

The effects of impacted premaxillary supernumerary teeth on permanent incisors

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ABSTRACT

Purpose: The aim of this study was to examine the radiographic features associated with impacted premaxillary supernumerary teeth, to determine the relationship between their characteristics and their effects on permanent incisors, and to investigate the types of orthodontic treatment that patients received after the extraction of impacted supernumerary teeth.

Materials and Methods: The clinical records and radiographs of 193 patients whose impacted premaxillary supernumerary teeth were removed were retrospectively reviewed, and 241 impacted supernumerary teeth were examined. Cone-beam computed tomographic images and panoramic radiographs were examined to determine the number, location, sagittal position, orientation, and morphology of the supernumerary teeth. Their effects on permanent incisors and the orthodontic treatment received by patients after the extraction of the supernumeraries were also investigated.

Results: Supernumerary teeth were most frequently observed in the central incisor region, in the palatal position, in the inverted orientation, and were most commonly conical in shape. The most common complication was median diastema, followed by displacement and delayed eruption of the adjacent incisors. Ten (71.4%) of the 14 odontomas showed delayed eruption of the adjacent incisors. Displacement of the incisors was more frequently observed in association with supernumerary teeth with tuberculate or supplemental shapes. Orthodontic traction was most frequently performed after the removal of odontomas. In 32 cases (13.3%), permanent incisors erupted after the orthodontic creation of sufficient space.

Conclusion: Median diastema was most common complication. The delayed eruption of incisors was common in supernumerary teeth with a vertical orientation and an odontoma shape. (*Imaging Sci Dent* 2016; 46: 251-8)

KEY WORDS: Maxilla; Tooth, Supernumerary; Cone-Beam Computed Tomography

Introduction

Supernumerary teeth are more often found in the maxillary anterior region than in any other area of either dental arch.¹ Unless supernumerary teeth are diagnosed early and managed properly, they may exert a variety of pathological effects on the developing permanent dentition.² It has been reported that if a significant delay or ectopic or

asymmetric eruption of the maxillary permanent incisors is observed clinically, the presence of mesiodens should be suspected.³

Supernumerary teeth, particularly those in the anterior maxilla, can cause failure of eruption, displacement, rotation of the permanent maxillary incisors, and median diastema.²⁻⁴ Other rare findings that are thought to be due to the presence of supernumerary teeth are root resorption of permanent teeth,⁵ cyst formation,⁶ and eruption of the supernumerary tooth into the nasal cavity.⁷ Early diagnosis of a supernumerary tooth is vital to reduce possible complications, the extent of surgery, and orthodontic treatment.⁸

Supernumerary teeth are detected via a thorough clin-

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ical examination and routine radiological examinations.⁹ Radiographic examinations are used to assess the number, location, path, and sagittal position of the impacted supernumerary tooth.¹⁰ Radiographic imaging plays an important role in deciding on an appropriate treatment plan and when to intervene, especially when removal of the supernumerary tooth is required.¹¹

The optimal timing for the surgical removal of unerupted maxillary anterior supernumeraries has often been the subject of debate.^{2,10} Some researchers have argued for immediate surgical removal after diagnosis to permit spontaneous eruption of the permanent incisors and to avoid possible orthodontic problems,¹² while others have advocated a delayed approach in order to avoid iatrogenic damage to the developing adjacent teeth.^{13,14} The immediate surgical removal of impacted supernumeraries is indicated when the chances of developing complications if the supernumerary tooth was left untreated are significant.³ The surgical removal of supernumerary teeth based on accurate radiographic localization minimizes the risk of devitalization of the permanent teeth when performed before the maturation of their apices.¹⁵

The aim of this study was to examine the radiographic features associated with impacted premaxillary supernumerary teeth, to determine the relationship between their characteristics and the effects on permanent incisors, and to investigate the types of orthodontic treatment that patients received after the extraction of impacted supernumerary teeth.

Materials and Methods

The Institutional Review Board of Pusan National University Dental Hospital approved this study. The subjects of this study were selected from patients who visited Pusan National University Dental Hospital and underwent cone-beam computed tomography (CBCT) and panoramic radio-

graphy to remove impacted premaxillary supernumerary teeth between 2012 and 2013. The clinical records and radiographs of 193 patients who had supernumerary teeth removed were retrospectively reviewed. The patients comprised 144 boys and 49 girls, with a mean age of 7.41 years at the time of supernumerary tooth extraction (age range, 4-12 years).

CBCT scans were acquired with a PaX-Zenith 3D scanner (Vatech Co., Hwasung, Korea). The scanning parameters were set at 105 kVp, 5.6 mA, 24 seconds, a voxel size of 0.2 mm, and field of view of 12 × 9 cm. The CBCT volumetric data were reconstructed using Ez3D Plus Professional CBCT software (Vatech Co., Hwasung, Korea). All panoramic radiographs were taken with a Proline XC machine (Planmeca Co., Helsinki, Finland).

The CBCT and panoramic images were examined to determine the number, location, sagittal position, orientation, and morphology of impacted supernumerary teeth. The location was classified as midline, central incisor, lateral incisor, or between the central and lateral incisors (Fig. 1). The sagittal position of the supernumerary teeth relative to the permanent incisors was classified as palatal, within the arch, or labial (Fig. 2). The orientation was categorized as normal, inverted, transverse, or horizontal (Fig. 3). The shape of the supernumerary tooth was described as conical, tuberculate, supplemental, or odontoma-type (Fig. 4).

Based on patients' clinical records, panoramic radiographs, and CBCT images, the following effects of supernumerary teeth on the permanent upper incisors were examined: median diastema, delayed eruption, displacement, rotation, and resorption (Fig. 5). The types of subsequent orthodontic treatment after the removal of supernumerary teeth were also investigated. The data were analyzed using the chi-square test and the Fisher exact test. *P*-values < .05 were considered to indicate statistically significant differences. All statistical analyses were per-

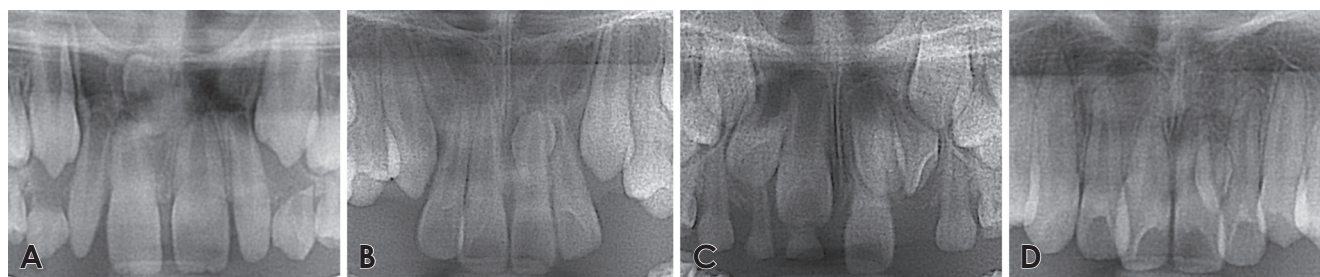


Fig. 1. The location of unerupted premaxillary supernumeraries on panoramic radiographs is classified into 4 regions such as midline (A), central incisor (B), lateral incisor (C), and interdental area between the central and lateral incisor (D).

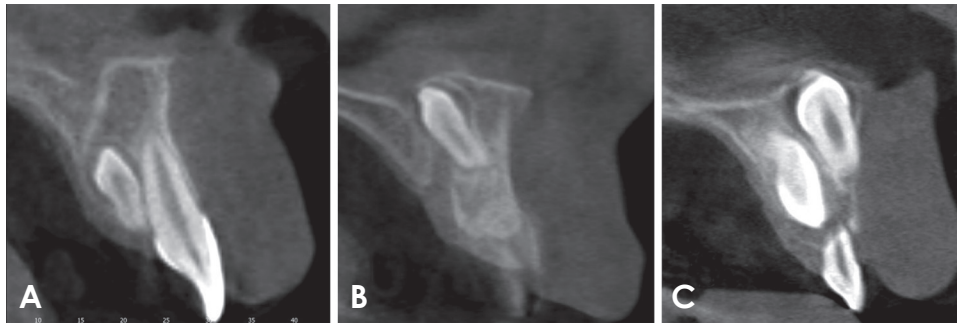


Fig. 2. The sagittal position of unerupted premaxillary supernumerary teeth relative to the permanent incisors is classified into 3 positions such as palatal (A), central (B), and labial (C).

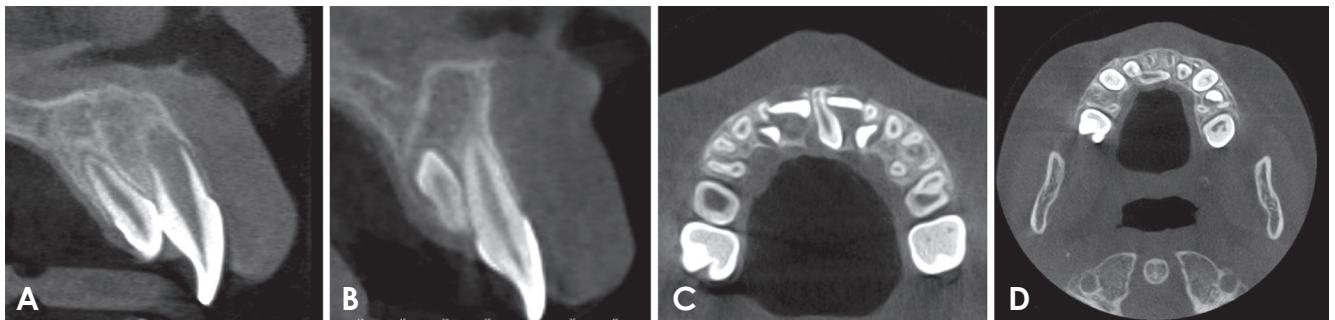


Fig. 3. The orientation of unerupted supernumerary teeth is classified into 4 directions such as vertical (A), inverted (B), transverse (C), and horizontal (D).

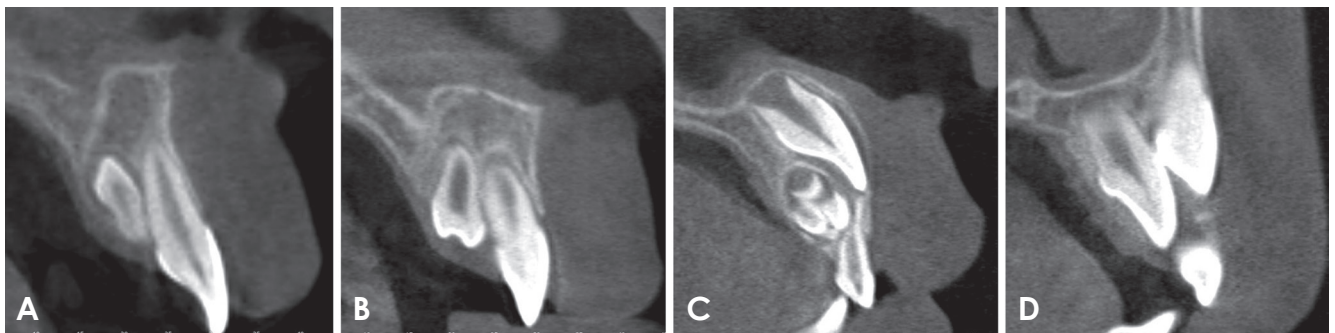


Fig. 4. The morphology of unerupted supernumerary teeth is classified into 4 shapes such as conical (A), tuberculate (B), odontoma (C), and supplemental (D).

formed using SPSS version 23.0 (IBM Corp., Armonk, NY, USA).

Results

The 193 patients had 14 erupted and 241 impacted supernumerary teeth. The 14 erupted supernumeraries were excluded, and the 241 impacted premaxillary supernumerary teeth were examined (Table 1). Of the 193 children, 132 (68.4%) had 1 supernumerary tooth, 60 (31.1%) had

2 supernumeraries, and 1 (0.5%) had 3 supernumeraries. There were 144 male and 49 female patients, and the sex distribution was in favor of males in the ratio of 2.9 : 1. No statistically significant difference was found in the number of supernumeraries according to sex (Table 2).

Premaxillary supernumerary teeth were most frequently observed in the central incisor region (64.7%) and palatal position (76.8%). An inverted orientation (60.6%) and conical shape (75.5%) were most common. The labial position was very rarely observed, appearing in only 1 case

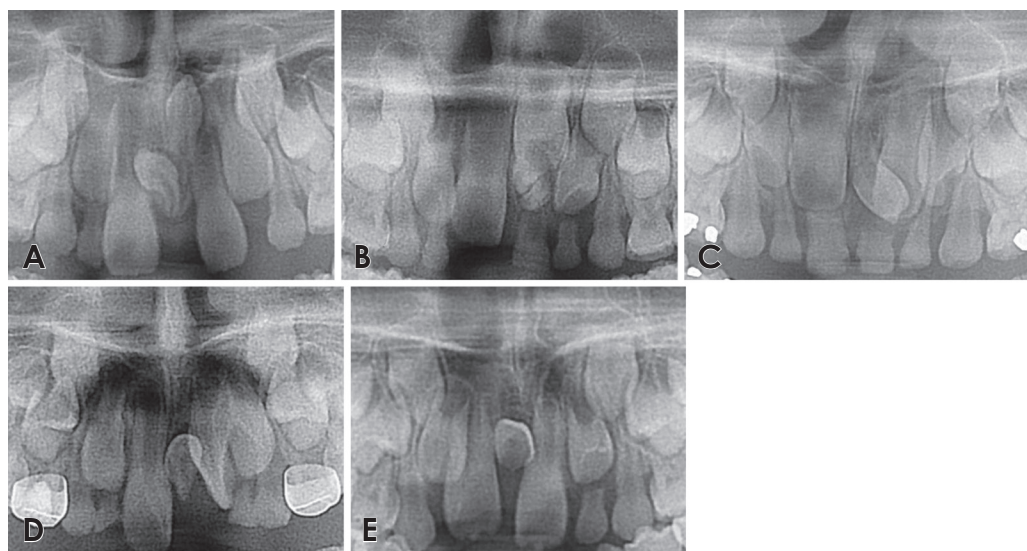


Fig. 5. The effects of premaxillary supernumerary teeth on permanent incisors are median diastema (A), delayed eruption (B), displacement (C), rotation (D), and resorption (E).

Table 1. Number of erupted and impacted supernumerary teeth in the premaxillary region

Number of supernumerary teeth	Number of patients	Erupted supernumerary teeth	Impacted supernumerary teeth
1	132		132
2	60	14	106
3	1		3
Total	193	14	241

Table 2. Sex distribution of the number of supernumerary teeth

Number of supernumerary teeth	Male		Female		Total	
	n	%	n	%	n	%
1	97	67.4	35	71.4	132	68.4
2	46	31.9	14	28.6	60	31.1
3	1	0.7	0	0.0	1	0.5
Total	144	100.0	49	100.0	193	100.0

(0.4%) (Table 3).

The main complications caused by supernumerary teeth were median diastema (17.8%), delayed eruption of incisors (12.9%), displacement (14.5%), and rotation (6.6%) of the adjacent teeth. Root resorption was noted in 1 case (0.4%) (Table 4).

The relationships among the characteristics of supernumeraries and complications were investigated. Median diastema was more frequently observed when the supernumerary was positioned in the midline, within the arch, or transversely ($P < .05$). Delayed eruption of adjacent in-

Table 3. Characteristics used to assess impacted premaxillary supernumerary teeth

		Total	
		n	%
Location	Midline	68	28.2
	Central incisor	156	64.7
	Lateral incisor	12	5.0
	Between the central and lateral incisor	5	2.1
Sagittal position	Palatal	185	76.8
	Within arch	55	22.8
	Labial	1	0.4
Orientation	Vertical	51	21.2
	Inverted	146	60.6
	Transverse	40	16.6
	Horizontal	4	1.7
Morphology	Conical	182	75.5
	Tuberculate	38	15.8
	Odontoma	14	5.8
	Supplemental	7	2.9
Total		241	100.0

incisors was more frequently observed in the vertical orientation than the inverted orientation ($P < .05$). Ten (71.4%) of the 14 odontomas showed delayed eruption. Displacement was more common for the tuberculate and supplement types than for the conical type ($P < .05$). Rotated incisors were more frequently noted in supernumeraries within the arch than in palatally positioned supernumeraries ($P < .05$) (Table 4).

The distribution of cases according to the type of ortho-

Table 4. Characteristics of supernumerary teeth and their effects on the permanent incisors

	Median diastema		Delayed eruption		Displacement		Rotation		Root resorption		Asymptomatic		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Location														
Midline	39	57.4	2	2.9	13	19.1	4	5.9	1	1.5	9	13.2	68	
Central incisor	4	2.6	25	16.0	19	12.2	11	7.1	0	0.0	97	62.2	156	
Lateral incisor	0	0.0	4	33.3	3	25.0	1	8.3	0	0.0	4	33.3	12	
Between the central and lateral incisor	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	100.0	5	
Sagittal position														
Palatal	25	13.5	23	12.4	22	11.9	7	3.8	0	0.0	108	58.4	185	
Within arch	18	32.7	8	14.5	13	23.6	8	14.5	1	1.8	7	12.7	55	
Labial	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	1	
Orientation														
Vertical	0	0.0	15	29.4	13	25.5	2	3.9	0	0.0	21	41.2	51	
Inverted	26	17.8	11	7.5	14	9.6	9	6.2	1	0.7	85	58.2	146	
Transverse	17	42.5	5	12.5	8	20.0	5	12.5	0	0.0	5	12.5	40	
Horizontal	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	100.0	4	
Morphology														
Conical	40	22.0	15	8.2	19	10.4	10	5.5	1	0.5	97	53.3	182	
Tuberculate	2	5.3	6	15.8	12	31.6	4	10.5	0	0.0	14	36.8	38	
Odontoma	1	7.1	10	71.4	1	7.1	0	0.0	0	0.0	2	14.3	14	
Supplemental	0	0.0	0	0.0	3	42.9	2	28.6	0	0.0	2	28.6	7	
Total	43	17.8	31	12.9	35	14.5	16	6.6	1	0.4	115	47.7	241	

odontic treatment after the extraction of supernumerary teeth was examined. Orthodontic traction was performed in 7 cases (50%) of the odontoma type. Orthodontic closure of median diastema was most frequently performed after extraction of supernumerary teeth located in the midline (Table 5).

Fifteen (34.9%) of 43 cases with median diastema were closed orthodontically after removal of the supernumerary tooth. Orthodontic traction was applied to 8 cases (25.8%) of incisors affected by delayed eruption. Twelve (34.3%) displaced incisors and 10 cases (62.5%) of rotated incisors were corrected by the orthodontic creation of sufficient space. Using orthodontic creation of space, 32 (13.3%) maxillary incisors were brought into a good position in the dental arch after the surgical removal of the unerupted supernumerary tooth. In 186 cases (77.2%), permanent incisors erupted without orthodontic treatment after the removal of the supernumerary tooth (Table 6).

Permanent incisors were more likely to erupt spontaneously when the supernumerary teeth were extracted from the primary dentition, although this trend was not statistically significant ($P = .066$). When supernumerary teeth were removed from the primary dentition, orthodontic traction was not required for unerupted maxillary incisors (Table 7).

Discussion

The present study included 193 patients in whom the surgical removal of impacted supernumerary teeth in the premaxillary area was performed. It was observed that premaxillary supernumerary teeth occurred more frequently in boys than in girls.^{2,10,16,17} In this study, the male-to-female ratio was 2.9 : 1, indicating a male predominance. Multiple occurrences of premaxillary supernumerary teeth have been reported in the literature, ranging from 8% to 34% of mesiodens cases.^{2,3,5} In our study, a single supernumerary tooth was found in 132 cases (68.4%), and 2 were found in 60 cases (31.1%). Triple or quadruple occurrence was extremely rare,¹⁰ with only a single such case (0.5%) observed in the patients within the present study.

A greater predilection was observed for supernumeraries to be positioned palatally in this study, similarly to previous studies.¹⁸⁻²¹ Several studies^{10,17,19,20,22,23} have reported that the vertical orientation was most frequent, although others^{2,18} have shown inverted supernumeraries to be the most common. In our study, most of the supernumerary teeth (60.6%) were found in the inverted position, followed by the vertical position (21.2%) and transverse position

Table 5. Characteristics of supernumerary teeth and types of orthodontic treatment

		No orthodontic treatment		Orthodontic traction		Creation of space with positional correction		Closing of median diastema		Total	
		n	%	n	%	n	%	n	%	n	%
Location	Midline	46	67.6	0	0.0	9	13.2	13	19.1	68	100.0
	Central incisor	128	82.1	6	3.8	20	12.8	2	1.3	156	100.0
	Lateral incisor	7	58.3	2	16.7	3	25.0	0	0.0	12	100.0
	Between the central and lateral incisor	5	100.0	0	0.0	0	0.0	0	0.0	5	100.0
Sagittal position	Palatal	150	81.1	6	3.2	19	10.3	10	5.4	185	100.0
	Within arch	35	63.6	2	3.6	13	23.6	5	9.1	55	100.0
	Labial	1	100.0	0	0.0	0	0.0	0	0.0	1	100.0
Orientation	Vertical	34	66.7	7	13.7	10	19.6	0	0.0	51	100.0
	Inverted	119	81.5	0	0.0	16	11.0	11	7.5	146	100.0
	Transverse	29	72.5	1	2.5	6	15.0	4	10.0	40	100.0
	Horizontal	4	100.0	0	0.0	0	0.0	0	0.0	4	100.0
Morphology	Conical	150	82.4	0	0.0	19	10.4	13	7.1	182	100.0
	Tuberculate	27	71.1	1	2.6	9	23.7	1	2.6	38	100.0
	Odontoma	4	28.6	7	50.0	2	14.3	1	7.1	14	100.0
	Supplemental	5	71.4	0	0.0	2	28.6	0	0.0	7	100.0
	Total	186	77.2	8	3.3	32	13.3	15	6.2	241	100.0

Table 6. Relationships among the effects on permanent incisors and types of orthodontic treatment

	No orthodontic treatment		Orthodontic traction		Creation of space with positional correction		Closing of the diastema		Total	
	n	%	n	%	n	%	n	%	n	%
Median diastema	27	62.8	0	0.0	1	2.3	15	34.9	43	100.0
Delayed eruption	15	48.4	8	25.8	8	25.8	0	0.0	31	100.0
Displacement	23	65.7	0	0.0	12	34.3	0	0.0	35	100.0
Rotation	6	37.5	0	0.0	10	62.5	0	0.0	16	100.0
Root resorption	0	0.0	0	0.0	1	100.0	0	0.0	1	100.0
Asymptomatic	115	100.0	0	0.0	0	0.0	0	0.0	115	100.0
Total	186	77.2	8	3.3	32	13.3	15	6.2	241	100.0

Table 7. Types of orthodontic treatment and age of patients

	Primary dentition (4-6 years)		Mixed dentition (7-12 years)		Total	
	n	%	n	%	n	%
No orthodontic treatment	64	86.5	122	73.1	186	77.2
Orthodontic traction	0	0.0	8	4.8	8	3.3
Creation of sufficient space with positional correction	6	8.1	26	15.6	32	13.3
Closing of the diastema	4	5.4	11	6.6	15	6.2
Total	74	100.0	167	100.0	241	100.0

(16.6%). Conical supernumeraries have been found to be the most common,^{18,20,21,23-25} which corresponded well with the results of our study.

Maxillary midline diastema has been reported in 10%-38% of patients with supernumerary teeth.^{2,4,10,25,26} These widely differing results could be due to the manner in

which median diastema was diagnosed.⁴ In the present study, the most common complication was median diastema (17.8%), and it was most frequent in midline supernumerary teeth. Vertically oriented supernumeraries were more frequently associated with delayed eruption of the permanent incisors than inverted types.^{22,26} In this study, the delayed eruption of adjacent incisors was more frequently observed in the vertical position than in the inverted position. Previous studies have reported that morphology was associated with the delayed eruption of teeth.^{9,16,26} Tuberculate supernumerary teeth were more frequently associated with delayed eruption than the conical type,^{9,16,27,28} which corresponds to the findings of our study. It has been reported that the most common cause of the impaction of the upper central incisors was odontoma-shaped supernumerary teeth.²⁹ In our study, 71.4% of odontoma-shaped teeth were associated with the delayed eruption of permanent incisors.

Orthodontic traction may be required to bring unerupted maxillary incisors into a good position after the surgical removal of impacted supernumerary teeth.^{16,20,24} In this study, 8 cases of unerupted incisors erupted after orthodontic traction, and 7 of the 8 cases were incisors associated with the odontoma type. The majority of delayed permanent teeth erupted spontaneously if sufficient space was available or was created at the time of impacted supernumerary removal.^{23,27} Insufficient space for the unerupted incisor may obstruct the eruption of permanent upper incisors after the removal of supernumerary teeth.^{24,27} Rotation or displacement of the permanent incisors has been found to be caused by a lack of space due to the presence of supernumerary teeth.⁴ In our study, the percentage of displaced or rotated incisors was high when space for the incisors was insufficient, and 34.3% displaced incisors and 62.5% rotated incisors were corrected via the orthodontic creation of space after the removal of supernumerary teeth.

Irrespective of whether or not an immediate or delayed surgical approach is adopted, early diagnosis is critical.^{3,10,30,31} The early diagnosis of mesiodens minimizes the treatment required and prevents the development of associated complications.^{8,32} If malalignment of the adjacent permanent teeth is anticipated, this is an indication for the early surgical removal of a supernumerary tooth.^{10,33} Surgical removal of impacted supernumerary teeth could be delayed when no complications due to supernumerary teeth are found to prevent damage to the adjacent unerupted developing teeth.^{23,25} Supernumerary teeth should be followed up radiographically²⁵ because a

delay in treatment can create the need for more complex surgical and orthodontic management.³² In this study, permanent incisors were more likely to erupt without orthodontic treatment when the supernumerary teeth were extracted from the primary dentition than from mixed dentition.

In conclusion, premaxillary supernumerary teeth were most frequently observed in the central incisor region, palatal position and inverted orientation, and the conical shape was the most common. Median diastema was more frequently observed in the midline supernumerary teeth. The percentage of delayed eruption was high in the supernumerary teeth with a vertical orientation and odontoma shape. Displacement of the incisors was more frequently observed in tuberculate or supplemental shapes. Orthodontic traction was most frequently performed after removal of odontoma-type supernumerary teeth. The early removal of impacted premaxillary supernumerary teeth might be advantageous when complications caused by the supernumerary teeth in the maxillary anterior regions are expected.

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