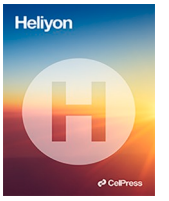
Heliyon 10 (2024) e35386

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon



Systematic review and meta-analysis

Post-surgical complications of supernumerary teeth in the mandibular premolar area: A systematic review

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ARTICLE INFO

Keywords:
Supernumerary teeth
Surgical management
Buccal approach
Lingual approach
Complication

ABSTRACT

In the mandibular premolar area, supernumerary teeth are a rare disorder that are rarely documented in the literature. The purpose of this study was to evaluate the post-surgical problems associated with the buccal and lingual techniques used to treat the extra teeth in this area. Using PubMed, PubMed Central, Science Direct, Cochrane, Wiley, and manual search, a thorough search was done to locate and identify cases and case series with extra teeth in the mandibular premolar region. For every study that was included, data on the surgical technique and postoperative problems were documented. Seven studies involving 90 patients were included. Supernumerary teeth in the mandibular premolar region were predominantly found in male patients (65.55 %), with most cases occurring in the right mandibular region (77.16 %). Postoperative complications after removing supernumerary teeth using buccal and lingual approaches were similar, with only one complication reported among the 90 cases reviewed. Although the findings suggest that surgical management of supernumerary teeth in the mandibular premolar region is relatively safe, caution is advised due to the limited sample size. Detailed pre-operative evaluation, a comprehensive treatment plan, and regular follow-up can minimize postoperative complications.

1. Introduction

Impacted teeth are commonly encountered in dental practice and are included as a common phenomenon with different prevalence and distribution between the maxilla and mandible [1]. They are frequently located in the mandibular and maxillary third molar regions and the maxillary canine area [2,3]. Impacted supernumerary teeth are uncommon, occurring in 1.2 %–6.0 % of permanent dentitions and 0.3 %–0.8 % of deciduous dentitions. This condition often goes undetected by dental practitioners [4].

A supernumerary tooth is any additional tooth or odontogenic structure beyond the usual number of dental germs in any dental arch area [5]. Supernumerary teeth are most frequently present after the maxillary incisor region, the mandibular molar, premolar, canine, and lateral incisor regions [6]. If left untreated, supernumerary teeth can lead to complications such as malocclusion, central

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https://doi.org/10.1016/j.heliyon.2024.e35386
Received 2 May 2023; Received in revised form 26 July 2024; Accepted 26 July 2024
Available online 30 July 2024

diastema, and the formation of dentigerous cysts [7–9]. Unlike other supernumerary teeth, those in the premolar region are more frequently found in the mandible and have distinct characteristics. They are often smaller or conical, making them easier to diagnose [10,11]. The lingual nerve, mental nerve, and blood vessels are among the critical organs that surround this region's physical structure, making complete management and careful attention necessary [10,11].

Impacted supernumerary teeth are typically removed before starting orthodontic treatment [12,13]. However, surgical management of these teeth, specifically in the premolar area, can be challenging [4,12,13]. Depending on anatomical variations, site accessibility, and specific teeth involved, alternative surgical therapies exist for impacted supernumerary teeth, including a buccal or lingual approach [4,12,14]. Few studies specifically discuss the surgical management of supernumerary teeth, with most of them being case reports [6,9,13,14]. Furthermore, most scientific literature primarily focused on a comprehensive review of the incidence and etiology of this case [4,10,15,16]. To our knowledge, no prior analyses have addressed the surgical management of impacted supernumerary teeth and the associated postoperative complications using either the buccal or lingual approach, specifically in the premolar region. Therefore, this systematic review aims to examine the management and post-surgical complications related to impacted supernumerary teeth in the mandibular premolar region. We hypothesize that the surgical management of impacted supernumerary teeth, whether via a buccal or lingual approach, is a safe procedure with a low complication rate.

2. Methods

2.1. Search strategy

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards were followed in this systematic review. The PICO format was used to construct the following focal questions: Patient/Population (P), Intervention (I), Comparisons (C), and Outcomes (O). The components were defined as follows: (P) surgical management of supernumerary teeth in the mandibular premolar region or para-premolar area; (I) buccal approach surgical technique; (C) lingual approach surgical technique; and (O) postoperative complications.

2.2. Information sources and eligibility criteria

The primary source of literature for this review was a systematic search of the major electronic databases, including PubMed, PubMed Central (PMC), Science Direct, Cochrane, and Wiley, from their inception onwards. Hand searches of the reference lists of included studies, pertinent reviews, and other relevant materials were conducted as an additional secondary source of possibly relevant material. A review committee of seasoned oral and maxillofacial surgeons searched.

The following Medical Subject Headings (MeSH) phrases were combined to do the computerized search: 'supernumerary teeth,' 'para premolar,' 'surgical management,' and 'odentectomy.' Table 1 details the keywords utilized in each database's search strategy and the number of results obtained.

Studies were included based on the following criteria: original research, case series, or case reports focusing on the surgical management of supernumerary teeth in the mandibular premolar region, utilizing either buccal or lingual approaches.; the sample is representative of the underlying general population; the presence of an English abstract; and full-text article. On the other hand, studies were excluded if they met the following criteria: limited patients with craniofacial syndromes or developmental disorders, abstract-only or closed-access articles, and literature review articles.

2.3. Study selection

The studies were assessed based on predetermined eligibility criteria through a two-step selection process. Initially, references were managed using the EndNote X9.2 reference manager, where duplicates from the initial search were removed. Following this, eligible full texts were analyzed after a preliminary screening process, which involved comparing and agreeing on the initial selections. Two

Table 1
Keywords used for each database.

Data base	Search strategy used	Record found
PubMed	(((((“supernumerary teeth"[MeSH Terms]) OR (“supernumerary tooth"[MeSH Terms])) OR (“supernumerary teeth"[Title/Abstract])) OR (“supernumerary tooth"[Title/Abstract])) OR (“parapremolar"[Title/Abstract])) AND ((((“surgical procedure"[MeSH Terms]) OR (“surgical removal"[Title/Abstract])) OR (“surgical management"[Title/Abstract])) OR (“odontectomy"[Title/Abstract]))	83
PubMed Central	(((((“Supernumerary teeth"[MeSH Terms]) OR “Supernumerary tooth"[MeSH Terms]) OR “Supernumerary teeth") OR “Supernumerary tooth")) AND ((((“Surgical procedure"[MeSH Terms]) OR “surgical remocal") OR “surgical management") OR “odontectomy")	136
Science Direct	((“supernumerary teeth" or “supernumerary tooth") and (“surgical procedure"))	7
Cochrane	MeSH descriptor: [Tooth, Supernumerary] explode all trees OR (supernumerary NEXT (teeth or tooth)):ti,ab,kw OR (“supernumerary"):ti,ab,kw AND MeSH descriptor: [Surgical Procedures, Operative] explode all trees OR (Surgical NEXT (removal or management)):ti,ab,kw OR (“odontectomy"):ti,ab,kw	5
Wiley	[[All: 'supernumerary teeth'] OR [All: 'supernumerary tooth']] AND [All: 'surgical procedure']	110

unbiased reviewers reviewed the titles, abstracts, and complete texts; any disagreements were resolved through conversation or by contacting a third reviewer. Studies needing full-text availability were excluded from the analysis. The process adhered to the PRISMA guidelines and was documented in a flow diagram (Fig. 1).

2.4. Data extraction

A standardized form was used to obtain data from each included study. The form asked for the following details: author name, country, number of cases, sex, surgical method (lingual or buccal), postoperative follow-up, and complications.

2.5. Risk of bias

Based on the type of publications included, two impartial reviewers used Joanna Briggs Institute (JBI) study-specific critical evaluation tools to assess the methodological quality of the included studies. The risk of bias was then assessed overall; studies were marked for more information if the risk was ambiguous, included if the risk was low, and omitted if it was high. The risk of bias was categorized as high if 50 % or more of the responses were 'no,' low if 50 % or more were 'yes,' and uncertain if 50 % or more were 'unclear.'

3. Results

3.1. Study selection and characteristics of patients

The flowchart of the search and selection procedure (Fig. 1) shows how the literature was searched using the given terms through an electronic database. The initial search produced 351 studies without a time filter, which is not surprising given the paucity of

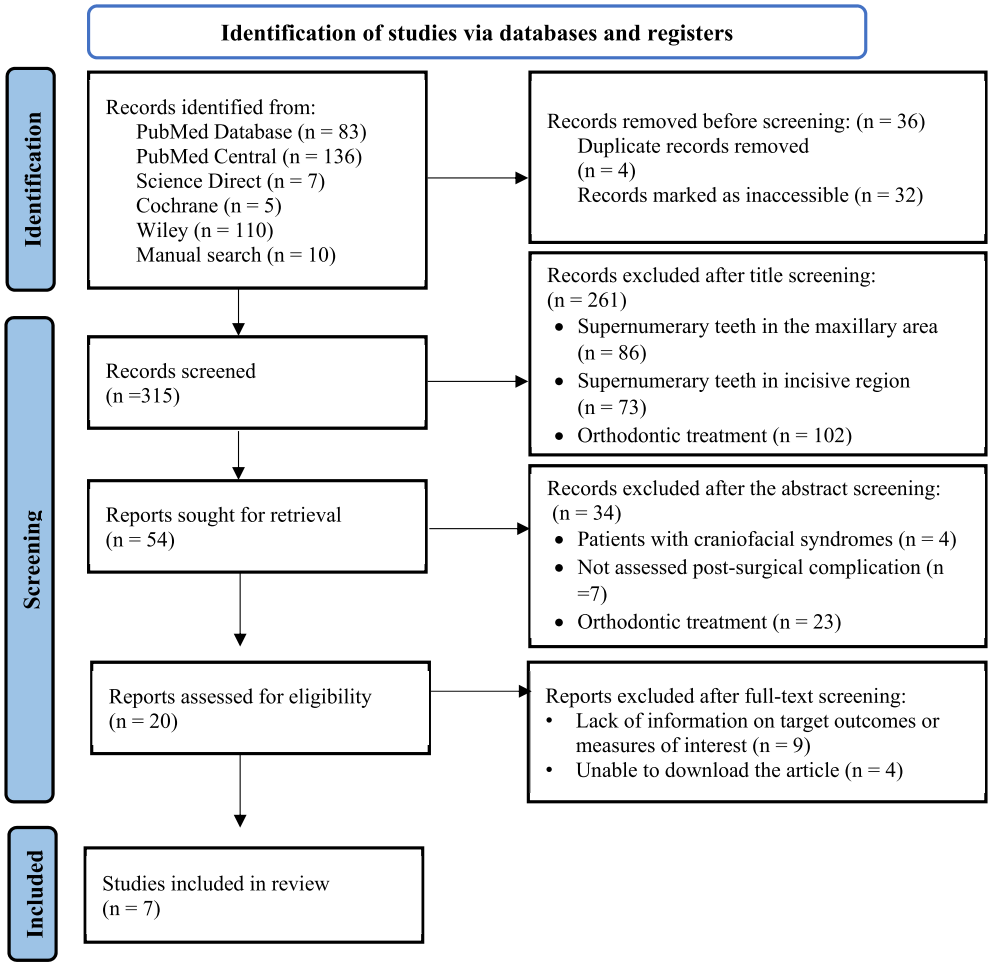

Fig. 1. Prisma flow chart.

publications on post-surgical problems and care of impacted supernumerary teeth in the mandibular premolar region. After removing four duplicate entries, 315 studies were screened using the inclusion and exclusion criteria, which resulted in the removal of 261 more studies and the non-retrieval of 34 studies. The systematic evaluation contained seven studies totaling ninety instances (Table 2).

Table 3 provides specifics regarding the patients' clinical features. Patients under 30 years of age accounted for the majority of occurrences with extra teeth in the mandibular premolar region; roughly 65.55 % of cases included men and 34.44 % involved females. Sixty-five percent of the ninety patients with extra teeth in the mandibular premolar region had one extra tooth, twenty-six percent had two extra teeth, and seventy-seven percent had more than one extra tooth. The right mandibular region included the majority of the extra teeth (77.16 %), while the left mandibular region only contained 22.83 %.

3.2. Risk of bias in studies

Following a rigorous evaluation of the papers included in the current review, the risk of bias was considered low. Three included studies (Beltrán et al. Liu et al., and Cruz et al.) [5,11,17] obtained a 75 % score on the quality evaluation for the case report studies. In contrast, two included studies (Pasha et al. and Shastri et al.) [6,18] received an 87.5 % score. All studies scored 90 % for the case series assessment. The analysis implied that the evaluated studies might be reliable and trustworthy. Tables 4 and 5 specify the case report and case series quality assessment following the JBI standards.

3.3. Surgical management and postoperative complications

The included studies described surgical management of supernumerary teeth in the mandibular premolar region with a buccal or lingual approach or a combination of both techniques. Table 6 highlights that as many as 40 cases utilized surgical management with the buccal approach, 39 cases were treated with surgical management with the lingual approach, and four instances utilized surgical management with a combination of the buccal and lingual approaches. In comparison, the surgical approach used was not mentioned for 7 cases.

In terms of postoperative complications, such as pain, bleeding, trismus, and nerve injury, these were only mentioned in one included study by Ferrés-Padró et al. [12], which reported 1 case with complications (1.02 %) [12], in which post-surgical bleeding appeared among 79 interventions performed in the study (Table 2). Surgical management of supernumerary teeth in the mandibular premolar region using both buccal and lingual approaches showed similar results.

Table 2
Characteristics of included studies.

Author, year	Country	No. of cases	Sex		Surgical approach	Post-operative follow-up	Complications	Additional treatment
			Male, n	Female, n				
Liu et al., 2019 [10]	China	1	–	1	Lingual approach	N/M	No complication	Computer designed surgical template
Cruz et al., 2016 [12]	Brazil	1	1	–	N/M under general anesthesia	Periodic follow-up	No complication	Conventional
Shastri et al., 2014 [13]	India	1	–	1	Buccal approach under local anesthesia	7 days post-operative	No complication	Conventional
Beltran et al., 2014 [4]	Chile	1	1	–	Buccal approach under general anesthesia	7 days post-operative	No complication	Endoscopic surgical approach
Pasha et al., 2013 [5]	India	1	1	–	Buccal approach under local anesthesia	7 days post-operative; 6 weeks post-operative; periodic examination	No complication	Conventional
Ferrés-Padró et al., 2009 [11]	Spain	79	51	28	Lingual approach, 49.39 %; buccal/vestibular approach, 45.57 %; combination, 5.06 %	N/M	1 case of complication (1.02 %), in which post-surgical bleeding appeared	Conventional
Zvolanek and Spotts, 1985 [14]	US	6	5	1	N/M	N/M	N/M	Conventional

N/M, not mentioned.

Table 3
Characteristics of patients.

Variable	Number (n)	Percentage (%)
Age	85	94.44
<30 years old	5	5.56
>31 years old		
Sex		
Male	59	65.55
Female	31	34.45
Number of supernumerary teeth		
Single (1)	59	65.55
Double (2)	24	26.67
Multiple (≥3)	7	7.78
Location of supernumerary tooth		
Right mandibular	98	77.16
Left mandibular	29	22.84

Table 4
Risk of bias for case reports.

Assessment	Author, year				
	Liu et al., 2019[10]	Cruz et al., 2016[12]	Shastri et al., 2014[13]	Beltrán et al., 2014[4]	Pasha et al., 2013[5]
Were patient's demographic characteristics clearly described?	Yes	Yes	Yes	Yes	Yes
Was the patient's history clearly described and presented as a timeline?	No	No	Yes	No	Yes
Was the current clinical condition of the patient on presentation clearly described?	Yes	Yes	Yes	Yes	Yes
Were diagnostic tests or assessment methods and the results clearly described?	Yes	Yes	Yes	Yes	Yes
Were the intervention(s) or treatment procedure(s) clearly described?	Yes	Yes	Yes	Yes	Yes
Was the post-intervention clinical condition clearly described?	Yes	Yes	Yes	Yes	Yes
Were adverse events (harms) or unanticipated events identified and described?	No	No	No	No	No
Does the case report provide takeaway lessons?	Yes	Yes	Yes	Yes	Yes
Overall appraisal	Included	Included	Included	Included	Included

Table 5
Risk of bias for case series.

Assessment	Author, year	
	Ferrés-Padró et al., 2009[11]	Zvolanek and Spotts, 1985[14]
Were there clear criteria for inclusion in the case series?	Yes	Yes
Was the condition measured in a standard, reliable way for all participants included in the case series?	Yes	Yes
Were valid methods used for identification of the condition for all participants included in the case series?	Yes	Yes
Did the case series have consecutive inclusion of participants?	Yes	Yes
Did the case series have complete inclusion of participants?	Yes	Yes
Was there clear reporting of the demographics of the participants in the study?	Yes	Yes
Was there clear reporting of clinical information of the participants?	Unclear	Yes
Were the outcomes or follow-up results of cases clearly reported?	Yes	Yes
Was there clear reporting of the demographic information of the presenting site(s)/clinic(s)?	Yes	Unclear
Was statistical analysis appropriate?	Yes	No
Overall appraisal	Included	Included

Table 6
Surgical approach.

Surgical approach	Number of cases	Percentage
Buccal approach	40	44.44
Lingual approach	39	43.33
Combination	4	4.45
Not mentioned	7	7.78

3.4. Additional treatment

Several points could be considered when dealing with the surgical management of supernumerary teeth in the mandibular premolar region, including additional treatment. As shown in Table 2, two studies reported additional therapies for surgically removing supernumerary teeth, and five studies were known to perform conventional surgical procedures. The extra treatments were noted in the study by Liu et al. [11], who used a computer-designed surgical template as a surgical guide to manage supernumerary teeth in the mandibular premolar region [11]. Furthermore, Beltrán et al. [5] utilized endoscopic surgical removal to manage supernumerary teeth in the mandibular premolar region [4].

4. Discussion

Supernumerary teeth are additional teeth or tooth-like structures that can erupt or remain unerupted, resulting from developmental and morphogenetic anomalies. These teeth can be found in all dental arches but are more frequently observed in the maxilla than in the mandible [11,12]. Supernumerary teeth may occur as single, multiple, unilateral, or bilateral cases, with the highest prevalence in the maxillary region [19,20]. Determining the right surgical approach for supernumerary teeth can minimize trauma to soft and hard tissues, reducing post-operative complications and accelerating healing. The buccal and lingual surgical approaches involve a limited incision in the impacted teeth. Despite this, supernumerary teeth located on the lingual side of the mandible could be more surgically demanding. Due to its anatomical location, surrounded by several vital organs, such as the lingual nerve and blood vessels, limited surgical access to this area should also be considered [11,18]. The present study revealed that surgical management of supernumerary teeth in the mandibular premolar region could be performed with buccal or lingual approaches, and both approaches showed minimal complications.

According to the patient characteristics observed in this review, those under 30 years old were frequently found to have extra teeth in the mandibular premolar region. This result is consistent with the research conducted by Salcido García et al. [21] observed that the mandibular premolar region has a peak occurrence of supernumerary teeth between the first and third decades of life. In a similar vein, McBeain et al. [22] noted that many individuals with supernumerary dentition were in the 8–12 age range, whereas Chou et al. [23] revealed that age 20–29 years was the most common for having extra teeth. While there is still some debate on the ideal age to treat extra teeth, individualized treatment plans must be tailored based on the specific characteristics of each case [24,25]. Early identification is crucial to prevent potential complications such as crowding, impaction, and root resorption associated with supernumerary teeth, especially considering that numerous cases are occasionally discovered unintentionally during routine radiographic examinations [24,25].

Supernumerary teeth in the mandibular premolar region were predominantly found in male patients compared to females. This observation is consistent with the findings of Pasha et al. [6], who reported that males are twice as likely to develop supernumerary teeth as females. Similarly, Cruz et al. [17] noted that the occurrence of supernumerary teeth in the mandibular premolar region is twice as high in males as females. Additionally, a study by Park et al. [26] highlighted a gender-based difference in the prevalence of supernumerary teeth, with a male-to-female ratio of 2:1 among Caucasians.

It is known that supernumerary teeth have been found in all areas within the dental arches, both in primary and permanent dentition. The current review found that supernumerary teeth predominate in the right mandibular area. When examining specific locations of supernumerary teeth, few references explore the lateralization of this dental anomaly. However, in both the maxilla and mandible, there is a prevailing occurrence of supernumerary teeth in the premolar area, with the highest frequency in the mandibular premolar region [27,28]. The prevalence of supernumerary teeth in the mandibular premolar region is relatively low, and the complex etiology of their formation still needs to be better understood [10,27]. Theoretical considerations regarding their development are posited from the standpoint of tooth development [29,30]. Genetic influence may play a role, given the frequent occurrence of supernumerary premolars and premolar hypodontia in the mandibular arch [29,30]. Nevertheless, it is crucial to recognize that while our study contributes to evidence supporting a predominant occurrence of supernumerary teeth in the right mandibular area, variations in sample characteristics and methodologies among studies should be considered. The specific mechanisms contributing to the right-sided predilection in supernumerary teeth need further exploration.

Supernumerary teeth can be bilateral, unilateral, numerous, or single [10,20]. The larger percentage of single supernumerary teeth than the percentage of multiple supernumerary teeth in the current analysis indicates that majority of the included studies had a single supernumerary tooth. This might be because only non-syndromic patients without developmental problems or craniofacial syndromes were included in the selection procedure of the papers included in the current analysis. Gardner's syndrome and cleidocranial dysplasia are two syndromes that are typically linked to several extra teeth [17]. Supernumerary teeth are typically linked to cleidocranial dysostosis, cleft lip, cleft palate, and Gardener's syndrome, according to a previously published study by Pasha et al. [6]. Furthermore, rare are non-syndromic multiple supernumeraries; most occur in the mandible, especially the mandibular anterior region [6]. In line with the previous study, most supernumerary teeth cases included in the present study were also found in the right mandibular region (77.16 %).

Supernumerary teeth can manifest as single, multiple, unilateral, or bilateral structures [10,20]. In this review, most of the included studies reported a higher percentage of single supernumerary teeth than various supernumerary teeth. This trend may be attributed to the selection criteria of this study, which only included non-syndromic patients without craniofacial syndromes or developmental disorders. Syndromes like cleidocranial dysplasia and Gardner's syndrome are commonly linked to multiple supernumerary teeth [17]. Pasha et al. [6] have discovered that cleidocranial dysostosis, cleft lip, cleft palate, and Gardner's syndrome are frequently associated with excess teeth. Moreover, non-syndromic multiple supernumerary teeth are uncommon and primarily located in the front mandible

[6]. The current investigation found that the majority of cases of extra teeth were found in the right mandibular region (77.16 %), which is consistent with these findings.

It has been reported that postoperative complications of the supernumerary teeth include pain, bleeding, trismus, and nerve injury. In our study, these were only mentioned in one included study by Ferrés-Padró et al. [12] found 1 case of complication (1.02 %), in which post-surgical bleeding appeared, out of 79 surgical interventions [12]. Bleeding can occur because, anatomically, this region is vascularized by the lingual arteries, mental arteries, and inferior labial arteries [30]. In addition to bleeding, there is a risk of trauma to the lingual and mental nerves after surgical management of supernumerary teeth. The lingual nerve is at risk of injury in several procedures, such as third molar extraction and procedures involving the floor of the mouth. This is because the anatomical position of the lingual nerve is located 3.0 mm apical to the alveolar crest and 2.0 mm medial to the lingual cortical bone [31]. Over-exposure of the surgical site can cause trauma to the apical teeth around the operating area and trauma to the lingual nerve. As a result, sensory disturbances in the form of paraesthesia, anesthesia, dysaesthesia, hyperalgesia, allodynia, hypoaesthesia and hyperaesthesia could occur in the innervated area [32–34].

Since several post-operative complications can occur after surgical management of supernumerary teeth, the present review emphasizes some recommendations from the included studies to reduce post-operative complications. A previous study by Liu et al. [11] employed a computer-designed three-dimensional template as a surgical guide. This approach helps to prevent unnecessary bone removal, particularly in cases where there is a strong indication for impacted supernumerary teeth located in deep or lingual areas [11]. Furthermore, Beltrán et al. [5] suggested that using an endoscopic surgical approach as a first-line treatment for removing supernumerary teeth can preserve bone and prevent possible damage to neurovascular structures [5]. This technique can be applied for unerupted supernumerary teeth, especially for the most common type of supernumerary teeth, mesiodens in the maxillary area [5].

The pre-operative evaluation and treatment plan is one of the crucial aspects to consider before the surgical management of impacted supernumerary teeth [35,36]. Ferrés-Padró et al. suggested a pre-operative evaluation using computed tomography to visualize the exact position of teeth, which could prevent any possible complication [12]. Furthermore, as noted by Cruz et al. [17], the management of extra teeth ought to involve a thorough treatment plan created in collaboration with orthodontists, pediatric dentists, and oral surgeons. Shastri et al. [18] state that the surgeon's ability to prioritize accurate regional anatomy knowledge, cautious tissue manipulation, and appropriate application of mechanical concepts related to tooth extraction are critical to the success of surgical therapy.

The present review highlights the post-surgical complications and management of impacted supernumerary teeth in the mandibular premolar region using buccal and lingual approaches. After various articles were compiled from different authors, one post-surgical-related complication was reported from the 90 cases. It became apparent that surgical management of supernumerary teeth in the mandibular premolar region showed a relatively low risk of complications. Nevertheless, dental practitioners must remain vigilant of possible complications following the procedure. For this reason, a detailed examination encompassing tooth eruption, shape, and anatomical location before proceeding to surgical intervention is the primary course of action.

The fact that this study did not include syndromic patients, who generally have a higher frequency of extra teeth, is one of its weaknesses. The reasoning behind their removal is that therapeutic procedures may have a potentially heightened risk, and consequences resulting from underlying disorders may be mistakenly linked to treatment outcomes. Furthermore, the need for original publications on postoperative outcomes following the removal of impacted supernumerary teeth in the mandibular premolar region limits the study and makes it impractical to do a quantitative analysis. Notwithstanding its limitations, this study is the first to evaluate post-surgical complications associated with impacted supernumerary teeth in detail. The research also offers a number of suggestions for reducing post-operative difficulties, including supplementary methods like computer-designed surgical templates and endoscopic surgical procedures. These insights serve as valuable references for dentists, heightening their awareness of potential issues that may arise after surgical procedures and establishing the basis for future research endeavors to address the problems identified.

5. Conclusion

Supernumerary teeth in the mandibular premolar region are predominantly found in male patients and the right mandibular region. Removing these teeth, either through buccal or lingual approaches, has a low incidence of post-surgical complications, indicating that both methods are relatively safe. It is recommended that detailed pre-operative evaluations, comprehensive treatment planning, and regular follow-up are essential to minimize complications. Further studies with standardized methodologies are advised to validate these findings and investigate additional factors that may affect post-surgical outcomes.

Data availability statement

All data used in the generation of the results presented in this manuscript will be made available upon reasonable request from the corresponding author.

CRediT authorship contribution statement

Hendrijaya Permana: Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Andi Sitti Hajrah Yusuf:** Writing – review & editing, Investigation, Formal analysis, Data curation. **Salem A. Alkaabi:** Writing – review & editing, Validation, Software, Resources, Project administration. **Yossy Yoanita Ariestiana:** Supervision, Resources, Investigation. **Mohammad Gazali:** Supervision, Methodology, Investigation. **Abul Fauzi:** Supervision, Software, Project

administration. **Andi Tajrin:** Validation, Resources, Project administration. **Muhammad Ruslin:** Visualization, Validation, Supervision, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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