-0 silk)
		Case 2	Symptomatic (misplaced front teeth/esthetics)	Yes	Labial	No	Local	No	Full-thickness flap from distal 11 to 12; bone guttering to expose the apex; extraction without sectioning; interrupted sutures (3-0 silk)
22	Ku et al. (2023) [22]	Case 1	NR	Yes	Through the nasal floor (labial vestibular access)	No	General + local	No	Labial vestibular incision; mucoperiosteal flap towards the ANS/nasal floor; nasal mucosa elevation; floor grinding; 4-0 Vicryl suture
		Case 2	NR	Yes	Through the nasal floor (labial vestibular access)	No	General + local	No	Labial vestibular incision; mucoperiosteal flap towards the ANS/nasal floor; nasal mucosa elevation; floor grinding; 4-0 Vicryl suture
22	Ku et al. (2023) [22]	Case 3	NR	Yes	Through the nasal floor (labial vestibular access)	No	General + local	No	Labial vestibular incision; mucoperiosteal flap towards the ANS/nasal floor; nasal mucosa elevation; floor grinding; 4–0 Vicryl suture
23	Iacomino et al. (2024) [23]	Case 1	Symptomatic (bloody discharge, pain, nasal obstruction; ~6 years of misdiagnosed symptoms)	Yes	Nasal endoscopic (exclusively intranasal, through the nostrils)	No (endoscope-assisted: Hopkins 0° endoscope; microdebrider)	NR	No (microdebrider)	Vertical hemitransfixion incision of the septum; submucoperichondral plane; bilateral mucoperichondral flap elevation; endoscopic osteotomy on the floor

Table 1. *Cont.*

					(b)				
	Authors (year)	**Patient/Group**	**Diagnosis**	**Use of CBCT**	**Surgical approach**	**Guided surgery**	**Anesthesia**	**Piezosurgery**	**Flap**
24	Li et al. (2023) [24]	Group IA (intranasal subperiosteal)—n = 10	Orthodontic reasons (no cysts/infections; detail for NR patient)	Yes	Intranasal subperiosteal (with subperiosteal dissection up to the piriformis and ANS)	No	General	Yes (in all groups)	Incision with subperiosteal dissection up to the piriformis and ANS; elevation of the nasal mucosa
		Group LA (labial)—n = 10	Orthodontic reasons (no cysts/infections; detail for NR patient)	Yes	Labial	No	General		Labial mucoperiosteal flap from lateral incisor to lateral incisor
24	Li et al. (2023) [24]	Group PA (palatal)—n = 10	Orthodontic reasons (no cysts/infections; detail for NR patient)	Yes	Palatal	No	General		Lateral palatine crevicular flap
25	Yoshizaki et al. (2025) [25]	Case 1	Symptomatic (malocclusion)	Yes	Palatal	Yes, surgical guide (surgical plate + 3D impaction model (CBCT/CT + 3Shape intraoral scan; 3D Slicer; Formlabs 3D printing))	General	No	Plaque-guided gingival incision, above the impacted tooth (not detailed)
		Case 2	Symptomatic (malocclusion)	Yes	Palatal	Yes, surgical guide (surgical plate + 3D impaction model (CBCT/CT + 3Shape intraoral scan; 3D Slicer; Formlabs 3D printing))	General	No	Plaque-guided gingival incision, above the impacted tooth (not detailed)
		Case 3	Symptomatic (discomfort in the anterior maxillary region)	Yes	Labial	Yes, surgical guide (surgical plate + 3D impaction model (CBCT/CT + 3Shape intraoral scan; 3D Slicer; Formlabs 3D printing))	General	No	Plaque-guided gingival incision, above the impacted tooth (not detailed)
26	Sharifi et al. (2021) [26]	Case 1	Accidental (routine dental check-up; normal dentition)	Yes	Intraoral through the nasal floor, subperiosteal dissection	No	Local	Yes	Full-thickness scalloped vestibular incision from lateral incisor to lateral incisor; two "V"-releasing incisions around the frenulum; subperiosteal dissection; 4–0 Vicryl suture

Table 1. *Cont.*

(b)									
	Authors (year)	**Patient/Group**	**Diagnosis**	**Use of CBCT**	**Surgical approach**	**Guided surgery**	**Anesthesia**	**Piezosurgery**	**Flap**
27	Tapia Contreras et al. (2024) [27]	Case 1	Mostly orthodontic (90%); 10% referral from pediatric dentistry	Yes	Non-endoscopic transnasal intraoral (nasal floor dissection)	No	General + local	No	Linear vestibular approach <1 cm above the tips of the central incisors; subperiosteal dissection; 4–0 Vicryl suture
		Case 10		Yes	Non-endoscopic transnasal intraoral (nasal floor dissection)	No	General + local	No	Linear vestibular approach <1 cm above the tips of the central incisors; subperiosteal dissection; 4–0 Vicryl suture
		Case 2		Yes	Non-endoscopic transnasal intraoral (nasal floor dissection)	No	General + local	No	Linear vestibular approach <1 cm above the tips of the central incisors; subperiosteal dissection; 4–0 Vicryl suture
		Case 3		Yes	Non-endoscopic transnasal intraoral (nasal floor dissection)	No	General + local	No	Linear vestibular approach <1 cm above the tips of the central incisors; subperiosteal dissection; 4–0 Vicryl suture
		Case 4		Yes	Non-endoscopic transnasal intraoral (nasal floor dissection)	No	General + local	No	Linear vestibular approach <1 cm above the tips of the central incisors; subperiosteal dissection; 4–0 Vicryl suture
		Case 5		Yes	Non-endoscopic transnasal intraoral (nasal floor dissection)	No	General + local	No	Linear vestibular approach <1 cm above the tips of the central incisors; subperiosteal dissection; 4–0 Vicryl suture
		Case 6		Yes	Non-endoscopic transnasal intraoral (nasal floor dissection)	No	General + local	No	Linear vestibular approach <1 cm above the tips of the central incisors; subperiosteal dissection; 4–0 Vicryl suture
		Case 7		Yes	Non-endoscopic transnasal intraoral (nasal floor dissection)	No	General + local	No	Linear vestibular approach <1 cm above the tips of the central incisors; subperiosteal dissection; 4–0 Vicryl suture
		Case 8		Yes	Non-endoscopic transnasal intraoral (nasal floor dissection)	No	General + local	No	Linear vestibular approach <1 cm above the tips of the central incisors; subperiosteal dissection; 4–0 Vicryl suture
		Case 9		Yes	Non-endoscopic transnasal intraoral (nasal floor dissection)	No	General + local	No	Linear vestibular approach <1 cm above the tips of the central incisors; subperiosteal dissection; 4–0 Vicryl suture

Table 1. *Cont.*

(b)									
	Authors (year)	**Patient/Group**	**Diagnosis**	**Use of CBCT**	**Surgical approach**	**Guided surgery**	**Anesthesia**	**Piezosurgery**	**Flap**
28	Yang et al. (2022) [28]	Case 1	Orthodontic reason (irregular teeth; mesiodens on X-ray)	Yes	Labial	No	Local	No	Mucoperiosteal flap after horizontal labial vestibular incision
		Case 2	Accidental (palpated palatal protuberance, without discomfort; CBCT)	Yes	Labial	No	Local	No	Mucoperiosteal flap after horizontal labial vestibular incision
		Case 3	Accidental (during oral implantology; not visible in the oral cavity; CBCT)	Yes	Labial	No	Local	No	Mucoperiosteal flap after horizontal labial vestibular incision
29	Hauer et al. (2019) [29]	Case 1	Accidental (asymptomatic; orthodontic indication)	Yes	Modified maxillary vestibular + subperiosteal intranasal dissection	No	General + local	Yes (in some cases)	Horizontal paramarginal incision ~3 cm below the fornix; periosteal cut; piriformis and ANS exposure; dorsal subperiosteal dissection; ANS always preserved; absorbable suture
		Case 2	Accidental (asymptomatic; orthodontic indication)	Yes	Modified maxillary vestibular + subperiosteal intranasal dissection	No	General + local		Horizontal paramarginal incision ~3 cm below the fornix; periosteal cut; piriformis and ANS exposure; dorsal subperiosteal dissection; ANS always preserved; absorbable suture
		Case 3	Accidental (asymptomatic; orthodontic indication)	Yes	Modified maxillary vestibular + subperiosteal intranasal dissection	No	General + local		Horizontal paramarginal incision ~3 cm below the fornix; periosteal cut; piriformis and ANS exposure; dorsal subperiosteal dissection; ANS always preserved; absorbable suture
		Case 4	Accidental (asymptomatic; orthodontic indication)	Yes	Modified maxillary vestibular + subperiosteal intranasal dissection	No	General + local		Horizontal paramarginal incision ~3 cm below the fornix; periosteal cut; piriformis and ANS exposure; dorsal subperiosteal dissection; ANS always preserved; absorbable suture
		Case 5	Accidental (asymptomatic; orthodontic indication)	Yes	Modified maxillary vestibular + subperiosteal intranasal dissection	No	General + local		Horizontal paramarginal incision ~3 cm below the fornix; periosteal cut; piriformis and ANS exposure; dorsal subperiosteal dissection; ANS always preserved; absorbable suture

Table 1. *Cont.*

(b)									
	Authors (year)	**Patient/Group**	**Diagnosis**	**Use of CBCT**	**Surgical approach**	**Guided surgery**	**Anesthesia**	**Piezosurgery**	**Flap**
29	Hauer et al. (2019) [29]	Case 6	Accidental (asymptomatic; orthodontic indication)	Yes	Modified maxillary vestibular + subperiosteal intranasal dissection	No	General + local		Horizontal paramarginal incision ~3 cm below the fornix; periosteal cut; piriformis and ANS exposure; dorsal subperiosteal dissection; ANS always preserved; absorbable suture
		Case 7	Accidental (asymptomatic; orthodontic indication)	Yes	Modified maxillary vestibular + subperiosteal intranasal dissection	No	General + local		Horizontal paramarginal incision ~3 cm below the fornix; periosteal cut; piriformis and ANS exposure; dorsal subperiosteal dissection; ANS always preserved; absorbable suture
		Case 8	Accidental (asymptomatic; orthodontic indication)	Yes	Modified maxillary vestibular + subperiosteal intranasal dissection	No	General + local		Horizontal paramarginal incision ~3 cm below the fornix; periosteal cut; piriformis and ANS exposure; dorsal subperiosteal dissection; ANS always preserved; absorbable suture
		Case 9	Accidental (asymptomatic; orthodontic indication)	Yes	Modified maxillary vestibular + subperiosteal intranasal dissection	No	General + local		Horizontal paramarginal incision ~3 cm below the fornix; periosteal cut; piriformis and ANS exposure; dorsal subperiosteal dissection; ANS always preserved; absorbable suture
30	Nam et al. (2017) [30]	Case 1	Intentional detection	Yes	NR	Yes, surgical guide (customized surgical stent from CBCT (vacuum-formed splint + 3 gutta-percha cones; OnDemand 3D; resin))	General	No	Full-thickness flap; stent placement for pilot drilling; bone removal based on the two guide holes
31	Hu et al. (2017) [31]	Group I (with guide)—n = 4	NR	Yes	Trapdoor method (vascularized pedicled bone flap), vestibular access	Yes, surgical guide (CAD surgical guide from CT/CBCT + optical scan models (Mimics; Geomagic))	Local	Yes	Upper vestibule incision; subperiosteal exposure; trapezoid/pentagon buccal osteotomy with piezosurgery; pedicled bone flap elevation
		Group II (freehand)—n = 4	NR	Yes	Trapdoor method (vascularized pedicled bone flap), vestibular access	No	Local	Yes	Upper vestibule incision; subperiosteal exposure; trapezoid/pentagon buccal osteotomy with piezosurgery; pedicled bone flap elevation

Table 1. *Cont.*

					(**b**)				
	Authors (year)	**Patient/Group**	**Diagnosis**	**Use of CBCT**	**Surgical approach**	**Guided surgery**	**Anesthesia**	**Piezosurgery**	**Flap**
32	Pourheidary (2025) [32]	Case 1	Symptomatic (failure/delayed eruption of permanent central incisors)	Yes	Labial	No	Local	No	Buccal submarginal mucoperiosteal flap; decidual removal; buccal cortical removal; extraction of the 2 mesiodentes; GBR; PGA 4/0 suture
33	Šarac et al. (2021) [33]	Case 1	Orthodontic reason	No (OPG + periapical radiographs)	Combined vestibular + palatal (1st phase); vestibular (2nd phase)	No	Local	No	1st phase: unilateral vestibular-releasing incision + palatal flap (palatal extracted); 2nd phase: Nowak–Peter incision + submucosal periosteal graft for the papilla
34	Jang, Lee, Kim (2025) [34]	Case 1	Accidental (routine examination in private practice); pre-orthodontic extraction	Yes	Palatal	Yes, surgical guide (custom surgical guide from CBCT + intraoral scan (R2GATE/FACEGIDE; Raydent print; open U-guide))	General + local	No	Palatal flap from 53 to 63; bone removal under irrigation
		Case 2	Orthodontic reason	Yes	Labial	Yes, surgical guide (custom surgical guide from CBCT + intraoral scan (R2GATE/FACEGIDE; Raydent print; open U-guide))	General + local	No	Flap 13 to 23; bone removal at minimum distance from the root
		Case 3	NR	Yes	Palatal	Yes, surgical guide (custom surgical guide from CBCT + intraoral scan (R2GATE/FACEGIDE; Raydent print; open U-guide))	General + local	No	Palatal flap from 54 to 64; bone removal with a high-speed round bur
35	Kumar et al. (2024) [35]	Case 1	Symptomatic (swelling and pain in the upper front region for 2 weeks; incisors not erupted)	Yes	Labial	No	Local	No	Crestal incision with vertical release; mucoperiosteal flap; extraction of the 3 mesiodentes; bonding brackets on the impacted incisors; 3–0 Vicryl suture
36	Gupta et al. (2024) [36]	Case 1	Symptomatic (anterior tooth malalignment; 2-year history of damage to the same tooth)	Yes	Palatal	No	General	No	Full-thickness palatal flap; exposed with a bone cutter; socket filled with bone wax; 3-0 silk suture

Table 1. *Cont.*

					(b)				
	Authors (year)	**Patient/Group**	**Diagnosis**	**Use of CBCT**	**Surgical approach**	**Guided surgery**	**Anesthesia**	**Piezosurgery**	**Flap**
36	Gupta et al. (2024) [36]	Case 2	Symptomatic (misalignment of front teeth/esthetics)	Yes	Labial	No	Local	No	Complete vestibular incision from 23 to 13; subperiosteal dissection; bone removal with burr; 3–0 silk suture + COE-pack
37	Abdellatif et al. (2023) [37]	Case 1	Symptomatic (transient pain in the maxillary incisor area)	Yes	Combined palatal + vestibular	No	NR	Yes	Palatal removal first with lever (4.0 suture); marginal vestibular flap for the buccal; piezosurgery under microscope; 5.0 suture
38	Ullah et al. (2023) [38]	Case 1	Accidental (visit for pain in tooth 85, decayed; periapical → multiple supernumerary teeth)	No	Palatal	No	Local	No	Palatal flap from 12–11 to 21; dislocation with lever and extraction with forceps
39	Uppada et al. (2021) [39]	Case 1	NR (clinical signs: median diastema and high frenulum)	Yes	Vertical split of the labial frenulum (no traditional crevicular/vestibular flap)	No	Local	No	Full-length frenulum splitting; bilateral tunneled subperiosteal dissection; bone trimming; tooth sectioning and removal
40	Sujlana et al. (2017) [40]	Case 1	Symptomatic (extra tooth with discomfort; sign)	No (Clark's rule for buccal/palatal radiographic localization, occlusal, periapical)	Transnasal (labial mucoperiosteal flap) for inverted teeth; extraction of the erupted teeth on the palatal side	No	Local	No	The palatal eruption was extracted first; then reversed via a transnasal approach with a labial mucoperiosteal flap; bone guttering; 3–0 silk suture.
		Case 2	Symptomatic (unsightly appearance of erupted teeth)	No (Clark's rule for buccal/palatal radiographic localization, occlusal, periapical)	Without flap (erupted teeth)	No	Local	No	Simple extraction
41	Jo et al. (2017) [41]	Case 1	Intentional detection	Yes	Combined palatal + vestibular	Yes, surgical guide (CAD only (simplant software; manually fabricated guide))	General	No	Labial and palatal crevicular incision; drill-guided labial ostectomy; apical cut with fissure bur; palatal ostectomy (round/fissure bur); palatal removal
		Case 2	Symptomatic (unsightly tooth; ectopic eruption of the canine)	Yes	Labial (preceded by orthodontic traction of the canine to create space)	Yes, surgical guide (CAD + CAM (Implant Studio 3Shape; ProJet 3510 3D printing; Trios scanner))	General	No	Orthodontic traction of the canine (~8 months) to create labial space; vertical labial incision; drill-guided labial ostectomy; luxation; removal from the labial side

Table 1. *Cont.*

					(b)				
	Authors (year)	**Patient/Group**	**Diagnosis**	**Use of CBCT**	**Surgical approach**	**Guided surgery**	**Anesthesia**	**Piezosurgery**	**Flap**
42	Rahadian et al. (2017) [42]	Case 1	Symptomatic (labial inversion of the right central incisor; unsightly appearance)	No (periapical + occlusal)	Labial	No	Local	No	Labial (crevicular) incision from mesial of 11 to mesial of 21; full-thickness labial flap; luxation and extraction; silk suture
43	Mulimani et al. (2017) [43]	Case 1	Accidental (incidental finding in orthodontics; routine OPG → mesiodens + extensive sinus)	Yes	Palatal	No	Local	No	Full-thickness mucoperiosteal flap from first premolar to first premolar; mesiodens trimmed completely with handpiece (minimal disruption) instead of dislocation
44	Yamamoto et al. (2019) [44]	Case 1	Symptomatic (local malocclusion/misalignment of upper anterior teeth)	Yes (TC)	Through the nasal floor bone (± palatal approach)	No	General	No	Upper vestibular incision avoiding the frenulum; flap towards the piriformis; elevation of the mucoperiosteum of the floor; bone removal with small chisels; extraction with levers; nylon suture
		Case 2	Symptomatic (local malocclusion/misalignment of upper anterior teeth)	Yes (TC)	Through the nasal floor bone (± palatal approach)	No	General	No	Nasal + palatal approach (angle: > 90°): palatal flap without incising the nasopalatine duct; minimal palatal bone removed; apex pushed from the palatal side; removal through the nasal floor
44	Yamamoto et al. (2019) [44]	Case 3	Symptomatic (local malocclusion/misalignment of upper anterior teeth)	Yes (TC)	Through the nasal floor bone (± palatal approach)	No	General	No	Approach through the nasal floor bone (as in Case 1)
45	Pallavi et al. (2020) [45]	Case 1	Symptomatic (missing upper left incisor after exfoliation)	No (OPG + Clark's rule for buccal/palatal radiographic localization)	Palatal; no removal of underlying bone	No	Local	No	Horizontal incision from 12 to 22; flap raised; extraction of the mesiodens (tuberculate); no removal of underlying bone; 3.0 silk sutures
46	Abdelemam et al. (2023) [46]	Case 1	Symptomatic (unerupted upper right central incisor)	Yes	Labial	No	NR	No	Complete mucoperiosteal flap with superficial vertical incisions; buccal osteotomy; dislocation with curved levers; 4/0 silk suture

Table 1. *Cont.*

(c)									
N	**Authors (year)**	**Patient/Group**	**Intraoperative complications**	**Operating time (min)**	**Postoperative complications**	**Preservation of adjacent teeth**	**Resumption of incisor eruption**	**Need for secondary orthodontics**	**Follow-up**
17	Urechescu et al. (2024) [17]	Case 1	None	30	None	Yes	NR	NR (in orthodontic evaluation)	OPG at 3 years; no complications
		Case 2	None	28	None	Yes	NR	NR	OPG at 3 years; no complications
		Case 3	None	31	None	Yes	NR	NR (in orthodontic evaluation)	OPG at 3 years; no complications
18	Yusa et al. (2023) [18]	Group (121)	NR	Average: 32.2 ± 18.1 (range: 4–91); single mesiodens: 30.7 ± 16.5; by position: Type I: 43.7; Type II: 33.0; Type III: 25.2	NR	NR	NR	NR	NR
19	Koyama et al. (2023) [19]	Case 1	None	47	None	Yes	NR (crowded dentition at 1 year)	NR	Check-ups at 2 weeks and 1 year; complete healing of soft tissue, crowded dentition
		Case 2	None	19	None	Yes	NR	NR	NR
		Case 3	None	30	None	Yes	NR	NR	NR
20	Kong et al. (2022) [20]	Group (625)	NR	NR	NR	NR	NR	NR	NR
21	Shetty et al. (2024) [21]	Case 1	NR	NR	NR	Yes	NR	Yes (post-surgery orthodontic diastema closure)	Monitoring until incisor root development
		Case 2	NR	NR	NR	Yes	NR	Yes (removal for orthodontic purposes)	Monitoring until incisor root development
22	Ku et al. (2023) [22]	Case 1	None	30	None	Yes	NR	NR	NR
		Case 2	None	29	None	Yes	NR	NR	NR
		Case 3	None	30	None	Yes	NR	NR	NR
23	Iacomino et al. (2024) [23]	Case 1	None	NR	None	NA (adult patient; mesiodens located in the nasal septum)	NA	NA	Nasal packing removed on postoperative day 5; uneventful healing

Table 1. *Cont.*

(c)									
N	**Authors (year)**	**Patient/Group**	**Intraoperative complications**	**Operating time (min)**	**Postoperative complications**	**Preservation of adjacent teeth**	**Resumption of incisor eruption**	**Need for secondary orthodontics**	**Follow-up**
24	Li et al. (2023) [24]	Group IA (intranasal subperiosteal)—n = 10	None	40.50 ± 4.33 (minimum osteotomy: 17.96 ± 4.56 mm^3; minimum bleeding: 5.69 mL; identification time: 5.60 min)	Swelling subsided in 7.90 ± 1.60 days; severe pain (VAS): 10%; pain subsided in 5.90 ± 1.85 days; nasal ventilation unchanged	Yes	NR	Yes	Suture removed at 7 days; follow-up at 6 months (no abnormalities in jaw development)
		Group LA (labial)—n = 10	None	40.20 ± 5.18 (osteotomy: 37.37 ± 2.06 mm^3; bleeding: 11.75 mL)	Swelling subsided in 11.70 ± 3.34 days (longest); severe pain (VAS): 30%; pain subsided in 7.90 ± 2.73 days	Yes	NR		Suture removed at 7 days; follow-up at 6 months (no abnormalities in jaw development)
		Group PA (palatal)—n = 10	None	51.90 ± 5.74 (longest; osteotomy: 84.93 ± 11.31 mm^3; bleeding: 15.57 mL)	Swelling subsided in 5.80 ± 1.48 days; severe pain (VAS): 50%; pain subsided in 9.20 ± 1.48 days	Yes	NR		Suture removed at 7 days; follow-up at 6 months (no abnormalities in jaw development)
25	Yoshizaki et al. (2025) [25]	Case 1	None	61	None	Yes	NR	NR	NR
		Case 2	None	44	None	Yes	NR	NR	NR
		Case 3	None	67	None	Yes	NR	NR	NR
26	Sharifi et al. (2021) [26]	Case 1	None	NR	None	Yes	NR	NR	NR

Table 1. *Cont.*

(c)									
N	**Authors (year)**	**Patient/Group**	**Intraoperative complications**	**Operating time (min)**	**Postoperative complications**	**Preservation of adjacent teeth**	**Resumption of incisor eruption**	**Need for secondary orthodontics**	**Follow-up**
27	Tapia Contreras et al. (2024) [27]	Case 1	None	NR	Mild edema + hypoesthesia (1 week)	Yes	NR	NR	Check-ups at 1, 3, 6 months and 1 year
		Case 10	None	NR	None	Yes	NR	NR	Check-ups at 1, 3, 6 months and 1 year
		Case 2	None	NR	None	Yes	NR	NR	Check-ups at 1, 3, 6 months and 1 year
		Case 3	None	NR	Mild edema	Yes	NR	NR	Check-ups at 1, 3, 6 months and 1 year
		Case 4	None	NR	Mild edema + hypoesthesia (1 week)	Yes	NR	NR	Check-ups at 1, 3, 6 months and 1 year
		Case 5	None	NR	None	Yes	NR	NR	Check-ups at 1, 3, 6 months and 1 year
		Case 6	None	NR	None	Yes	NR	NR	Check-ups at 1, 3, 6 months and 1 year
		Case 7	None	NR	None	Yes	NR	NR	Check-ups at 1, 3, 6 months and 1 year
		Case 8	None	NR	Moderate edema + hypoesthesia for 1 month	Yes	NR	NR	Check-ups at 1, 3, 6 months and 1 year
		Case 9	None	NR	None	Yes	NR	NR	Check-ups at 1, 3, 6 months and 1 year
28	Yang et al. (2022) [28]	Case 1	NR	NR	NR	NR	NR	NR	Check-up at 2 weeks
		Case 2	NR	NR	NR	NR	NR	NR	Check-up at 2 weeks
		Case 3	NR	NR	NR	NR	NR	NR	Check-up at 2 weeks

Table 1. *Cont.*

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N	Authors (year)	Patient/Group	Intraoperative complications	Operating time (min)	Postoperative complications	Preservation of adjacent teeth	Resumption of incisor eruption	Need for secondary orthodontics	Follow-up
29	Hauer et al. (2019) [29]	Case 1	None	20	None	Yes	NR	NR (subsequent orthodontics assumed to be less demanding or unnecessary)	Check-up at 1–2 weeks
		Case 2	None	28	None	Yes	NR	NR (subsequent orthodontics assumed to be less demanding or unnecessary)	Check-up at 1–2 weeks
		Case 3	None	28	None	Yes	NR	NR (subsequent orthodontics assumed to be less demanding or unnecessary)	Check-up at 1–2 weeks
		Case 4	None	40	None	Yes	NR	NR (subsequent orthodontics assumed to be less demanding or unnecessary)	Check-up at 1–2 weeks
		Case 5	None	40	None	Yes	NR	NR (subsequent orthodontics assumed to be less demanding or unnecessary)	Check-up at 1–2 weeks
		Case 6	None	45	None	Yes	NR	NR (subsequent orthodontics assumed to be less demanding or unnecessary)	Check-up at 1–2 weeks
		Case 7	None	30	None	Yes	NR	NR (subsequent orthodontics assumed to be less demanding or unnecessary)	Check-up at 1–2 weeks
		Case 8	None	20	None	Yes	NR	NR (subsequent orthodontics assumed to be less demanding or unnecessary)	Check-up at 1–2 weeks
		Case 9	None	22	None	Yes	NR	NR (subsequent orthodontics assumed to be less demanding or unnecessary)	Check-up at 1–2 weeks

Table 1. *Cont.*

(c)									
N	**Authors (year)**	**Patient/Group**	**Intraoperative complications**	**Operating time (min)**	**Postoperative complications**	**Preservation of adjacent teeth**	**Resumption of incisor eruption**	**Need for secondary orthodontics**	**Follow-up**
30	Nam et al. (2017) [30]	Case 1	None	NR	None	Yes	NR	NR	NR
31	Hu et al. (2017) [31]	Group I (with guide)—n = 4	None	11.50 ± 1.29	None	Yes	NR	NR	Average of 13.25 months (range: 6–21); uneventful recovery
		Group II (freehand)—n = 4	1 case required extra osteotomy due to insufficient exposure	15.75 ± 1.71	None	Yes	NR	NR	Average of 13.25 months (range: 6–21); uneventful recovery
32	Pourheidary (2025) [32]	Case 1	None	NR	None	Yes	Central incisors not yet erupted at follow-up (possible delayed eruption: 6–36 months)	Yes (advanced orthodontics with distalization to recover lost space)	Satisfactory healing; eruption not yet occurred
33	Šarac et al. (2021) [33]	Case 1	Unexpected fusion finding (modified 2-stage plan); no major complications	NR	Interincisal recession then treated with grafting	Yes	NA	NR	Suture removal at 8 days; papilla healing at 6 weeks
34	Jang, Lee, Kim (2025) [34]	Case 1	None	NR	None	Yes	NR	Yes (correction of incisor rotation)	Suture removal at 1 week; periapical radiographs/CT
		Case 2	None	NR	None	Yes	NR	Yes	Check-up at 1 week
		Case 3	None	NR	None	Yes	NR	NR	Check-up at 1 week
35	Kumar et al. (2024) [35]	Case 1	None	NR	None	NR	Erupted after 8.5 months with orthodontic extrusion (not spontaneous)	Yes (orthodontic extrusion; leveling/alignment in progress)	Regular follow-up
36	Gupta et al. (2024) [36]	Case 1	NR	NR	NR	NR	NR	NR	Suture removal at 7 days
		Case 2	NR	NR	None	NR	NR	NR	Suture removal at 7 days
37	Abdellatif et al. (2023) [37]	Case 1	None	NR	None	Yes	NR	NR	Check-up at 2 months
38	Ullah et al. (2023) [38]	Case 1	NR	NR	NR	NR	NA	Yes (2 × 4 devices; debonding at 3 months; follow-up after another 3 months)	Recall at 7 days

Table 1. *Cont.*

(c)

N	Authors (year)	Patient/Group	Intraoperative complications	Operating time (min)	Postoperative complications	Preservation of adjacent teeth	Resumption of incisor eruption	Need for secondary orthodontics	Follow-up
39	Uppada et al. (2021) [39]	Case 1	None	NR	None	NR	NR	NR	NR
40	Sujlana et al. (2017) [40]	Case 1	NR	NR	None	NR	NR	NR	Suture removal at 1 week
		Case 2	NR	NR	NR	NR	Spontaneous eruption of central incisors within 1 year	Not required	Reviewed every 2 months for 1 year
41	Jo et al. (2017) [41]	Case 1	None	NR	None	Yes	NA	NR	NR
		Case 2	None	NR	None	Yes	NA	NR (presurgical orthodontic traction of the canine; no post-extraction described)	NR
42	Rahadian et al. (2017) [42]	Case 1	NR	NR	None	NR	NR	NR	1 week
43	Mulimani et al. (2017) [43]	Case 1	NR	NR	None	NR	NA	Yes (extraction of 4 first premolars; orthodontics in progress)	Regular follow-up; ongoing orthodontics
44	Yamamoto et al. (2019) [44]	Case 1	None	NR	None	Yes	NR	NR	NR
		Case 2	None	NR	None	Yes	NR	NR	NR
		Case 3	None	NR	None	Yes	NR	NR	NR
45	Pallavi et al. (2020) [45]	Case 1	NR	NR	NR	Yes	After 4 months: spontaneous eruption on the 21st; on the 11th without signs of eruption	Yes (surgical exposure of 11; brackets on 11/21/22/12; traction; expansion; ~6 months)	Recall after 1 week; reviews every 15 days with periapical radiographs
46	Abdelemam et al. (2023) [46]	Case 1	None	NR	NR	Yes	Orthodontic traction of the impacted right central incisor (until complete alignment)	Yes (integral part: exposure + traction + leveling/alignment; active treatment for 13 months + retention)	Active treatment for 13 months + retention

3.1. Population and Patients' Characteristics

The total surgical population amounted to 845 patients; however, this total is significantly influenced by two large retrospective studies (147 and 877 mesiodentes, with 121 and 625 patients, respectively). Excluding these two studies, the remaining 28 studies described a total of 99 patients. In 22 of the 30 studies (73.3%) every patient treated was under 18 years of age; seven studies included at least one adult and in one the age was not reported.

With respect to age, a mean value was obtained by weighing the mean age reported in each study by its corresponding number of patients. Considering all included studies, the mean age of the surgical population was 8.0 ± 3.0 years. This value is strongly influenced by the two large pediatric cohorts, which reported mean ages of 7.6 and 7.5 years in 121 and 625 patients, respectively. When these two studies were excluded, the mean age of the remaining population was 11.9 ± 5.0 years (Figure 3). Regarding sex, considering the 25 studies that reported it for the individual patient (59 patients), there were 42 males and 17 females, with a clear male predominance (male:female ratio ≈ 2.5:1) (Figure 4). This finding is consistent with the classically described male predilection for mesiodens (Table 1a).

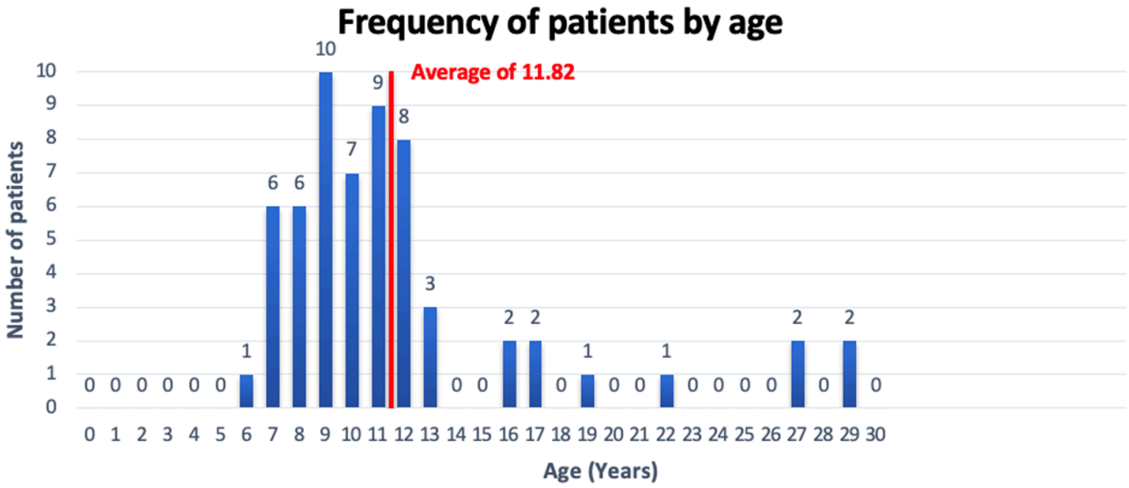


Figure 3. Vertical bar chart of the age distribution of the 60 patients whose individual age was reported; studies reporting only a mean age are not included. Mean: 11.82 years.

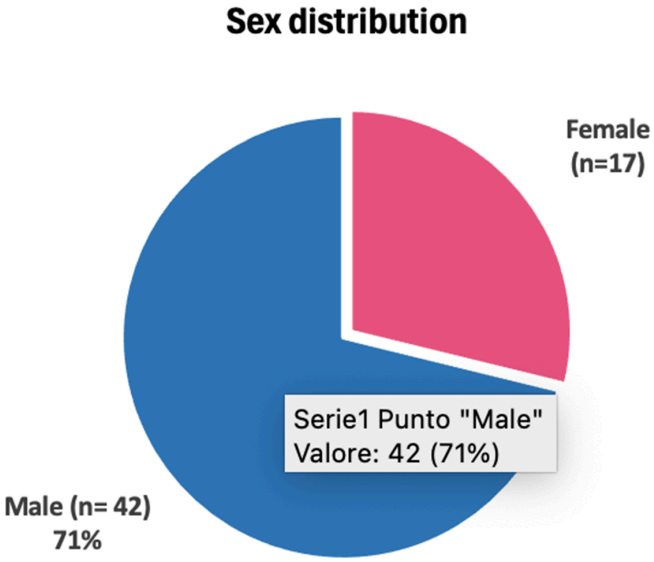


Figure 4. Pie chart of the sex distribution. Only studies that explicitly reported sex were included, with a total of 59 patients.

3.2. Diagnostic Modality and Treatment Indications

The mode of presentation was described at patient level in 25 of the 30 studies. It was symptomatic or clinically evident in 13 of them (52.0%), most often because of malalignment or failure of the incisors to erupt, and swelling or esthetic concern, and asymptomatic in 12 (48.0%), the supernumerary being found on radiographs taken for a routine examination or for orthodontic assessment. The largest series reported this information only in aggregate form, describing it as predominantly incidental, and in four studies it was not reported. The indication for surgical treatment was, in almost all cases, the prevention or correction of eruptive and orthodontic alterations in the permanent incisors.

Cone beam computed tomography (CBCT) was used in 22 of the 30 studies (73.3%) and conventional computed tomography in a further three (10.0%), so that three-dimensional imaging was available for localization and planning in 25 studies (83.3%). In the remaining five studies (16.7%) localization relied on two-dimensional radiographs and on techniques such as the Buccal Object Rule (SLOB/Clark) (Table 1b).

3.3. Surgical Approach and Technique

The approaches described were heterogeneous (palatal, labial/buccal, nasal floor/transnasal, endoscopic). Regarding technological aids, extraction was performed freehand in 24 studies (80.0%), while a surgical guide or dedicated plate was used in five (16.7%) and navigation with mixed reality in one. Piezosurgery was used in five studies (16.7%), in one of them only in some cases, and not used in 23 (76.7%), while in two its use was not reported. One study explicitly proposed avoiding it in favor of conventional instruments for cost reasons (Table 1b) (Figure 5).

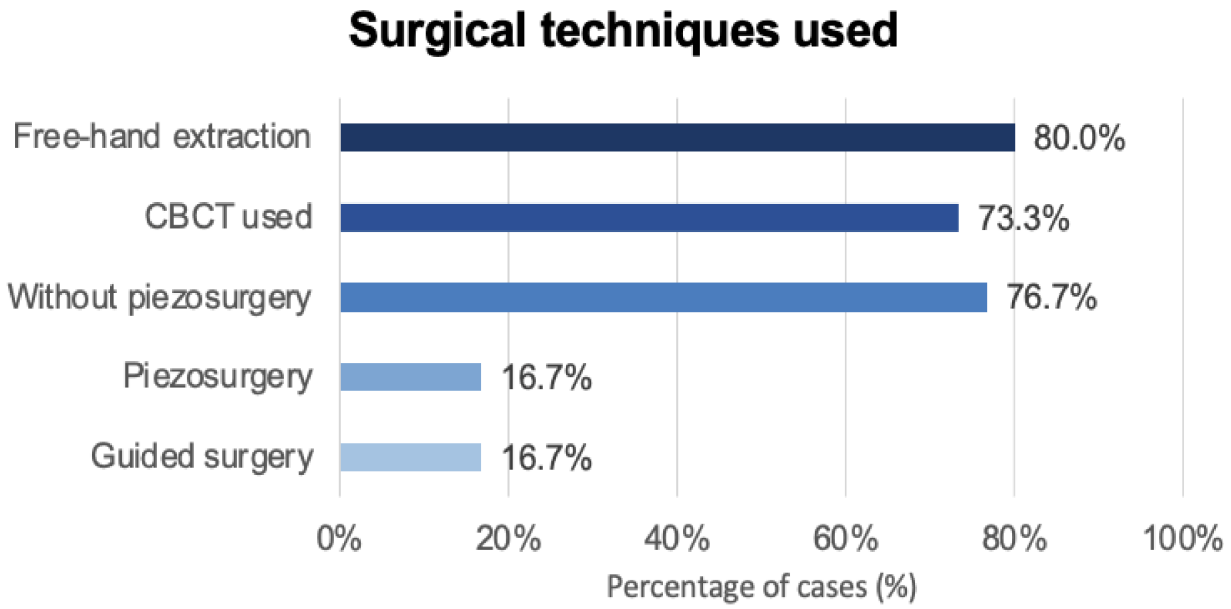


Figure 5. Horizontal bar chart of surgical techniques used.

3.4. Anesthetic Management

The type of anesthesia used (Figure 6) was reported in 26 of the 30 included studies. Local anesthesia was the most common modality, adopted in 13 studies (43.3%), followed by general anesthesia in seven (23.3%) and by the use of both modalities within the same study in six (20.0%); in four studies (13.3%) the anesthetic modality was not specified.

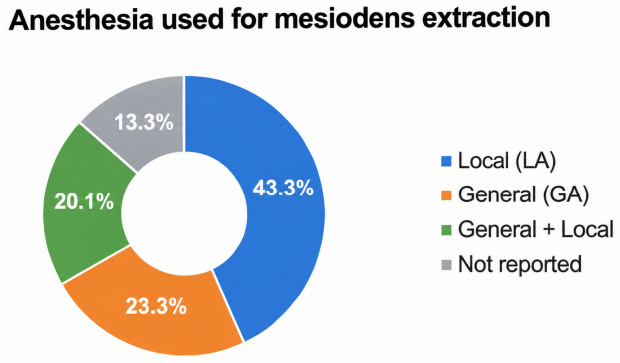


Figure 6. Pie chart of anesthesia techniques used.

In the studies that explicitly specified the criteria, the choice between general and local anesthesia was based on the patient's age, level of cooperation, and the depth and position of the mesiodens relative to the nasopalatine canal. General anesthesia was used primarily in pediatric patients and for the extraction of deeply impacted teeth, while local anesthesia was also used in older patients or for more accessible teeth; the combination of the two techniques was described in a limited number of cases. Gupta et al. [36] explicitly reported a differentiated choice based on tooth position, using general anesthesia for palatal mesiodens near the nasopalatine canal and local anesthesia for buccal mesiodens.

The largest retrospective series [18] excluded patients treated with local anesthesia from the analysis; this exclusion criterion limits the representativeness of the aggregate data relating to this anesthetic modality (Table 1b).

3.5. Clinical Outcomes

Operative time was reported in only a few studies and with inconsistent definitions: the available mean values were approximately 30 min in four studies and 57 min in one; one comparative study reported significantly shorter times (11.5 min with guidance vs. 15.75 min freehand) but measured only the actual surgical time. Re-eruption of permanent incisors was reported in five of the 30 studies (16.7%) and the need for secondary orthodontics in 10 (33.3%), while the duration of follow-up was stated in 18 (60.0%); in the remaining studies these items were not reported, which prevents any reliable aggregate estimate (Table 1c) (Figure 7).

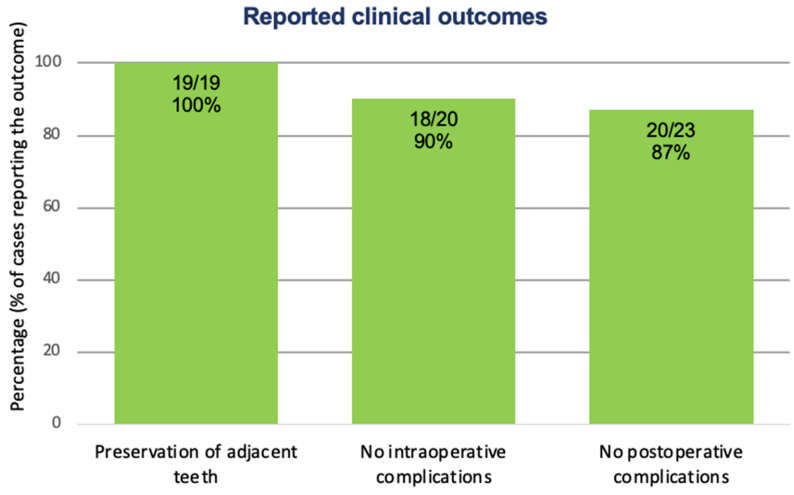


Figure 7. Distribution of reported clinical outcomes, expressed as the number of studies reporting each outcome and the number of studies in which the outcome was observed. Denominators refer to studies, not patients.

Outcomes were reported inconsistently and predominantly qualitatively. Where reported, the outcome was favorable in most cases. Preservation of adjacent teeth was documented in 19 studies and was achieved in all of them (19/19); in one further study the outcome did not apply, the mesiodens lying in the nasal septum of an adult patient, and in ten it was not reported. Intraoperative complications were documented in 20 studies and occurred in two of them (10.0%); postoperative complications were documented in 23 studies and occurred in three (13.0%). The complications described were minor: an additional osteotomy made necessary by insufficient exposure, the intraoperative finding of a fusion between the supernumerary and the incisor, transient edema and pain, and one interincisal recession subsequently treated with grafting. In one series the edema was accompanied by transient hypoesthesia, and one patient had a superficial injury of the nasopalatine neurovascular bundle, treated with cauterization. Other complications of particular concern, including nasal-floor mucosal exposure or injury and injury to adjacent incisor apices, were not reported as discrete outcomes in the included studies and therefore cannot be assigned a reliable study-level or patient-level complication ratio. Their absence from the reports should not be interpreted as evidence that these complications do not occur.

3.6. Results of the JBI Critical Appraisal

The JBI appraisal highlighted variation in the completeness of reporting across the included studies. For case reports and case series, the findings primarily describe how fully the clinical presentation, diagnostic assessment, surgical procedure and outcomes were reported; they should not be interpreted as overall risk-of-bias classifications. Unclear responses frequently reflected insufficient information in the published reports.

The single randomized controlled trial (Table 2) was adequately randomized and the outcome assessors were blinded, follow-up was complete, participants were analyzed in the groups to which they had been allocated, outcomes were measured reliably and uniformly and the statistical analysis was appropriate, with an a priori sample size calculation. Allocation concealment was not described and it remained unclear whether the groups were treated identically apart from the intervention, while neither the participants nor the operators could be blinded to allocation because of the intrinsically surgical nature of the comparison between three access routes. Nine of the thirteen items were rated "Yes" (69%), which corresponds to a moderate risk of bias.

Table 2. Table of risk-of-bias assessment of RCT. Rating: Low, ≥70% "Yes"; moderate, 50–69%; high, <50% (based on applicable items). Y = "Yes", N = "No", U = "Unclear", NA = "Not applicable".

N	Author, Year	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	% of "Yes"	Risk
24	Li et al. 2023 [24]	Y	U	Y	N	N	Y	U	Y	Y	Y	Y	Y	Y	69%	Moderate

In the cohort studies (Table 3), the assessment was heterogeneous. The only two-group comparative study (surgical guidance versus freehand technique) met almost all criteria, with a low risk of bias: groups drawn from the same population and treated by the same operator with the same technique, clearly defined exposure, confounders identified and managed, reliable outcomes, reported and adequate follow-up, and appropriate statistical analysis. The remaining three studies were descriptive single cohorts, without a second comparison group: for these, the items based on the comparison between two groups (items 1, 2, and 5) were necessarily rated "Not applicable". In these three studies, the identification of the condition and the measurement of outcomes were valid, but the duration and completeness of follow-up were often unclear, and in one prospective study, no inferential

statistical analysis was performed. The risk of bias for these three studies was therefore rated low to moderate.

Table 3. Table of risk-of-bias assessment of cohort studies. Rating: Low, ≥70% "Yes"; moderate, 50–69%; high, <50% (based on applicable items). Y = "Yes", N = "No", U = "Unclear", NA = "Not applicable".

N	Author, Year	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	% of "Yes"	Risk
18	Yusa et al. 2023 [18]	NA	NA	Y	U	NA	Y	Y	U	U	NA	Y	57%	Moderate
20	Kong et al. 2022 [20]	NA	NA	Y	U	NA	Y	Y	U	N	NA	Y	57%	Moderate
29	Hauer et al. 2019 [29]	NA	NA	Y	U	NA	Y	Y	Y	Y	NA	U	71%	Low
31	Hu et al. 2017 [31]	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	100%	Low

The JBI appraisal of the 12 case series (Table 4) showed variation in the completeness of reporting across individual checklist items. The main limitations concerned the reporting of consecutive and complete participant inclusion and the specification of inclusion criteria. Statistical analysis was not applicable to most descriptive case series.

Table 4. JBI appraisal of reporting completeness for case series. Individual checklist items are reported as "Yes" (Y), "No" (N), "Unclear" (U) or "Not applicable" (NA). No overall summary score or risk-of-bias category was assigned.

N	Author, Year	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
17	Urechescu et al. 2024 [17]	U	Y	Y	U	U	Y	Y	Y	Y	NA
19	Koyama et al. 2023 [19]	U	U	Y	U	U	U	Y	Y	Y	NA
21	Shetty et al. 2024 [21]	U	Y	Y	U	U	Y	Y	U	Y	NA
22	Ku et al. 2023 [22]	Y	Y	Y	U	U	Y	Y	Y	Y	NA
25	Yoshizaki et al. 2025 [25]	U	U	Y	U	U	Y	Y	Y	Y	NA
27	Tapia Contreras et al. 2024 [27]	Y	Y	Y	U	U	Y	Y	Y	Y	U
28	Yang et al. 2022 [28]	U	Y	Y	U	U	Y	Y	U	Y	NA
34	Jang et al. 2025 [34]	U	Y	Y	U	U	Y	Y	Y	Y	NA
36	Gupta et al. 2024 [36]	U	Y	Y	U	U	Y	Y	U	Y	NA
40	Sujlana et al. 2017 [40]	U	Y	U	U	U	Y	Y	Y	Y	NA
41	Jo et al. 2017 [41]	U	Y	Y	U	U	U	Y	Y	Y	NA
44	Yamamoto et al. 2019 [44]	Y	Y	Y	U	U	Y	Y	Y	Y	NA

The most recurring limitations concerned two items in particular: consecutive participant inclusion and complete participant inclusion were almost never stated (rated "Unclear" in all studies), and explicit inclusion criteria were present in only a minority of studies. Statistical analysis was rated "Not applicable" in most series, as

they were small and descriptive case series. Series with a more structured methodology achieved the highest scores.

The JBI appraisal of the 13 case reports (Table 5) highlighted the extent to which individual reports documented the clinical presentation, diagnostic assessment, treatment and outcomes. These findings describe reporting completeness and should not be interpreted as an overall risk-of-bias classification. The clinical condition at presentation, diagnostic tests, treatment procedure, and post-intervention status were clearly described in all reports, and the majority provided explicit practical lessons and identified adverse or unexpected events. The few shortcomings included the presentation of the clinical history in the form of a structured timeline, which was not always explicit, and—in a single study—the absence of patient demographic characteristics (age and sex not reported), which was rated "No" for that item.

Table 5. JBI appraisal of reporting completeness for case reports. Individual checklist items are reported as "Yes" (Y), "No" (N), "Unclear" (U) or "Not applicable" (NA). No overall summary score or risk-of-bias category was assigned.

N	Author, Year	P1	P2	P3	P4	P5	P6	P7	P8
23	Iacomino et al. 2024 [23]	Y	Y	Y	Y	Y	Y	Y	Y
26	Sharifi et al. 2021 [26]	Y	U	Y	Y	Y	Y	Y	Y
30	Nam et al. 2017 [30]	Y	U	Y	Y	Y	Y	U	Y
32	Pourheidary 2025 [32]	Y	Y	Y	Y	Y	Y	Y	Y
33	Šarac et al. 2021 [33]	Y	Y	Y	Y	Y	Y	Y	Y
35	Kumar et al. 2024 [35]	Y	Y	Y	Y	Y	Y	Y	Y
37	Abdellatif et al. 2023 [37]	Y	U	Y	Y	Y	Y	U	Y
38	Ullah et al. 2023 [38]	Y	Y	Y	Y	Y	Y	Y	Y
39	Uppada et al. 2021 [39]	N	U	Y	Y	Y	Y	Y	Y
42	Rahadian et al. 2017 [42]	Y	Y	Y	Y	Y	Y	Y	Y
43	Mulimani et al. 2017 [43]	Y	Y	Y	Y	Y	Y	Y	Y
45	Pallavi et al. 2020 [45]	Y	Y	Y	Y	Y	Y	Y	Y
46	Abdelemam et al. 2023 [46]	Y	Y	Y	Y	Y	Y	Y	Y

3.7. Subgroup and Sensitivity Analyses

Grouping the studies by access route shows that the distribution of techniques follows the anatomy of the supernumerary rather than the preference of the operator. A labial or vestibular route alone was used in eight studies, a palatal route alone in three, both routes within the same study or a combined access in nine, the nasal floor or a transnasal route in seven and an exclusively intranasal endoscopic route in one, while one study compared three routes within the same trial and one did not specify the access. In the seven studies in which the nasal floor or transnasal route was the primary access, the treated mesiodens were predominantly inverted; however, Tapia Contreras et al. [27] also reported vertical mesiodentes with a caudally oriented crown in 20% of cases. Therefore, the association between this surgical route and tooth orientation should not be interpreted as absolute.

This is the most consistent association between anatomical presentation and technique in the whole dataset, and it supports the selection of the access on anatomical grounds rather than any claim of comparative superiority, since the studies dedicated to the transnasal route recruit precisely the cases for which that route was devised. Grouping by age adds nothing comparable: the adult patients appear as isolated cases with atypical presentations, too few and too heterogeneous to support a comparison with the pediatric population.

Sensitivity analyses were performed. It excluded the two large retrospective series, leaving 28 studies and 99 patients with a mean age of 11.9 ± 5.0 years instead of 8.0 ± 3.0, which shows how strongly the aggregate demographic figures depend on those two cohorts.

4. Discussion

This review collected and analyzed 30 studies on the surgical management of mesiodentes, with the aim of describing the diagnostic methods, operative strategies, and outcomes reported in the literature. Surgical removal appears feasible and has generally favorable outcomes in the published literature; however, the evidence is predominantly derived from case reports and small case series and is therefore vulnerable to selection and publication bias.

4.1. Demographic Profile and Characteristics of the Mesiodens

The male predominance is the most consistent finding in the entire review, and it is the only one confirmed by sources of very different sizes. In the 25 studies that reported sex for the individual patient, the aggregate ratio was approximately 2.5 males for every female (42 males out of 59 patients). The two largest case studies, which reported their data in aggregate form, indicated ratios of 2.1:1 in 121 patients [18] and 3.25:1 in 625 children [20], while the included narrative review reported, out of 44 epidemiological studies, a prevalence of 1.12% and a ratio of 2.07 [37]. The convergence of estimates obtained from such different populations strengthens the solidity of this element, although the specific value remains variable depending on the case study. The population treated was predominantly pediatric (22 out of 30 studies; 73.3%), consistent with the fact that surgical indication almost always arises in mixed dentition, when the supernumerary dentition interferes with the eruption of the permanent incisors [38,39]. Adult patients appear in a minority of studies, as isolated cases with atypical presentations. This distribution suggests that in adults, mesiodentes come to the surgeon's attention for different reasons than in pediatric patients: no longer because of the eruption disorder, but rather the occasional finding, nasal symptoms, or pre-orthodontic needs. These values are consistent with the scientific literature. In the case series by Liu et al. [47], based on 626 supernumerary teeth evaluated by cone beam computed tomography (CBCT) in 487 patients, the male/female ratio was 2.64:1 and the teeth were located in the anterior maxilla in 92% [47].

From a morphological and orientation perspective, the two numerically largest series agree in attributing significant weight to the inverted shape, found in 54.4% of the 147 mesiodentes of one series [18] and in 43% of the 625 cases of the other [20]. Because inverted mesiodentes tend to migrate toward the nasal floor and do not erupt spontaneously, this prevalence explains why much of the technical effort documented in the literature focuses precisely on accessing the high and deep teeth.

4.2. Diagnostic Modalities and the Role of Three-Dimensional Imaging

The comparison between the clinical presentation modalities deserves particular attention, as it highlights a probable selection effect. Considering the studies that described the mode of presentation at patient level, it was symptomatic in 13 of 25 (52.0%) and

asymptomatic in 12 (48.0%). The largest series reporting this datum, however, describes a markedly different distribution, where 79 of 121 patients (65.3%) had their mesiodens identified during radiographs performed for routine dental check-ups or orthodontic evaluations, without subjective or objective symptoms [18]. The discrepancy is not contradictory, but informative: case reports and small series tend to be published precisely when the presentation is clinically striking—swelling, pain, failure to erupt, and esthetic alteration—while large consecutive series reflect the real distribution, in which the occasional finding predominates. This leads to an important practical indication: mesiodens is, in most cases, a silent condition whose identification depends on the quality and systematicity of pediatric radiographic controls.

Cone beam computed tomography (CBCT) was used in 22 of 30 studies (73.3%), and conventional computed tomography in three more, so that three-dimensional imaging was available in 25 of the 30 studies (83.3%); its contribution is evident in three main ways. First, it allows for the three-dimensional localization necessary to choose the appropriate approach. Defining the labiopalatal position and the relationship with adjacent roots guides the flap design, while measuring the distance from the anterior nasal spine orients the approach from the nasal floor, and assessing cortical thickness directs the approach toward the buccal or palatal aspect. Second, it enables diagnoses that two-dimensional imaging would not allow, such as the recognition of a dens invaginatus within the supernumerary or the identification of a hyperpneumatized maxillary sinus extending to the incisive foramen; failure to recognize this would have exposed the patient to the risk of oroantral communication. Third, it improves communication with parents thanks to three-dimensional imaging. However, three-dimensional imaging was not essential in all cases. In fact, in some studies, the diagnosis was based on intraoral, occlusal, and panoramic radiographs with localization techniques, and in one case the choice was explicitly motivated by the palpability of the tooth on the palate, which made a more complex investigation superfluous. The issue of radiation dose is directly raised in two studies: one discusses the balance between diagnostic accuracy and radiation exposure, while another acknowledges that performing both preoperative and postoperative tomography scans is not fully compliant with the ALARA (As Low As Reasonably Achievable) principle and proposes reserving only two-dimensional projections for postoperative verification. This self-criticism points to a reasonable direction: to use tomography scans when the position is uncertain, deep, or at risk for adjacent structures, and to limit it when the tooth is superficial, palpable, or already sufficiently defined by conventional radiographic projections.

4.3. Timing of the Intervention

The optimal timing of extraction is the subject of differing opinions. Studies distinguish between early extraction, performed before the age of six, and late extraction, performed between the ages of eight and ten when adjacent teeth have completed root development. Acknowledging the advantages for both, the first prevents the failure of central incisors to erupt, loss of space in the anterior region, and deviation in the midline, as well as requiring less extensive surgery; the second reduces the risk of injury to permanent teeth [18]. Other contributions favor intervention in mixed dentition, indicating the ideal timeframe between the ages of eight and ten [42,43] or around the age of seven [32], on the assumption that timely removal maximizes the likelihood of spontaneous eruption and reduces the need for complex orthodontic treatments.

The consequences of delay are well documented. In a case treated at age eleven, the central incisors had not yet erupted at the end of the follow-up, and mesial drift of the adjacent teeth had caused such a loss of space that orthodontic distalization was necessary; the authors note that, after late removal, spontaneous eruption can still

occur, but with delays ranging from six to thirty-six months [32]. Similarly, in another case, mesiodens diagnosed after age ten had already caused delayed eruption and dislocation of the right central incisor [42]. On the other hand, when local conditions are favorable, abstention can be rewarded with the removal of the erupted supernumerary teeth alone, without further surgery, followed by the eruption of the permanent central incisors within a year [40]. In the cohort study by Shih et al. [48], conducted on 105 children who underwent mesiodens odontectomy under general anesthesia with tomographic control, early removal—before the age of five or in any case before the adjacent central incisor had reached one third of the root formation—was associated with a reduction in complications and the need for subsequent orthodontic treatment [48]. An even stronger contribution, on a quantitative level, comes from the systematic review with meta-analysis by Seehra et al. [49], who analyzed the eruption of impacted maxillary incisors after removal of the supernumerary in fifteen studies: the probability of eruption was higher when the obstruction was removed in deciduous dentition (odds ratio [OR] 0.42; 95% CI 0.20–0.90), when the supernumerary was conical in shape (OR 2.91; 95% CI 1.98–4.28), when the incisor was in the correct position (OR 2.19; 95% CI 1.14–4.20) and when it presented an incomplete root formation (OR 9.02; 95% CI 2.04–39.78) [49]. These values provide a numerical measure of what the present review could only describe in qualitative terms, and corroborate its findings: the conical shape, root immaturity, and early removal, recurring features in the included cases with favorable eruption outcomes, are the same factors that Seehra et al. [49] identify as statistically significant predictors. The temporal data are also consistent, with the authors reporting that spontaneous eruption can take up to three years [49], a timeframe compatible with the six- to thirty-six-month delay observed in the case of late removal included in the review.

From these elements, an operational criterion shared by several studies emerges: after removal of the supernumerary tooth, it is reasonable to allow a period of observation before proceeding with surgical exposure and orthodontic traction, and evaluating the stage of root development and the availability of space.

The available evidence does not support routine surgical removal of every mesiodens. The decision to remove a mesiodens should be based on its clinical and three-dimensional anatomical relationship with the permanent incisors and surrounding structures, considering factors such as eruption disturbance, displacement or root resorption of adjacent teeth, interference with orthodontic treatment, associated pathological changes, tooth orientation and depth, and proximity to critical anatomical structures. Conversely, asymptomatic mesiodens without evidence of interference with adjacent teeth or surrounding structures may be managed with clinical and radiographic observation in selected cases.

4.4. Selection of the Surgical Approach

Interpreting the surgical approaches used for mesiodens removal is complicated by the heterogeneity of nomenclature adopted in the literature. Numerous terms used by different authors describe, upon examination of the operative steps, the same surgical procedure, distinguished only by the instrumentation used and the indication criteria, not by the access route. Recognizing these terms as variants of the same approach is a prerequisite for a coherent synthesis of the data and suggests the advisability of adopting a classification of approaches based on the access side in mesiodens research.

The relative frequency of the different approaches must be interpreted with caution, as it is closely dependent on the composition of the population studied. The prevalence of palatal access observed in larger retrospective studies and the broader representation of transnasal vestibular access in case series dedicated to this technique are not a discordant

finding, but rather a reflection of the different selection criteria of the respective studies: the retrospective case series describe an unselected population, while the studies dedicated to the transnasal technique electively include inverted and deeply impacted teeth, for which this approach is specifically designed. Consequently, the frequency data cannot be aggregated to establish which approach is preferable in absolute terms but merely indicate that the choice is influenced by the anatomical presentation of the tooth.

The most consistent element emerging from the included studies is the subordination of the approach choice to the three-dimensional position of the tooth. The criteria independently proposed by different authors, based on the distance from the anterior nasal spine and the angle of the dental axis relative to the palatal plane, converge on the same principle: identifying the approach that minimizes the distance from the tooth, the volume of bone to be removed, and the risk to adjacent structures. This convergence lends consistency to the evidence, but its validity is limited by the fact that these criteria are derived from small case series and have not been prospectively validated with respect to clinical outcomes. Their value is therefore indicative, as they provide a rationale for surgical planning but not a proven decision rule.

The combined approach category requires specific consideration, as it groups together non-equivalent clinical situations under a single name. The use of two access routes may result from the presence of multiple mesiodentes located on opposite sides, each removed from the corresponding slope, or from the need to approach a single tooth from two directions for anatomical reasons.

The approach selection criteria deduced from the included studies are consistent with the three-dimensional classifications of supernumerary teeth proposed in the broader literature, in which the sagittal position of the tooth with respect to the incisor roots defines categories of different surgical relevance [47]. This concordance indicates that approach selection in mesiodens surgery is susceptible to anatomical systematization. However, the overall evidence does not allow for the identification of an optimal approach, since the prevalence of descriptive designs, the heterogeneity of nomenclature, the absence of standardized definitions of outcomes, and the paucity of comparative studies preclude conclusions on the relative efficacy of the different techniques. Available data supports a rational selection of the access route on an anatomical basis, while demonstrating its superiority over alternative strategies remains a goal for adequately designed prospective studies.

4.4.1. Guided Surgery and Supporting Technologies

The use of a surgical guide or a dedicated plate was documented in five out of 30 studies (16.7%), to which we can add one with a mixed reality navigation experience [19] and one case of tomographic planning without physical guidance [46]. The comparative evidence on guided surgery remains limited, and the available studies are small and potentially affected by confounding factors such as surgeon experience. In the comparative study by Hu et al. [31], operating time was 11.50 ± 1.29 min with surgical guidance and 15.75 ± 1.71 min with the freehand technique.

A further contribution highlights how the reduction in operating time translates, in pediatric age, into less exposure to general anesthesia [30]. Both sources are small and uncontrolled for the surgeon's experience, and the advantage they describe should therefore be regarded as plausible rather than established.

These advantages, however, must be balanced with limitations that the authors themselves acknowledge. The cost of the 3D scanning and printing equipment is indicated as the main obstacle [34], followed by a laborious manufacturing [41], the need for additional preoperative time for the design and the need for a learning curve.

4.4.2. Instrumentation: Piezosurgery and Conventional Alternatives

Piezosurgery was used in five out of 30 studies (16.7%), was not used in 23 and was not reported in two. The advantages reported concern the selectivity of the cut, which spares the soft tissues, and the possibility of performing conservative osteotomies in proximity to delicate structures; in one case it was associated with the use of the operating microscope for the conservative removal of the bone around the crown [37]. However, the position of some authors deserves attention, who observe that piezosurgery is not very widespread due to its high cost, and deliberately propose the use of small chisels and levers, underlining that the method thus conceived is reproducible in most hospitals [44]. This comparison suggests that piezosurgery constitutes a useful but not an indispensable aid, and that the safety of the intervention depends more on the correct planning of the access than on the technology used for the osteotomy [45].

4.5. Anesthetic Management

Local anesthesia was the most frequently reported modality (13 of 30 studies; 43.3%), followed by general anesthesia (seven studies; 23.3%) and by the use of both modalities within the same study (six studies; 20.0%). However, this data should be interpreted with caution because it is influenced by the composition of the sample. Indeed, the largest case series excluded patients treated under local anesthesia from the analysis [18], thus adopting a criterion that limits its transferability to this specific point.

The selection criteria explained in the individual studies appear overall consistent and can be traced back to three factors: the depth and position of the supernumerary tooth, its relationship with the nasopalatine canal, and the patient's level of cooperation.

4.6. Clinical Outcomes

The reported outcomes are overall favorable. Preservation of adjacent teeth was documented in all 19 studies reporting the outcome, intraoperative complications occurred in two of the 20 studies documenting them (10.0%) and postoperative complications in three of the 23 that reported them (13.0%). The complications described were minor and, in the intraoperative setting, manageable during the same procedure: the need for an additional osteotomy due to insufficient exposure and the unexpected finding of a fusion between the supernumerary and the incisor, which required a two-stage strategy. The postoperative events were transient edema and pain, reported in two studies, with hypoesthesia and superficial injury of the nasopalatine neurovascular bundle, and interincisal recession subsequently treated with grafting. These values, while encouraging, require a cautious interpretation of the study's methodology. Critical evaluation has highlighted that consecutive and complete inclusion of participants was not declared in any of the case series examined, which makes it plausible that case selection was biased toward favorable outcomes, compounded by the well-known tendency to not publish failures. The actual complication rate in current practice is therefore likely higher than this summary describes.

Operative time is the only quantitative outcome comparable across studies, but its interpretation is hampered by the inconsistency of the definitions adopted. The reported mean values are around thirty minutes in four studies [17,19,21–23,29] and fifty-seven minutes in another [25]; a large series reports an average of 32.2 $\pm$ 18.1 min for 147 teeth, with a direct relationship between duration and distance from the alveolar crest, documented by the values of 43.7 $\pm$ 11.6 min for the highest position versus 25.2 $\pm$ 15.8 min for the lowest position in the 96 single-mesiodens patients [18]. The significantly lower times reported in the comparative study on the bone flap technique (11.50 and 15.75 min) can be explained by measuring only the interval between the first incision and the last suture and by the higher age of the patients [26–28,31], whereas in

one of the series cited above the time was measured from draping to the postoperative dressing [22]. The direct comparison between these numbers, in the absence of a shared definition, is therefore not methodologically correct; rather, the clinically useful data is the relationship, consistent across studies, between the depth of the supernumerary and the duration of the intervention.

Re-eruption of permanent incisors was reported in five of the 30 studies (16.7%) and the need for secondary orthodontics in 10 (33.3%), mostly in case reports with dedicated follow-up, and neither allowed a reliable aggregate estimate. This is the most significant gap in the entire body of evidence, as these are precisely the outcomes that justify surgical indication in most pediatric patients.

4.7. Quality and Bias in Available Evidence

The JBI appraisal describes the methodological features and completeness of reporting of the included studies. For case reports and case series, these checklists should not be interpreted as providing an overall risk-of-bias classification. Although several reports described the clinical presentation, diagnostic investigations, surgical procedure and outcomes in detail, the predominance of uncontrolled designs, the possible selective reporting of cases and the incomplete documentation of participant inclusion limit the strength of the conclusions that can be drawn. The critical appraisal conducted using JBI tools outlines a body of evidence whose main limitation is not so much the intrinsically high risk of bias of individual studies, but rather the overall nature of the available designs. The clear prevalence of case reports and case series places much of the evidence at the lower levels of the methodological hierarchy. This finding is consistent with the very purpose of the review, in which surgical treatment of mesiodens is a frequent but heterogeneous procedure, rarely studied through controlled comparisons between techniques.

The strongest evidence emerges, as expected, from the randomized trial and from the comparative cohort study. The trial was adequately randomized, blinded the outcome assessors, analyzed the participants in the groups to which they had been allocated and adopted an appropriate statistical plan, although allocation concealment was not described, which places it at moderate rather than low risk of bias; the comparative cohort study met every applicable criterion. Their findings therefore carry more weight than those of the remaining designs, but they remain two small studies conducted in single centers, and their conclusions are provisional.

In case series, the most systematic issues concern the consecutive and complete inclusion of participants, which is almost never declared. This gap exposes the risk of selection bias: since it cannot be ruled out that the cases presented were selected non-consecutively, an overrepresentation of favorable outcomes is plausible. This consideration is directly linked to a caution already noted regarding clinical outcomes: the preservation of adjacent teeth and the absence of complications, reported as virtually constant in the studies reporting them, must be interpreted in light of this likely publication and selection bias, since failures tend not to be published or included. The good descriptive quality of the series does not compensate for this vulnerability in terms of representativeness.

The case reports, evaluated against the criteria of their specific checklist, proved to be overall well-conducted in terms of descriptiveness: the completeness in the description of the clinical presentation, diagnostic investigations, treatment, and outcome is a recurring strength. This does not, however, alter its place in the hierarchy of evidence: a case report, however accurate, documents a single case and does not allow for inferences about comparative effectiveness. The identified gaps are easily correctable and do not undermine the illustrative value of these contributions.

Overall, the risk-of-bias assessment confirms and reinforces this review's methodological choice to limit itself to a descriptive synthesis. The combination of predominantly non-comparative designs, the lack of homogeneous comparison groups, and inconsistent reporting make any meta-analysis with aggregate effect measures inappropriate; such an attempt would attribute a structure to the studies they lack. The results of this review should therefore be interpreted as a descriptive snapshot of the practices and outcomes reported, with the most reliable indications coming from the few higher-quality comparative studies, while the broad base of series and case reports offers, above all, descriptive depth and hypothesis generation. This suggests a need for prospective comparative studies with explicit inclusion criteria, consecutive inclusion, and complete, standardized follow-up, as a guideline for future research.

4.8. Limitations of the Review

The main limitation of this review lies in the nature of the available studies. The clear prevalence of case reports and case series, the lack of homogeneous comparison groups, and the heterogeneity of outcome definitions make any quantitative synthesis using aggregate effect measures inappropriate: calculating odds ratios, pooled estimates, or heterogeneity indices would have given the data a comparative structure they lack. The search was confined to three bibliographic databases. Although PubMed, Scopus, and Web of Science were selected to provide complementary biomedical and multidisciplinary coverage, no trial registry or source of the gray literature was interrogated, and databases such as Embase and the Cochrane Library were not searched. Studies not indexed in the three selected databases may therefore have been missed, and a degree of publication bias cannot be excluded.

The total number of patients treated is significantly impacted by just two case series, which alone account for 746 of the total 845 patients. Excluding these, the remaining 28 studies document 99 patients, largely single cases or small series. Reporting was incomplete on several fronts, including type of anesthesia, diagnostic modality, and operating time. Furthermore, internal inconsistencies or typos emerged in the original texts, which concern discrepancies between abstracts and tables on age, number of teeth or position, a classification with two identically defined categories [36], a discrepancy between the two linguistic versions of a bilingual article [33], a satisfaction scale reported in the opposite direction between text and table [24] and consent forms with gender not corresponding to the described patient [35]. These elements, promptly reported during the extraction phase, do not modify the descriptive synthesis but require interpretative caution and justify the choice to always report the effective denominator of each proportion.

A second group of limitations concerns the conduct of this review. The search was confined to three bibliographic databases: no trial registry and no source of the gray literature were interrogated, so that studies not indexed in PubMed, Scopus or Web of Science may have been missed and a degree of publication bias cannot be excluded. Four full texts could not be retrieved because they were not accessible through the subscriptions available to the review team. Reporting bias was discussed qualitatively but was not assessed by a formal method, since funnel plots and their associated tests require a number of comparable effect estimates that this body of evidence does not provide. For the same reason the certainty of the evidence was not rated with the GRADE approach: GRADE rates the certainty of an estimate of effect for a defined comparison, and the only comparative estimates available here come from two small studies, the randomized trial comparing the labial, palatal and subperiosteal intranasal routes and the retrospective comparison between guided and freehand extraction, so that the remaining outcomes would all have received a uniform rating of very low certainty determined entirely by the uncontrolled design of the

source studies, adding nothing to what the critical appraisal already states. Because age, indication, anatomical complexity, and outcome definitions were inconsistently reported across the included studies, the available evidence does not support a robust age-specific correlation between patient age and the indication, complications, or outcome of surgery. A further limitation is that PROSPERO registration was completed retrospectively, after study selection and data extraction had begun; therefore, the registration did not prospectively document the review process.

4.9. Clinical Implications and Research Perspectives

From the synthesis of the data analyzed, some consistent operative indications emerged:

- Three-dimensional tomographic assessment is recommended when the tooth is deep, inverted, or in close contact with the nasopalatine canal, the nasal floor, or the maxillary sinus, while it can be omitted in superficial situations or those already identified by conventional imaging.
- Access should be chosen based on the principles of shortest distance from the supernumerary tooth, least tissue damage, and maximum protection of adjacent structures, reserving the nasal floor approach for inverted and high teeth, for which measurable criteria based on the distance from the anterior nasal spine and the angle between the palatal plane and the dental axis have been proposed.
- Guided surgery may reduce operating times and localization inaccuracies, although this advantage now rests on a single small comparative study, and additional costs and preparation time limit its use to complex access cases.
- After removal, a period of observation before resorting to orthodontic traction appears justified, tailored to the stage of root development and available space.

The identified gaps clearly outline the agenda for future research. Prospective comparative studies are needed, with explicit inclusion criteria, consecutive enrollment, and comprehensive follow-up. These studies should adopt standardized outcome definitions, starting with the measurement of surgical time, which is currently reported using inconsistent criteria. Above all, studies that systematically document the truly relevant medium-term outcomes for the patient—the re-eruption of permanent incisors, the need for and duration of subsequent orthodontic treatment, and the preservation of the vitality of adjacent teeth—are needed, which represent the clinical justification for the intervention and which this review found them to be documented only episodically. Only on this basis will a quantitative synthesis be possible in the future, which the current body of evidence does not permit.

5. Conclusions

This review mapped the surgical techniques described in the recent literature for the treatment of mesiodens, evaluating their reported outcomes, complications, and predictability. Surgical removal appears feasible and has been reported with generally favorable outcomes in the published literature; however, the evidence base consists predominantly of case reports and small case series, with important risks of selection and publication bias. The reported complication frequencies should therefore not be interpreted as the true complication rate of mesiodens surgery, and the available evidence is insufficient to formulate an evidence-based clinical guideline. The surgical approaches reported for mesiodens removal were heterogeneous and included palatal, labial or vestibular, combined, nasal floor/transnasal and endoscopic routes. The choice of access was generally related to the anatomical position and depth of the supernumerary tooth. Surgical guides and other supportive technologies were reported in selected cases, but the comparative evidence remains limited. Reported outcomes were generally favorable in the studies

documenting them; however, inconsistent outcome definitions, incomplete reporting and the predominance of case reports and case series prevent reliable estimates of comparative effectiveness or complication rates. The available evidence therefore supports individualized, anatomically informed surgical planning rather than a single preferred technique or a universal recommendation. Further prospective comparative studies with standardized outcome definitions and adequate follow-up are needed.

In this context, supportive technologies find their place. Cone beam computed tomography (CBCT), used in most of the studies, is valuable for both three-dimensional localization and diagnoses beyond the scope of two-dimensional imaging, but should be evaluated in light of the radiation minimization principle and reserved for deep or anatomically complex positions. Guided surgery may help improve localization and reduce operating time in selected cases; however, the available comparative evidence is limited, and its potential advantages require confirmation in further well-designed studies.

Piezosurgery remains a useful adjunct rather than a necessity, as the safety of the procedure depends more on proper access planning than on a single instrument. These results, however, must be interpreted with caution: the uniformly favorable outcomes are likely optimistic, as no case series has documented consecutive and complete patient inclusion, and, more importantly, the outcomes that actually justify the procedure have only been reported episodically. The available evidence therefore supports a rational and anatomically sound framework for planning mesiodens surgery, but not yet a strictly evidence-based clinical guideline. Filling this gap will require prospective comparative studies with explicit and consecutive inclusion criteria, standardized outcome definitions and comprehensive medium-term follow-up focused on patient-relevant outcomes. Only on this basis will the quantitative synthesis that the current body of evidence does not allow be possible, and the surgical management of mesiodens can be based on evidence commensurate with the frequency with which it is performed.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/dj14110697/s1. Table S1: excluded references; Table S2: studies design; Table S3: PRISMA 2020 checklist; Table S4: PRISMA 2020 abstract checklist.

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Abbreviations

The following abbreviations are used in this manuscript:

PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
PROSPERO	International Prospective Register of Systematic Reviews

CBCT	Cone beam computed tomography
MeSH	Medical Subject Heading
JBI	Joanna Briggs Institute
RCT	Randomized controlled trial
ANS	Anterior nasal spine
VAS	Visual Analog Scale
ALARA	As Low As Reasonably Achievable
CT	Computed tomography
SLOB	Same Lingual, Opposite Buccal (Clark's tube-shift rule)
GRADE	Grading of Recommendations, Assessment, Development and Evaluations
PGMA	Palatal gingival margin approach
LPA	Local palatal approach
LGMA	Labial gingival margin approach
LLA	Local labial approach
CLPA	Combined labial–palatal approach
OPG	Orthopantomography
NR	Not reported
NA	Not applicable

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