# Retrospective analysis of the factors influencing mesiodentes eruption

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**Aim.** This study aimed to evaluate the factors that predict the spontaneous eruption of mesiodens.

**Design.** From the records of 431 patients (346 boys and 85 girls, average age 8.8 years) who visited Samsung Medical Center from January 2002 to December 2006, 471 mesiodentes were reviewed. The eruption rate was investigated according to the width/length ratio, angulation, location, and shape determined from periapical or panoramic radiographs.

# **Results.** The regression model showed that the width/length ratio and angulation were important determinants influencing the eruption of mesiodentes (P < 0.001, Pearson's r = 0.619). The location of the mesiodentes also affected their eruption (P < 0.01). However, no significant relationship was detected between the shape and eruption rate of mesiodentes (P > 0.05).

**Conclusions.** A lower probability of spontaneous eruption existed when the tooth had a greater angulation, shorter length, and wider width. Spontaneous eruption occurs more often when the mesiodens is located between the permanent incisors.

#### Introduction

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Supernumerary teeth are defined as those that are present in excess of the normal component of human dentition<sup>1</sup>. Many hypotheses regarding the aetiology of supernumerary teeth have been reported, such as atavism, division of the dental follicle, and inheritance. The latest theory advanced regarding the development of supernumerary teeth suggests that hyperactivity of the dental lamina exists<sup>2,3</sup>. Two genes known to be involved in dental anomalies in humans - Msx1 and Runx2 are thought to be transcriptional targets of FGF signalling<sup>4,5</sup>. The molecular events at the bud–cap transition lead to the prolonged survival or proliferation of the dental lamina<sup>1,6,7</sup>. Supernumerary teeth are also related to specific clinical syndromes, such as cleidocranial dysostosis and Gardner syndrome. A supernumerary tooth is usually first detected on radiographic examination during a routine dental visit. A supernumerary tooth may develop anywhere in either dental arch, but generally occurs in the anterior region of the maxilla<sup>8,9</sup>. A mesiodens is defined as a supernumerary tooth that develops at the front of the maxilla around the permanent central incisors. The prevalence of supernumerary teeth is 0.3–0.8% in the primary dentition stage, and 1.5–3.5% in the permanent dentition stage<sup>3,10–12</sup>. The ratio between the prevalence rates of supernumerary teeth in boys and girls is 2 : 1. Most mesiodentes are impacted and often inverted, with a conical shape and a single root<sup>13</sup>. Mesiodentes can cause crowding, diastema, rotation, dislocation, and resorption of the adjacent permanent teeth, and interfere with the eruption of permanent teeth or form cysts<sup>14–18</sup>.

When mesiodentes are noted clinically, it is often difficult to decide whether they must be extracted surgically or observed periodically without extraction. Some studies strongly recommend that mesiodentes be removed<sup>2,19</sup>, whereas others suggest that they can be left *in situ*<sup>20–22</sup>. Tyrologou *et al.*<sup>22</sup> investigated if any complications occurred, such as dislocation of the mesiodens or a change in the size of the dental follicle, when a supernumerary tooth was not removed, and found no such complications. Only a few studies have addressed the

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problems associated with the dislocation of a mesiodens or the size change of the dental follicle. Based on this limited clinical evidence, it is logical to avoid extraction unless necessary, such as when the mesiodens interferes with the eruption of the permanent incisor, or when early surgical extraction is required for orthodontic purposes.

If no persistent complications are noted, watchful waiting for spontaneous eruption of the mesiodens is acceptable. Such an approach can reduce the trauma of supernumerary tooth extraction and facilitate subsequent extraction, thereby shortening the treatment time. In this regard, it is important to recognize various factors that may affect spontaneous eruption of the mesiodens.

This study evaluated the various factors that affect the spontaneous eruption of mesiodentes in order to create predictable clinical indices.

### Materials and methods

#### Study subjects

A clinical survey examined all of the patients who had visited the Department of Pediatric Dentistry and Oral & Maxillofacial Surgery of Samsung Medical Center from January 2002 to December 2006 for treatment of supernumerary teeth or whose supernumerary teeth were detected incidentally during a radiographic examination. We evaluated 471 mesiodentes in 431 patients. The ratio of boys to girls with supernumerary teeth was 4 : 1, and the average age was 8.8 years. This study was approved by the Institutional Review Board of Samsung Medical Center.

#### Study methods

The mesiodentes were divided into two groups by direction: inverted or non-inverted. Spontaneous eruption (eruption into occlusal direction) of the mesiodens was evaluated based on the width/ length ratio, angulation, shape, and location of the mesiodens from periapical or panoramic radiographs (Kodak 2200; Eastman Kodak, Rochester, NY, USA). The measured data were retraced and re-analysed in a week by the same investigator. Spontaneous eruption was determined by observ-



**Fig. 1.** The length (a–b) and width (c–d) of supernumerary teeth.

ing the emergence of the mesiodens intraorally, and the failure of spontaneous eruption was determined by a lack of movement on the radiographs during follow-up observations 6– 12 months after the mesiodens was first observed.

### The width/length ratio of the mesiodens

The radiographic length of the mesiodens was defined as the distance from the crown tip to the root apex in the long axis, and the width of the mesiodens was defined as the greatest width of the mesiodens perpendicular to the long axis (Fig. 1). The width/length ratio was calculated.

### Angulation of the mesiodens

The angulation of the mesiodens was defined as the angle between the midpalatal line and the long axis of the mesiodens (Fig. 2).

### Shape of the mesiodens

The shape of the mesiodens was described as either conical (wedge-shaped mesiodens) or tuberculate (mesiodens with one or more cusps or tubercles (Fig. 3)<sup>23</sup>.

### Location of the mesiodens

The location of the mesiodens was described as either between or overlapping the permanent incisors (Fig. 4).



Fig. 2. The angulation of supernumerary teeth.

If the mesiodens was not extracted and observed periodically, the follow-up period was a minimum of 6 months and a maximum of 5 years; the average follow-up period was approximately 1 year. Cystic changes of the dental follicle or resorption of the adjacent tooth were examined by evaluating follow-up radiographs.

#### Statistical analysis

In order to estimate the level of significance of the data, measured by the same investigator in a week interval, the intraclass correlation coefficient (ICC) was calculated.

The significance of the differences in spontaneous eruption according to the width/length ratio and angulation of the mesiodens was analysed by using SPSS (version 13.0, SPSS, Chicago, IL, USA) and logistic regression analysis. A Pearson's chi-squared test was used if any statistically significant difference was detected in the degree of spontaneous eruption with different shapes or locations of the mesiodentes (P = 0.05).

#### Results

The ICC (0.81~0.96) showed that the data measured by the same investigator were highly reliable.



**Fig. 3.** The shape of supernumerary teeth. (a) The tuberculate type of supernumerary possesses more than one cusp or tubercle. It is frequently described as barrel shaped and may be invaginated. (b) A small, peg-shaped, conical tooth is the supernumerary most commonly found in the permanent dentition.

Of the 471 mesiodentes, 43% were noninverted mesiodentes (196 mesiodentes), whereas 57% were inverted (275 mesiodentes). In the non-inverted group, 56.6% (111 mesiodentes) erupted spontaneously. In the inverted group, no spontaneous eruption was observed. Therefore, the statistical analysis examined the degree of spontaneous eruption for non-inverted mesiodentes only.

#### Width/length ratio and angulation of the mesiodens

The width/length ratio and angulation of the mesiodens had a high correlation with the probability of eruption (Pearson's r = 0.619, P < 0.05). Logistic regression analysis (Table 1) showed a significant difference in the degree of spontaneous eruption based on the width/ length ratio and angulation of the mesiodens. A greater probability of eruption was observed with longer length, narrower width, and smaller angulation. The logistic regression model was

 $probability of eruption = \frac{exp \ (6.1399 - 1.094 \times 10 \times (diameter/length) - 0.0714 \times angle)}{1 + exp \ (6.1399 - 1.094 \times 10 \times (diameter/length) - 0.0714 \times angle)}$ 



Fig. 4. The location of mesiodentes: (a) between the central incisors, and (b) overlapping the incisors.

Table 1. Logistic regression analysis.

Parameter	Estimate	Standard error	Wald chi-squared	P value
Intercept	6.1399	0.9716	39.9373	<0.0001
Width/length	-1.0940	0.2131	26.3623	<0.0001
Angle	-0.0714	0.0149	22.9549	<0.0001

### Shape of the mesiodens

For the spontaneously erupted mesiodentes (n = 111), the ratio of conical to tuberculate shape was 2 : 1, whereas it was 1.2 : 1 for non-erupted mesiodentes (n = 85; Table 2). The Pearson's chi-squared test, however, did not identify a significant difference in the degree of spontaneous eruption between conical and tuberculate mesiodentes.

Table 2.	Significance in the correlations with shape and
location	(Pearson's chi-squared test).

		Erupted	Not erupted	P value
Shape	Conical	74	47	0.0739
	Tuberculate	37	38	
Location	Between central incisors	96	51	0.0001
	Overlapped the incisors	15	34	

# Location of the mesiodens

The ratio of mesiodentes between permanent and overlapping the permanent central incisors was approximately 6:1 in the erupted state, and the difference was significant (P < 0.05). In the non-erupted state, the ratio was 1.5:1.

## Discussion

According to Garvey *et al.*<sup>23</sup>, supernumerary teeth are more frequent in boys and a conical shape is the most frequent, which is in agreement with our results. However, we found more inverted mesiodentes than non-inverted ones, which differs from other reports<sup>8,14,23</sup>. Many of the sample population in this study were individuals who were referred from local dental clinics for surgical extraction of the mesiodents, which could explain why inverted mesiodentes were more prevalent in our study.

Garvey *et al.*<sup>23</sup> also reported that fewer spontaneous eruptions occurred with tuberculate versus conical supernumerary teeth. In our study, no significant difference (P = 0.0739) was seen in the degree of spontaneous eruption according to crown shape.

In this study, a logistic regression analysis showed that the degree of spontaneous eruption was significantly influenced by the width/length ratio and angulation of the mesiodentes. These clinical findings could be applied to an eruption probability model using the following equation:

The absolute value of the length or width of the mesiodens was not used for this equation,

 $probability of eruption = \frac{exp \ (6.1399 - 1.094 \times 10 \times (diameter/length) - 0.0714 \times angle)}{1 + exp \ (6.1399 - 1.094 \times 10 \times (diameter/length) - 0.0714 \times angle)}$ 

because great individual variation likely exists in radiographic image distortion. Instead, the ratio (width/length) was used for this equation.

According to this regression model, a lower probability of spontaneous eruption exists with a greater width/length ratio (P < 0.001). Similarly, the model shows a lower probability of spontaneous eruption when the angle increases (P < 0.001).

In this study, neither cystic changes of the dental follicle nor any resorption of adjacent permanent incisors was observed during the follow-up period, whereas other studies have reported cyst formation involving the dental follicle or the resorption of adjacent permanent teeth<sup>2,17,21</sup>. These studies were case reports, rather than cohort studies, and therefore, generalizing the observed side effects is not appropriate. Concurring with our results, several other studies<sup>8,22</sup> also found no complications during the observation period while the mesiodentes were erupting spontaneously, such as the resorption of adjacent permanent incisors. Therefore, the early extraction of supernumerary teeth is not recommended, except for a clear negative indication, such as disturbing the eruption of the permanent tooth. In each patient, the management of the supernumerary tooth should be based on clinical and radiographic examinations. Surgical removal of the supernumerary tooth should be limited to those cases in which complications (eruption disturbances or resorption of the permanent tooth) are obvious. The supernumerary tooth should not be removed just because the follicle space is widened, because the formation of cysts is very rare. A mesiodens that does not cause specific complications does not require early surgical extraction because it does not interfere with the orthodontic alignment of the permanent teeth. The vertical growth of the jaw will solve the problem of space alignment without surgical extraction of the mesiodens. Moreover, in some cases, supernumerary teeth are resorbed and disappear naturally, although this is very rare $^{2,21}$ .

Early surgical extraction is only necessary when the mesiodentes interfere with the eruption of permanent incisors, or for orthodontic reasons. Early extraction is unnecessary and spontaneous eruption can be expected, which can reduce the trauma of surgical extraction. Therefore, the ability to predict the probability of spontaneous eruption of a mesiodens is meaningful clinically. This study showed that the spontaneous eruption of the mesiodens is influenced by several factors, including the direction, location, length, width, and angulation of the mesiodens. An eruption probability model was also proposed.

#### What this paper adds

- The factors that influence the spontaneous eruption of the mesiodens (width/length ratio, angulation to the mid-palatal line, shape, and location of the mesiodens) have been analysed.
- The first study that can predict the possibility of the spontaneous eruption of the mesiodens using the regression model.

Why this paper is important to paediatric dentists

- Paediatric dentists should be able to predict the possibility of the spontaneous eruption of the mesiodens.
- The factors that influence the spontaneous eruption of the mesiodens, which have been analysed from this study, will support paediatric dentists in order to make more accurate predictions of the spontaneous eruption of the mesiodens.

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