

SURGICAL MANAGEMENT OF MESIODENS BASED ON CHARACTERISTICS AND COMPLICATIONS OF THE CONDITION: A SYSTEMATIC REVIEW

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ABSTRACT

Disturbances in dental development may result in anomalies, such as supernumerary teeth in the upper or lower jaw. Mesiodens is the most prevalent supernumerary tooth that is often found in the midline of the maxilla and can cause problems, such as malpositioned permanent teeth, diastema formation, cyst formation, and delayed eruption of maxillary anterior incisors. Surgical treatment might be an option for the management of this condition. This study aims to review the characteristics and complications, which need to be considered for the surgical management of mesiodens. A literature search for articles written in English and published within the last 10 years was conducted using the electronic database, PubMed. The keywords verified by Medical Subject Headings included mesiodens, characteristics, complications, and management. A total of 60 articles were retrieved; however, after exclusion, only 45 articles were relevant for evaluation. Subsequently, only 30 articles with full-text versions available online were included in the study. Based on this review, the majority of studies factored in the complications of mesiodens during treatment planning. Very few studies covered the relationship between the characteristics and complications of this condition and its management.

KEY WORDS: surgical management, mesiodens, supernumerary teeth, tooth abnormalities, radiographic study.

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INTRODUCTION

Mesiodens is an abnormality in the number of teeth in the upper or lower jaw, which results from disturbances in dental development [1, 2]. Although the etiology of this condition remains to be understood, several theories have been developed in the past. Among them, the theory of dental lamina hyperactivity is still considered as the main reason for the development of mesiodens [1, 3, 4]. Several cases were shown to be associated with various craniofacial deformities, including cleft lip and palate, Down's syndrome, and cleidocranial dysostosis [3]. The mesiodens is commonly located at

the midline of maxilla as a single, unerupted, and inverted entity. Few studies have shown that mesiodens can be found in the mandible, being bilaterally multiple, already erupting, and growing vertically [2-4]. It occurs more frequently in men than in women, with a ratio of 2 : 1 [1-5]. The prevalence of mesiodens in general population is 0.15-13.9% [3].

Mesiodens can be diagnosed by clinical and radiographic examinations. Clinical examination can reveal the presence of supernumerary tooth or teeth in the midline of maxilla, usually followed by a complication of the condition, including diastema [2, 3]. Radiographic investigations are also performed to evaluate the posi-

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tion of mesiodens and the condition of adjacent tooth. Periapical, panoramic, and occlusal radiographs can provide clear information regarding mesiodens [2-4]. In some cases, computed tomography (CT) and cone-beam CT can also be used for diagnoses [2].

Various complications related to mesiodens include delayed eruption of permanent tooth, central diastema formation, and rotation of maxillary anterior teeth. Additionally, root resorption and cyst formation are the less commonly associated complications of mesiodens [1, 2]. The main complaints of patient are based on these complications. The time of diagnosis is an important factor to be considered while managing a mesiodens. In some cases, a patient is diagnosed at the age of 6-10 years based on complaints. Furthermore, the appropriate time for the removal of a mesiodens remains controversial [3].

The characteristics of mesiodens must also be considered for the management of this condition [1, 3]. Some types of mesiodens can be treated by a simple tooth extraction, whereas in some cases, the mesiodens must be removed using complicated methods, including surgical extraction. Surgical procedure can be followed by additional procedures for other complex complications, including orthodontic treatment [1, 4, 5].

It is important to evaluate the optimal management of mesiodens based on the characteristics and complications of this condition. This study aims to review these factors and evaluate their association with the treatment methods used in previous studies.

MATERIAL AND METHODS

A literature search was performed by one author and included electronic database PubMed search for eligible studies published between January 2008 and December 2017. The question "How to determine the management of mesiodens considering the characteristics and complications of the condition?" guided the search strategy. Keywords, such as mesiodens, characteristics, complications, and management were applied to obtain an appropriate result. The final string used was mesiodens *AND characteristics *AND complications *AND surgical manage-

ment. Additional criteria, such as language and the time of publication, were included. The studies had to be published in English. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) flowchart was also used. Those with review formats and topics that were unrelated to mesiodens were excluded (Table 1).

RESULTS

During the initial search, 330 articles were shown as results using the keyword "mesiodens", among which, 155 articles were published within the last 10 years. However, 60 out of 155 articles were excluded because of non-compliance with the aim of this study.

Figure 1 was formulated based on the PRISMA guidelines. After using the terms "mesiodens" AND "characteristics", we found 14 articles that were published within the last 10 years. Further detailed search using the keywords "mesiodens" AND "complication", and "mesiodens" AND "management" resulted in 18 and 28 articles, respectively, which were published within the last 10 years. Among a total of 60 articles, 45 articles relevant to our inclusion criteria were identified; however, only 30 full-text articles were available online for downloading (Table 2).

A majority of the studies (25 articles) were single or serial case reports, while the remaining 5 were retrospective studies (Tables 3 and 4). A review of case reports revealed 41 cases of mesiodens in 30 patients (Tables 4 and 5). They were determined based on the characteristics, chief complaints, complications, and management of the condition. Additionally, the characteristics and complications that needed to be considered for the management of mesiodens were determined in the five retrospective studies included in the present study (Table 3).

Most of the retrospective studies showed a prevalence rate of less than 1%, except for the Patil study, which reported a prevalence of > 1% (Table 3). Although the majority of the studies reported a predilection for males, a female tendency was reported in the study by Colak *et al.* Likewise, the majority of these studies reported that the mesiodens occurs more frequently in young individuals (maximum age, 16 years). The most common characteri-

TABLE 1. Inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Period time	January 2008 to December 2017	Any study outside the period
Language	English	Non-English
Type of article	Case report, original articles	Review
Study focus	Mesiodens, complication, management	Unrelated to mesiodens, complication, and management
Geographical area of interest	International studies	None
Sample	Human, medical record	None
Type of study	Clinical report Retrospective study	Review article

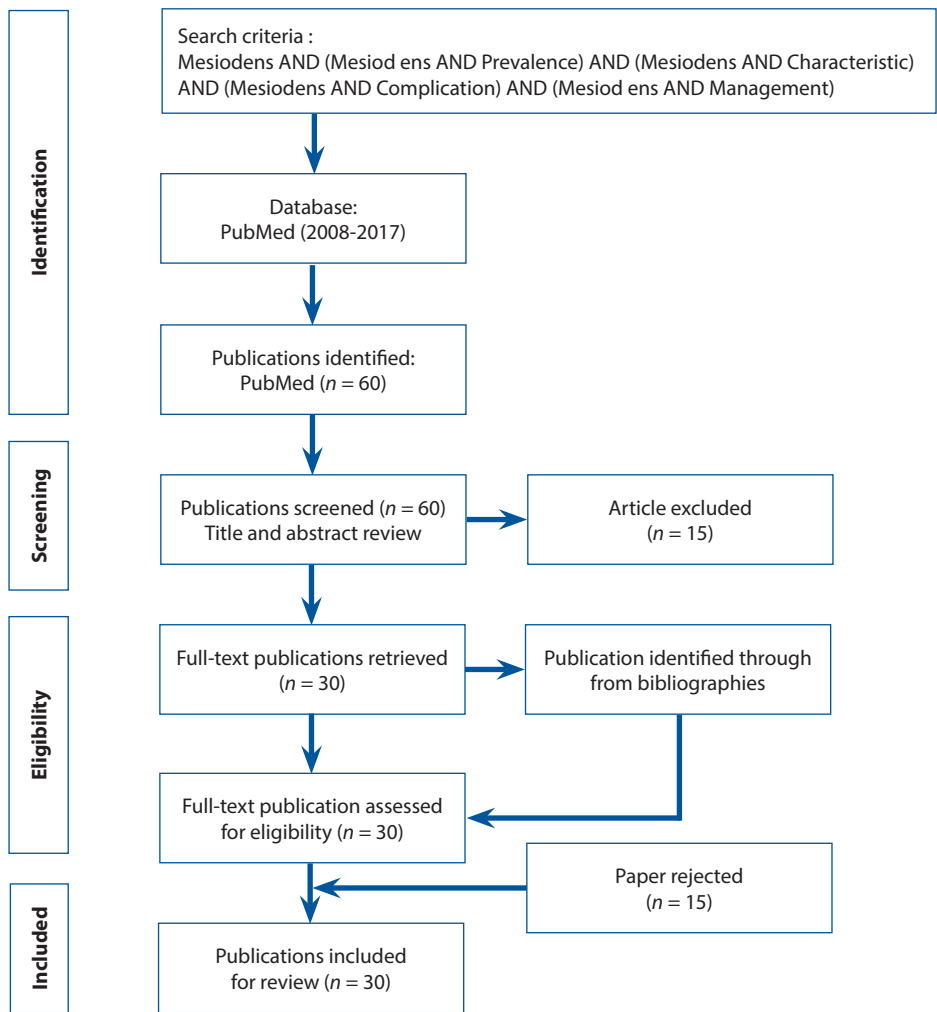


FIGURE 1. Flowchart of the study design

stics of mesiodens based on the studies were the number (single) and position (vertical) of the supernumerary tooth. However, differences in the eruption status and the shape of the crown were observed among the studies. Furthermore, only one study reported that most patients with mesiodens had no complications (Table 5).

DISCUSSION

As an abnormal additional tooth commonly located at the midline of maxilla, the mesiodens may occur as single or multiple entities. Variations in the eruption status, shape of the crown, and position have been observed. However, the etiology of this condition has not been clearly documented so far. Among the various theories proposed, dental lamina hyperactivity is considered as the most relevant [1-4].

All of the five retrospective studies reviewed in the current study indicated a prevalence of approximately 0.3-1.5%, and a male to female ratio of 1.5 : 2.1 [1-5]. Only one out of these five retrospective studies stated that

the mesiodens occurs more frequently in women than in men [4]. The mesiodens were usually found at the midline of maxilla. However, two case studies reported the anterior midline of mandible as the site of mesiodens, which are very rare occurrences [6, 7]. The reason for this predilection for the maxilla remains unknown.

The mesiodens is usually found at a young age, especially in 6-9 years old individuals. However, few case reports have detected this anomaly in older patients (third to fifth decade) [8-11]. The chief complaints of young patients with mesiodens were delayed eruption, central diastema in the maxilla, and axial rotation of the permanent central incisors causing functional and esthetic issues. Older patients may not have been aware of the problem until accompanied by pain or swelling that may be related to the development of dentigerous cyst. Therefore, the timing of chief complaint may affect the timing of diagnosis of mesiodens.

The characteristics of mesiodens can be ascertained from the number, eruption status, shape of the crown, and the position in relation to the adjacent teeth. In a number of instances, the mesiodens occurs more fre-

TABLE 2. Overview of publications included in this study

No.	Authors	Year	Title	Journals	Aim	Sample	n	Type of Study	Time of Experience
1	Cogulu D, Yetkiner E, Akay C, Seckin O, Alpoz R	2008	Multidisciplinary management and long-term follow-up of mesiodens: a case report	The Journal of Clinical Pediatric Dentistry	To present multidisciplinary management of bilateral mesiodens	Human	1	Case report	1 day
2	Gunduz K, Celenk P, Zengin Z, Sumer P	2008	Mesiodens: a radiographic study in children	Journal of Oral Science	To describe mesiodens in Turkish children	Radiograph	69	Retrospective study	3 years (2003-2005)
3	Canoglu E, Er N, Cehreli ZC	2009	Double inverted mesiodens: report of an unusual case	European Journal of Dentistry	To present radiographic features of a unique occurrence of two impacted, inverted mesiodens in a child patient	Human	1	Case report	1 day
4	Nagaveni NB, Umashankara KV, Sreedevi, Radhika NB, Satisha TS	2010	Multilobed mesiodens with palatal talon cusp: a rare case report	Brazilian Dental Journal	To present a multilobed mesiodens	Human	1	Case report	1 day
5	Neeraja R, Kayalvizhi G, Baig M	2010	Mandibular mesiodens and maxillary mid-palatal mesiodens: rare occurrences	Pediatric Dental Journal	To report two mesiodens in mandibular and mid palatal	Human	1	Case report	1 day
6	Hosseini SV, Moradzadeh M, Lotfi M, Aghbali A, Fattahi S	2011	Dentigerous cyst associated with a mesiodens: a case report	Journal of Dental Research, Dental Clinics, Dental Prospects	To present mesiodens with a dentigerous cyst in an 18-year-old woman	Human	1	Case report	1 day
7	Kazanci F, Celikoglu M, Miloglu O, Yildirim H, Ceylan I	2011	The frequency and characteristics of mesiodens in a Turkish population	European Journal of Dentistry	To know the types and frequency of mesiodens among a group of patients in Turkey	Radiograph	10	Retrospective study	5 years (June 2003-July 2008)
8	Avsever H, Gunduz K, Orhan K, Aksoy S	2012	An inverted eruption of mesiodens: report of a rare case	MUSBED	To present an inverted erupted mesiodens in mid-palatal	Human	1	Case report	1 day
9	Jindal R, Sharma S, Gupta K	2012	Clinical and surgical considerations for impacted mesiodens in young children	Indian Journal of Oral Sciences	To report clinical problems associated with mesiodens management	Human	3	Case report	1 day
10	Khambete N, Kumar R, Risbud M, Kale L, Sodhi S	2012	Dentigerous cyst associated with an impacted mesiodens: report of two cases	Imaging Science in Dentistry	To present two rare cases of dentigerous cyst related to mesiodens	Human	2	Case report	1 day
11	Sulabha AN, Sameer C	2012	Association of mesiodens and dens invaginatus in a child: a rare entity	Case Reports in Dentistry	To describe dens invaginatus associated with two mesiodens in a child	Human	1	Case report	1 day
12	Sulabha AN, Sameer C, Umesh K, Warad N	2012	Mesiodens: a radiographic study among the children of Bijapur, India	Journal of Advanced Oral Research	To know the frequency and the types of mesiodens among children in Bijapur, India	Radiograph	18	Retrospective study	24 months (March 2009-March 2011)

TABLE 2. Cont.

No.	Authors	Year	Title	Journals	Aim	Sample	n	Type of Study	Time of Experience
13	Colak H, Uzgur R, Tan E, Hamidi MM, Turkal M, Colak T	2013	Investigation of prevalence and characteristics of mesiodens in non-syndromic dental outpatients	European Review for Medical and Pharmacological Science	To know the frequency of mesiodens in a group of Turkish population	Radiograph	15	Retrospective study	18 months (July 2009-January 2012)
14	Dave B, Patel J, Swadas M, Mallikarjuna R	2013	Multilobed mesiodens: a supernumerary tooth with unusual morphology	BMJ Case Report	To present a multilobed mesiodens	Human	1	Case report	1 day
15	Gurgel CV, Cota AL, Kobayashi TY, Silva SM, Machado MAA, Rios D, Garib DG, Oliveira TM	2013	Bilateral mesiodens in monozygotic twins: 3D diagnostic and management	Case Reports in Dentistry	To report a case of two mesiodens in monozygotic twin boys	Humans	2	Case report	1 day
16	Mangalekar SB, Ahmed T, Zakirulla M, Shivappa HS, Bheemappa FB, Yavagal	2013	Molariform mesiodens in primary dentition	Case Reports in Dentistry	To present molariform mesiodens	Human	1	Case report	1 day
17	Patel K, Patel N, Venkataraghavan	2013	Management of a dentigerous cyst associated with inverted and fused mesiodens: a rare case report	Journal of International Oral Health	To describe an unusual case of a dentigerous cyst involved an inverted mesiodens	Human	1	Case report	1 day
18	Patil S, Pachori Y, Kaswan S, Khandelwal S, Likhayani L, Maheshwari S	2013	Frequency of mesiodens in the pediatric population in North India: a Radiographic Study	Journal of Clinical and Experimental Dentistry	To know the frequency of mesiodens among children of North India	Radiograph	57	Retrospective study	September 2008-December 2012
19	Vinod K, Venkataraghavan	2013	Paired erupted and unerupted mesiodens: a case report	Annals of Dental Research	To report an unusual case of paired erupted and unerupted mesiodens	Human	1	Case report	1 day
20	Ephraim R, Dilna NC, Sreedevi S, Shubha M	2014	A labially positioned mesiodens and its repositioning as a missing central incisor	Journal of International Oral Health	To present a conservative approach of early extraction in labially positioned mesiodens	Human	1	Case report	1 day
21	Ghogre P, Singh VD	2014	Management of an impacted inverted mesiodens associated with a large circumferential type of dentigerous cyst	International Journal of Case Report and Images	To present an inverted mesiodens with circumferential type of dentigerous cyst	Human	1	Case report	1 day
22	Sharma M, Parashar K, Kashyap N, Kappadi D	2014	A mesiodens in an 8-year-old girl: a case report	American Journal of Advances in Medical Science	To present a labially positioned maxillary midline mesiodens	Human	1	Case report	1 day
23	Asha ML, Laboni G, Rajarathnam BN, Kumar M, Lekshmy J, Priyanka LB	2015	Twin mesiodens: a case report	International Journal of Advanced Health Sciences	To describe a double mesiodens	Human	1	Case report	1 day
24	Dalldone M, Losso E	2015	Mesiodens surgery in the deciduous and permanent dentition	RSBO (Revista Sul-Brasileira de Odontologia)	To describe management of two mesiodens	Human	1	Case report	1 day

TABLE 2. Cont.

No.	Authors	Year	Title	Journals	Aim	Sample	n	Type of Study	Time of Experience
25	Jain S, Jain P	2015	Surgical management of palatally placed impacted mesiodens: a case report	IJSS Case Reports & Reviews	To present the management of palatally placed mesiodens	Human	1	Case report	1 day
26	Viswanathan R, Pai S	2014	Bilateral impacted inverted mesiodens in the palatal vault: a rare case report	Pediatric Dental Journal	To report bilateral impacted and inverted mesiodens in the palate	Human	1	Case report	1 day
27	Vyas SM, Shah NR, Dave BH	2014	Unusual morphology of mesiodens: a rare case report	RRJDS	To describe management of an unusual mesiodens	Human	1	Case report	1 day
28	Aoun G, Nasseh I	2016	Mesiodens within nasopalatine canal: an exceptional entity	Clinic and Practice	To describe a mesiodens in the nasopalatine canal	Human	1	Case report	1 day
29	Karthik A, Yamini V	2016	Labially positioned conical mesiodens: a rare case report	International Journal of Life and Biosciences	To report a labially placed mesiodens in a 14-year-old boy	Human	1	Case report	1 day
30	Palanisamy V, Rao A, Ongole R, Chacko V	2017	Mandibular mesiodens: a rare case report	Journal of Oral and Maxillofacial Surgery, Medicine, and Pathology	To present a mandibular mesiodens	Human	1	Case report	1 day

TABLE 3. Overview of retrospective studies included in the present review

No.	Authors	Prevalence	Ratio male/female	Age (years)	Characteristic (most common)	Complications	Management consideration
1	Gunduz <i>et al.</i> (2008)	0.3%	2 : 1	4-14	Single (76.8%) Impacted (79.9%) Conical (72.9%) Vertical direction (55.2%)	Delayed eruption (38.8%) Midline diastema (17.6%) Rotation (16.4%)	When complication was diagnosed, surgical removal must be performed
2	Kazanci <i>et al.</i> (2011)	0.3%	1.5 : 1	8-16	Single (80%) Impacted (66.7%) Conical (75%) Vertical direction (58.3%)	Delayed eruption (41.7%)	Surgical removal (83.3%) Follow up with orthodontic treatment (16.7%)
3	Sulabha (2012)	0.3%	1.5 : 1	3-14	Single (77.2%) Erupted (63.3%) Conical (77.3%) Vertical direction (72.8%)	Midline diastema (45.5%) None (27.2%) Delayed eruption (18.2%)	Early extraction to facilitate spontaneous eruption of incisors
4	Colak (2013)	0.13%	1 : 4	Not mentioned	Single (100%) Impacted (53.3%) Canine-like (60%) Vertical direction (67%)	None (60%) Midline diastema (27%) Axial rotation (13%)	Not explained
5	Patil (2013)	1.4%	1.8 : 1	6-9	Single (89.7%) Impacted (62.9%) Conical (77.4%) Vertical direction (59.6%)	None (28%) Midline diastema (24.5%) Delayed eruption (22.8%)	Removal of mesiodens at 8-9 years Delayed extraction performed if the root formation has completed

TABLE 4. Overview of case reports included in this study

No.	Authors	Gender	Age (years)	Characteristics of mesiodens			Chief complaints	Complications	Management	
				Number	Eruption status	Shape of crown				
1	Cogulu <i>et al.</i> (2008)	Female	8	Double	Impacted Impacted	Conical Conical	Vertical Vertical	Retention of the maxillary primary incisors	Malposition	The extraction of primary central incisors, followed by the surgical extraction of mesiodens and the exposure of the impacted permanent incisors
2	Canoglu <i>et al.</i> (2009)	Male	8	Double	Impacted Impacted	Conical	Inverted Inverted	Crowding of maxillary anterior	Malposition	Surgical removal of mesiodens under general anaesthesia
3	Nagaveni <i>et al.</i> (2010)	Male	11	Single	Erupted	Multilobed	Vertical	An extra tooth was noticed in the maxilla	Displacement	Extraction Orthodontic treatment
4	Neeraja (2010)	Case 1 Male	7	Single	Erupted	Conical	Vertical	No complaint (routine dental check-up)	Space deficiency for the eruption	Extraction of mesiodens Observation
		Case 2 Female	7	Double	Erupted Erupted	Conical Conical	Horizontal Vertical	The eruption of the tooth in the mid-palate	Delayed eruption	Extraction of erupted mesiodens and surgical removal of the partially erupted one
5	Hosseni <i>et al.</i> (2011)	Female	18	Single	Impacted	Conical	Not described	Painless swelling in the upper jaw	Dentigerous cyst	Surgical removal of mesiodens and enucleation in the same visit
6	Avsever (2012)	Male	18	Single	Erupted	Conical	Inverted	Tooth eruption in the mid-palate	No complications	Extraction of mesiodens under local anaesthesia
7	Jindal <i>et al.</i> (2012)	Case 1	9	Double	Erupted Impacted	Conical Conical	Vertical Inverted	The extra tooth in the upper front region	Displacing 11 labially	The extraction of erupted mesiodens, followed by surgical removal of the unerupted one
		Case 2 Male	10	Single	Impacted	Conical	Inverted	Proclined incisor	Displacing 11	Surgical extraction of mesiodens
		Case 3	9	Double	Impacted Impacted	Not described Not described	? ?	Missing permanent left central incisor	Delayed eruption	Surgical removal

TABLE 5. Overview of mesiodens cases among the 25 case reports reviewed in this study

Aspect	Criteria	n
Age (total of 30 patients)	≤ 16 years	23
	> 16 years	7
Gender (total of 30 patients)	Male	20
	Female	7
	Not described	3
Location (total of 41 mesiodens)	Maxilla	39
	Mandibula	2
Number (total of 30 patients)	Single	19
	Double/Multiple	11
Eruption status (total of 41 mesiodens)	Erupted	15
	Impacted	26
Shape of crown (total of 41 mesiodens)	Conical	26
	Uncommon shaped	5
	Not described	10
Position (total of 41 mesiodens)	Vertical	19
	Horizontal	3
	Inverted	14
	Not described	5

quently as a single entity (76-89%) [1-5]. Most of the mesiodens were found to be fully impacted, followed by reports on partially and fully erupted mesiodens. Only one retrospective study reported that erupted mesiodens were more frequently seen (63.3%) than other.

Several cases with rare characteristics were observed among the case reports that were discussed in the present study. Eleven out of 30 patients presented with double mesiodens and 3 of them had different eruption status (1 erupted tooth and 1 impacted tooth) [6, 12, 19]. Furthermore, 15 cases of erupted mesiodens were observed out of a total of 41 mesiodens [20-26].

Rare characteristics in terms of the shape of crown or the position or direction of the mesiodens were reported in some of the case reports. Mesiodens with multilobed or molariform crowns were also reported by several researchers. Likewise, horizontally placed and inverted mesiodens were also identified in several cases [8, 11, 14, 27]. The shape of crown of the mesiodens may vary from conical, canine-, or incisor-like to tuberculated or round. The majority of articles reviewed in the present study reported the presence of conical-shaped (70%) mesiodens. However, Colak *et al.* reported that the canine-like form was the most dominant (60%) compared to other [4]. As for the position or direction of the mesiodens in relation to the adjacent tooth, it may be vertical, horizontal, or inverted. All studies reported the vertical position as the most common (55-72%) [1-5].

Patients' primary complaint when they visited the dentist was that mesiodens were causing complications. However, Colak *et al.* and Patil *et al.* have reported the absence of complications in about 60% and 28% of patients

with mesiodens, respectively [4, 5]. In contrast, midline diastema and delayed eruption were the most common complications in some other retrospective studies [1-3]. Cyst formation does not appear to be a common complication in mesiodens, probably because the patients were examined at a young age (first and second decades) [1].

A number of cases with rarely seen complications, such as dentigerous cysts and root resorption, were reported in some of the case reports reviewed in this study. These types of complications generally occur in long-standing cases (during or after the second decade of life). If associated with a major complaint, the presence of a dentigerous cyst is usually characterized by the major complaints of pain and swelling.

The management of mesiodens can be viewed in terms of the timing (immediate or delayed) and technique (simple or surgical) of removal. Immediate treatment is usually considered for cases that are associated with complications, whereas delayed treatment usually occurs due to the age of patient, the absence of complaints, or when the roots of adjacent permanent teeth have not been fully formed. The age of 8-9 years is considered as appropriate for the procedure using simple techniques or surgery with local anesthesia. In addition, the characteristics of mesiodens, such as the eruption status, must also be considered while performing simple procedures. An impacted mesiodens clearly requires surgery, although local anesthesia might be sufficient for the procedure. However, sometimes a vertically erupted mesiodens might require surgical extraction as long as there is no risk of damage to the adjacent fully erupted teeth [3].

Among the 25 case reports, 41 mesiodens in 30 patients were identified in this study. Immediate removal was carried out in 32 cases, whereas delayed removal was performed in the remaining 4 cases. This is understandable because almost all of these cases presented with complications or the risk of future complications, which could impact the complexity of treatment. The characteristics of mesiodens in relation to their management have not been well documented so far. However, in various cases when mesiodens has fully erupted, it can be removed by simple extraction, but an inverted mesiodens may require surgical removal to avoid damage to adjacent permanent teeth. The number of mesiodens (single or multiple) or form of the crown is generally not considered while determining the treatment method in these cases. On the other hand, the presence of complications, such as dentigerous cyst, can influence treatment planning.

Nevertheless, this review has to be interpreted with caution due to limitation of this study that has used only the PubMed as database information. Further review may use other databases.

CONCLUSIONS

In this study, we reviewed the management of 41 cases of mesiodens based on their characteristics and associat-

ed complications. The chief complaints of patients were dependent on the complications associated with mesiodens. The mesiodens was generally treated when the patient presented to the dentist with a chief complaint. Furthermore, the characteristics of mesiodens (especially, the eruption status and position) were likely to be considered during the management of this condition. Unfortunately, it was not possible to determine the significance of the characteristics and complications on the timing and surgical management of the mesiodens from the 30 articles that were reviewed in this study.

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CONFLICT OF INTEREST

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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