

From detection to decision: radiographic predictors of clinical complications in 514 supernumerary teeth: A retrospective cross-sectional study

Elif Kabacioglu

elifkabacioglu@gmail.com

Marmara University

Betul Sen Yavuz

Marmara University

Selma Yaltkaya

Marmara University

Sebnem Ercalik Yalcinkaya

Marmara University

Ali Menten

Marmara University

Research Article

Keywords: Complications, Pediatric dentistry, Panoramic radiography, Supernumerary teeth, Tooth morphology

Posted Date: October 21st, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-11283991/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

Additional Declarations: No competing interests reported.

Abstract

Background

Supernumerary teeth exhibit various morphological characteristics and may lead to a range of complications. This study aimed to evaluate radiographic characteristics of supernumerary teeth in children and to determine associations with complications and treatment status.

Materials and methods

This study included 386 systemically healthy paediatric patients (5–15.9 years) with 514 supernumerary teeth identified on panoramic radiographs. Variables included number, location, morphology, eruption direction, eruption status, root development stage, and complications. Statistical analyses included chi-square tests, independent samples t-tests, and multivariable binary logistic and multinomial regression models.

Results

The mean age was 9.07 ± 2.08 years, and 70.2% of patients were male. Significant differences were observed between erupted and impacted teeth regarding morphology, eruption direction, root development stage, complications, and Cone-beam computed tomography (CBCT) use ($p < 0.05$). Morphology and root development stage were associated with complication patterns ($p < 0.05$). Multivariable regression analyses showed that CBCT use was associated with eruption status, dentition stage, side distribution, and delayed eruption. Anterior maxillary localisation was strongly associated with conical and tuberculate morphologies. Midline location was associated with increased odds of both complete and partial root development ($p < 0.001$).

Conclusion

Supernumerary teeth exhibit distinct radiographic characteristics associated with clinical complications. Morphology, eruption status, and root development were associated with clinical and radiographic findings. Early radiographic evaluation is essential for individualised treatment planning.

Introduction

Dental number anomalies are among the most common developmental disorders and may be associated with both syndromic and non-syndromic conditions. These anomalies may result in either an increased or decreased number of teeth (hyperdontia or hypodontia) [1]. The terms supernumerary teeth (ST), extra teeth, or hyperdontia refer to any dental or tooth-derived tissue identified in excess of the normal count [2]. The prevalence of ST in the primary dentition ranges between 0.3% – 0.6%, whereas in the permanent dentition it increases from 0.5% to as high as 3.8% [3].

Although several hypotheses have been proposed regarding the aetiology of ST, a definitive cause has yet to be established. Both genetic and environmental factors have been suggested as potential contributors. ST originate from a dental germ and can appear in any region of the dental arch [4]. These teeth may be observed as single or multiple, and unilaterally or bilaterally. They are most commonly observed as a single tooth and without associated diseases [5]. However, when five or more ST are present, the possibility of associated syndromes should be considered. Cleft lip and palate as well as cleidocranial dysostosis are among the most commonly associated syndromes [6]. ST may also exhibit considerable variation in morphology, location, eruption pattern, and developmental stage [7, 8].

Accurate radiographic localisation of ST is essential for preventing complications and determining appropriate timing of intervention. It is particularly important for evaluating relationships with surrounding anatomical structures and diagnosing dental anomalies [9]. Periapical, occlusal, and panoramic radiographs are most commonly obtained to evaluate ST. These radiographs usually provide sufficient diagnostic information; however, they may not adequately demonstrate three-dimensional relationships [10, 11]. Although CBCT provides more detailed and accurate three-dimensional imaging, its use should be justified because of the higher radiation exposure compared with conventional radiography [12].

Although ST are often asymptomatic, they can lead to various complications, including delayed eruption of adjacent teeth, displacement, crowding, malocclusion, diastema, root resorption, and cyst formation [13]. To reduce the risk of complications affecting adjacent teeth, the timely extraction of the supernumerary tooth during the mixed dentition stage is recommended. The successor tooth usually erupts spontaneously following removal of the supernumerary tooth. However, if the apex of the permanent tooth is closed and eruption does not occur, surgical exposure combined with orthodontic traction may be required to facilitate eruption [14].

Previous studies have often evaluated ST alongside other dental anomalies or have focused on selected clinical and radiographic features. By jointly assessing tooth morphology, root development stage, CBCT use, and a broad range of associated complications within a large cohort, the present study aimed to provide a detailed characterization of ST and clarify the relationships among these variables. The primary aim was to investigate whether supernumerary tooth morphology was associated with clinical complications and radiographic characteristics. The secondary aims were to examine the associations of root development stage with clinical complications and radiographic characteristics and, as an exploratory objective, to determine whether CBCT use was associated with specific clinical and radiographic characteristics, including dentition stage, side distribution, eruption status, and associated complications. The primary null hypothesis was that supernumerary tooth morphology would not be associated with clinical complications or radiographic characteristics. The secondary null hypotheses were that (i) root development stage would not be associated with clinical complications or radiographic characteristics and (ii) CBCT use would not be associated with these characteristics.

Materials and methods

This retrospective cross-sectional study was conducted at a university-affiliated paediatric dentistry clinic. Ethical approval was obtained from the institutional Clinical Research Ethics Committee on May 29, 2025 (Decision No. 2025-43). The requirement for informed consent was waived by the Ethics Committee due to the retrospective nature of the study. The study was carried out in accordance with the principles of the Declaration of Helsinki for biomedical research involving human subjects.

Based on the study by Uyar and Uyar, the required sample size was calculated using G*Power 3.1 software (Faul, Erdfelder, Lang, and Buchner, Düsseldorf, Germany). Assuming a 95% confidence level ($1 - \alpha$), a test power of 95% ($1 - \beta$), and an effect size of 0.326, the minimum required sample size for the study population was calculated as 246 participants [15].

Study design and study population

This study included systemically healthy patients aged between 5 and 16 years who were diagnosed with at least one supernumerary tooth at the Department of Pediatric Dentistry of Marmara University. As the study centre is a university dental hospital, patients attended the department with various dental complaints, including delayed eruption or crowding potentially associated with a supernumerary tooth. Some patients may have been referred to the hospital for further dental evaluation; however, the study sample was not selected on the basis of referral status. The records of all patients who attended the department between 2009 and 2024 were screened to identify those who met the eligibility criteria.

Eligibility criteria and radiographic quality assessment

Eligibility criteria included an age below 16 years, the absence of any systemic disease, and the presence of at least one supernumerary tooth, and had an initial diagnostic panoramic radiograph available for evaluation. A total of 402 patients' initial diagnostic panoramic radiographs were retrieved from the radiology archives of the study centre and assessed for eligibility. Patients with syndromic conditions associated with ST or with panoramic radiographs of insufficient diagnostic quality were excluded.

The presence of syndromic conditions was determined from the patients' documented medical records. Radiographic quality was assessed according to the 2020 Guidance Notes for Dental Practitioners on the Safe Use of X-ray Equipment [16]. Only panoramic radiographs considered diagnostically acceptable, defined as having sufficient image quality for reliable diagnostic interpretation despite the presence of minor errors, were included. Radiographs with image deficiencies that could interfere with reliable assessment or diagnosis were excluded.

Of the 402 patients initially assessed for eligibility, 16 were excluded because of insufficient radiographic quality or the presence of syndromic conditions. The final study sample therefore comprised 386 paediatric patients with a total of 514 ST.

Radiographic acquisition and assessment

All initial diagnostic panoramic radiographs were obtained using one of two panoramic imaging systems: Planmeca ProMax (Planmeca Oy, Helsinki, Finland), operated at 65 kV, 5 mA, and 8 s, or Veraviewpocs (VeraView IC5, J. Morita MFG. Corp., Kyoto, Japan), operated at 64 kV, 7 mA, and 15.8 s. All radiographs were stored digitally in the institutional radiology archive. Following institutional authorization, the radiographic images were retrieved from the hospital imaging system in digital format and evaluated electronically.

The panoramic radiographs were evaluated by two calibrated paediatric dentists who had undergone standardised training in the assessment criteria prior to data collection. Radiographic findings were recorded based on consensus between the two examiners. In cases of diagnostic uncertainty, an experienced paediatric dentist was consulted to reach a final decision. When available and considered necessary for clarification of the radiographic findings, existing periapical radiographs were used as adjunctive imaging.

Radiographic variables

The following variables were recorded: demographic characteristics (age and sex); radiographic characteristics (number of ST, dentition stage, location, side, orientation, eruption status, morphology, and root development stage); associated complications (delayed eruption, displacement, crowding, dilaceration, diastema, root resorption, and cystic change); CBCT use; and treatment status. Each complication was recorded separately as a binary variable (yes/no). CBCT use was also recorded as a binary variable (yes/no) according to whether a CBCT examination had been obtained and documented in the available institutional records. This variable represented actual CBCT utilization rather than an independently adjudicated indication or objective need for CBCT. The analysis explored whether CBCT was more frequently used in cases presenting with particular clinical or radiographic characteristics that might reflect greater diagnostic or treatment-planning complexity. Treatment status was determined retrospectively from the available clinical records and was recorded as a binary variable according to whether treatment had been performed (yes/no). For treated cases, the records were also reviewed to determine whether the treatment involved surgical removal of the supernumerary tooth. Treatment and surgical decisions had been made by the clinicians responsible for the patients' routine care and were not independently determined by the study investigators.

Dentition stage was classified as primary, mixed, or permanent. Primary dentition was defined as the presence of erupted primary teeth with all permanent teeth remaining unerupted within the jaws. Mixed dentition was defined as the simultaneous presence of erupted primary and permanent teeth, whereas permanent dentition was defined as the presence of erupted permanent teeth with no remaining primary teeth [9].

The location of each supernumerary tooth was classified according to the jaw (maxilla or mandible) and region (anterior or posterior). ST located anterior to the premolar region were classified as anterior, whereas those located within or posterior to the premolar region were classified as posterior.

According to their position within the dental arch, ST were classified as unilateral, bilateral, or midline. A unilateral location was recorded when the supernumerary tooth or teeth were confined to one side of the dental arch, whereas a bilateral location was recorded when both sides were involved. ST located between the central incisors were classified as midline.

The orientation of each supernumerary tooth was classified as vertical, horizontal, or inverted according to the relationship between its longitudinal axis and that of the adjacent tooth [6]. A vertical orientation was recorded when the longitudinal axis of the supernumerary tooth was parallel or approximately parallel to that of the adjacent tooth. A horizontal orientation was recorded when its longitudinal axis was perpendicular or approximately perpendicular to that of the adjacent tooth. A supernumerary tooth was classified as inverted when its crown was directed opposite to the normal direction of eruption.

Eruption status was classified as erupted or impacted based on the panoramic radiographic findings. A supernumerary tooth was classified as impacted when it was positioned apical to the cervical level of the adjacent tooth and remained covered by hard tissue and/or radiographically visible soft tissue. Conversely, a supernumerary tooth was classified as erupted when it was positioned coronal to the cervical level of the adjacent tooth without radiographic evidence of hard- or soft-tissue coverage.

ST were morphologically classified as conical, tuberculate, supplemental, or odontoma.¹⁷ Conical teeth were characterised by a symmetrical, tapered crown with a pointed appearance. Tuberculate teeth were characterised by a crown with multiple cusps. Supplemental teeth were defined as those closely resembling a normal tooth of the adjacent tooth series in morphology. Odontomas were defined as irregular or malformed structures lacking normal crown morphology and root development.

Root development was assessed according to the eight-stage (A–H) classification described by Demirjian et al. Owing to the skewed distribution of observations across the individual stages, the eight stages were grouped into three categories for statistical analysis: stages A–D were classified as crown-only development, stages E–F as partial root development, and stages G–H as full root development [18].

Statistical analyses

Statistical analyses were performed using SPSS version 22.0 for Windows (IBM Corp., Armonk, NY, USA). Inter- and intra-examiner reliability for the radiographic identification of ST were assessed using Cohen's kappa coefficient. For intra-examiner reliability assessment, the same examiner re-evaluated 50 randomly selected panoramic radiographs two weeks after the initial assessment. Excellent inter-examiner agreement was observed ($\kappa = 0.94$), while intra-examiner agreement was also excellent for both examiners, with kappa values of $\kappa = 0.94$ and $\kappa = 0.96$.

Descriptive statistics were presented as mean $\pm$ standard deviation, percentages, and frequency distributions. Continuous variables were investigated for normality using the Shapiro–Wilk test. Age was compared between groups using the independent samples t-test. Associations between categorical variables were analysed using the chi-square test or Fisher's exact test where appropriate.

Multivariable binary logistic regression and multinomial logistic regression models were used to identify factors associated with CBCT use, morphology, and root development stage of ST. Initially, univariate analyses were conducted to screen potential predictors. Variables with clinical relevance and/or statistical significance were subsequently entered into multivariable models. The final binary logistic regression model examined whether clinical and radiographic characteristics, including side distribution, dentition stage, eruption status, and associated complications, were associated with CBCT use. Multinomial logistic regression analyses were performed to evaluate the associations of independent variables with supernumerary tooth morphology, using odontoma as the reference category, and root development stage, using "crown-only formation" as the reference category. Categorical variables were appropriately coded, and reference categories were defined for each model. The results are presented as odds ratios (ORs) with 95% confidence intervals (CIs). A p-value < 0.05 was considered statistically significant.

The study was reported in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines.

Results

The study included 386 patients with 514 ST. The patients were between 5 and 15.9 years of age, with a mean age of 9.07 ± 2.08 years. Of the patients, 70.2% were male, corresponding to a male-to-female ratio of 2.4:1, and 73.3% had a single supernumerary tooth. CBCT had been used in 42.5% of the cases. ST were located exclusively in the anterior maxillary region in 94.6% of the patients, and 95.3% of all ST were located in the anterior maxilla. Conical morphology was the most frequent type (53.1%), followed by supplemental (21.6%), tuberculate (20.6%), and odontoma (4.7%) morphologies. Of the ST, 59.5% were impacted and 85.1% had a vertical orientation. Fully developed roots were observed in 48.1% of the teeth, whereas 30.5% showed crown formation only and 21.4% showed partial root development. Displacement was the most frequent associated complication (80.4%), followed by delayed eruption (48.6%) and crowding (26.3%); root resorption was not observed. Periapical radiographs were additionally available for 37.3% of the patients and were used as adjunctive imaging when necessary. Surgical removal was performed for 94.0% of the ST, whereas the remaining 6.0% were managed by follow-up. Detailed descriptive characteristics are presented in Table 1.

Table 1
Distribution of patient- and tooth-based descriptive data

Patient-based variable		n _p (%)
Gender	Male	271 (70.2)
	Female	115 (29.8)
Number of ST	One tooth	283 (73.3)
	More than one tooth	103 (26.7)
Dentition	Primary	18 (4.6)
	Mixed	306 (79.3)
	Permanent	62 (16.1)
Location	Max ant	365 (94.6)
	Mand ant	11 (2.8)
	Multiple ^a	10 (2.6)
CBCT	No	222 (57.5)
	Yes	164 (42.5)
Eruption status	Erupted	346 (89.6)
	Impacted	-
	Multiple ^a	40 (10.4)
Side	Midline	125 (32.4)
	Unilaterally	184 (47.7)
	Bilaterally	58 (15)
	Multiple ^a	19 (4.9)
Complications	No	28 (7.3)
	One	72 (18.7)
	Two	240 (62.1)
	More than two	46 (11.9)
Total		386 (100)
Tooth-based variable		n _t (%)
Location	Max ant	490 (95.3)
	Mand ant	24 (4.7)
CBCT	No	262 (57.5)
	Yes	252 (42.5)
Morphology	Conical	273 (53.1)
	Tuberculate	106 (20.6)
	Supplemental	111 (21.6)
	Odontoma	24 (4.7)
Eruption status	Erupted	208 (40.5)
	Impacted	306 (59.5)
Dentition	Primary	24 (4.7)
	Mixed	396 (77)
	Permanent	94 (18.3)
Complications	Delayed eruption	250 (48.6)
n _p : the number of patients, ST: supernumerary teeth, n _t : the number of teeth, CBCT: Cone-beam computed tomography. ^a Multiple indicates patients with more than one supernumerary tooth in whom the teeth were classified into different categories for the corresponding variable.		

Patient-based variable		n _p (%)
	Displacement	413 (80.4)
	Crowding	135 (26.3)
	Dilaceration	10 (2)
	Diastema	34 (6.6)
	Root resorption	-
	Cyst formation	2 (0.4)
	No effect	68 (13.2)
Direction of eruption	Vertical	437 (85.1)
	Horizontal	36 (7)
	Inverted	41 (7.9)
Root development	Fully formed	247 (48.1)
	Partially formed	110 (21.4)
	Crown only	157 (30.5)
Surgical treatment performed	Yes	483 (94)
	No	31 (6)
Total		514 (100)
n _p : the number of patients, ST: supernumerary teeth, n _t : the number of teeth, CBCT: Cone-beam computed tomography. ^a Multiple indicates patients with more than one supernumerary tooth in whom the teeth were classified into different categories for the corresponding variable.		

The eruption characteristics of the ST are presented in Table 2. Impacted teeth were more frequently observed in male patients than erupted teeth (75.5% vs. 65.4%, $p = 0.013$). CBCT use was also more frequent for impacted teeth than for erupted teeth (70.3% vs. 17.8%, $p < 0.001$). Morphology differed significantly according to eruption status ($p < 0.001$): conical and supplemental morphologies were more frequent among erupted teeth (71.2% and 26.4%, respectively) than among impacted teeth (40.8% and 18.3%, respectively), whereas tuberculate morphology was more frequent among impacted teeth (33.0% vs. 2.4%). All odontomas were impacted. Delayed eruption was more frequent in association with impacted teeth than with erupted teeth (69.9% vs. 17.3%, $p < 0.001$). In contrast, displacement (85.1% vs. 77.1%, $p = 0.026$), crowding (47.1% vs. 12.1%, $p < 0.001$), and diastema (12.0% vs. 2.9%, $p < 0.001$) were more frequent among erupted teeth. All erupted teeth had a vertical orientation, whereas 11.8% of impacted teeth were horizontally oriented and 13.4% were inverted ($p < 0.001$). Fully developed roots were more frequent among erupted teeth than impacted teeth (81.2% vs. 25.5%), whereas crown-only development was observed exclusively among impacted teeth (51.3%; $p < 0.001$).

Table 2
Analysis of the eruption characteristics of supernumerary teeth

Variable		Erupted	Impacted	P
Gender	Male	136 (65.4)	231 (75.5)	0.013^a
	Female	72 (34.6)	75 (24.5)	
CBCT	No	171 (82.2)	91 (29.7)	< 0.001^a
	Yes	37 (17.8)	215 (70.3)	
Location	Max ant	202 (97.1)	288 (94.1)	0.114 ^a
	Mand ant	6 (2.9)	18 (5.9)	
Morphology	Conical	148 (71.2)	125 (40.8)	< 0.001^a
	Tuberculate	5 (2.4)	101 (33)	
	Supplemental	55 (26.4)	56 (18.3)	
	Odontoma	-	24 (7.8)	
Dentition	Primary	9 (4.3)	15 (4.9)	0.640 ^a
	Mixed	157 (75.5)	239 (78.1)	
	Permanent	42 (20.2)	52 (17)	
Complications	Delayed eruption	36 (17.3)	214 (69.9)	< 0.001^a
	Displacement	177 (85.1)	236 (77.1)	0.026^a
	Crowding	98 (47.1)	37 (12.1)	< 0.001^a
	Dilaceration	2 (1)	8 (2.6)	0.214 ^b
	Diastema	25 (12)	9 (2.9)	< 0.001^a
	Root resorption	-	-	-
	Cyst formation	-	2 (0.7)	0.517 ^b
	No effect	26 (12.5)	42 (13.7)	0.687 ^a
Direction of eruption	Vertical	208 (100)	229 (74.8)	< 0.001^c
	Horizontal	-	36 (11.8)	
	Inverted	-	41 (13.4)	
Root development	Fully formed	169 (81.2)	78 (25.5)	< 0.001^a
	Partially formed	39 (18.8)	71 (23.2)	
	Crown only	-	157 (51.3)	
Surgical treatment performed	Yes	208 (100)	275 (89.9)	< 0.001^a
	No	-	31 (10.1)	
Total		208 (100)	306 (100)	
CBCT: Cone-beam computed tomography. ^a Chi-square test; ^b Fisher's exact test; ^c Likelihood ratio test. Bold values indicate statistically significant differences (p < 0.05).				

Table 3 summarizes the distribution of complications and surgical treatment according to morphology, eruption direction, and root development stage. Delayed eruption, crowding, diastema, and absence of effect differed significantly across morphological types (p < 0.001). Orientation was significantly associated with diastema and no-effect outcomes (p = 0.028 and p = 0.01, respectively). Root development stage was significantly associated with delayed eruption, crowding, diastema, and no-effect categories (p < 0.001).

Table 3
Comparison of complications and surgical treatment according to morphology, eruption direction, and root development stage

Morphology		Conical	Tuberculate	Supplemental	Odontoma	Total	P
Complications	Delayed eruption	79 (31.6)	98 (39.2)	49 (19.6)	24 (9.6)	250 (100)	< 0.001^a
	Displacement	213 (51.6)	86 (20.8)	95 (23)	19 (4.6)	413 (100)	0.403 ^a
	Crowding	79 (58.5)	8 (5.9)	46 (34.1)	2 (1.5)	135 (100)	< 0.001^a
	Dilaceration	4 (40)	3 (30)	2 (20)	1 (10)	10 (100)	0.747 ^b
	Diastema	34 (100)	-	-	-	34 (100)	< 0.001^a
	Root resorption	-	-	-	-	-	-
	Cyst formation	1 (50)	-	-	1 (50)	2 (100)	0.199 ^b
	No effect	53 (77.9)	5 (7.4)	10 (14.7)	-	68 (100)	< 0.001^a
Surgical treatment performed	Yes	253 (52.4)	101 (20.9)	105 (21.7)	24 (5)	483 (100)	0.432 ^a
	No	20 (64.5)	5 (16.1)	6 (19.4)	-	31 (100)	
Orientation		Vertical	Horizontal	Inverted		Total	P
Complications	Delayed eruption	216 (86.4)	21 (8.4)	13 (5.2)		250 (100)	0.077 ^b
	Displacement	355 (86)	23 (5.6)	35 (8.5)		413 (100)	0.092 ^b
	Crowding	118 (87.4)	4 (3)	13 (9.6)		135 (100)	0.078 ^b
	Dilaceration	8 (80)	1 (10)	1 (10)		10 (100)	0.933 ^b
	Diastema	27 (79.4)	1 (2.9)	6 (17.6)		34 (100)	0.028^b
	Root resorption	-	-	-		-	-
	Cyst formation	1 (50)	-	1 (50)		2 (100)	0.453 ^b
	No effect	51 (75)	11 (16.2)	6 (8.8)		68 (100)	0.010^b
Surgical treatment performed	Yes	424 (87.8)	26 (5.4)	33 (6.8)		483 (100)	< 0.001^b
	No	13 (41.9)	10 (32.3)	8 (25.8)		31 (100)	
Root development stage		Fully formed	Partially formed	Crown only		Total	P
Complications	Delayed eruption	41 (16.4)	60 (24)	149 (59.6)		250(100)	< 0.001^a
	Displacement	191 (46.2)	90 (21.8)	132 (32)		413 (100)	0.228 ^a
	Crowding	99 (73.3)	26 (19.3)	10 (7.4)		135 (100)	< 0.001^a
	Dilaceration	3 (30)	2 (20)	5 (50)		10 (100)	0.393 ^b
	Diastema	32 (94.1)	2 (5.9)	-		34 (100)	< 0.001^a
	Root resorption	-	-	-		-	-
	Cyst formation	1 (50)	-	1 (50)		2 (100)	0.586 ^b
	No effect	49 (72.1)	16 (23.5)	3 (4.4)		68 (100)	< 0.001^a
Surgical treatment performed	Yes	227 (47)	103 (21.3)	153 (31.7)		483 (100)	0.073 ^a
	No	20 (64.5)	7 (22.6)	4 (12.9)		31 (100)	

^a Chi-square test; ^b Likelihood ratio test. Bold values indicate statistically significant differences ($p < 0.05$).

Multinomial logistic regression analysis for morphology is shown in Table 4. Anterior maxillary location was strongly associated with higher odds of conical and tuberculate morphology compared to anterior mandible ($p < 0.001$ and $p = 0.001$, respectively). Compared with teeth associated with crowding, those without crowding had significantly lower odds of conical (OR = 0.211, $p = 0.042$) and supplemental morphologies (OR = 0.128, $p = 0.008$) relative to odontoma. Other variables did not show significant associations with morphology.

Table 4
Multiple logistic regression models assessing the predictors of morphology of supernumerary teeth (final model)

Categorical variables		Multivariate logistic regression					
		Model 2					
		Conical		Tuberculate		Supplemental	
		OR (CI95%)	P	OR (CI95%)	P	OR (CI95%)	P
Gender	Male	Not included		Not included		Not included	
	Female						
Direction	Vertical	Not included		Not included		Not included	
	Horizontal						
	Inverse						
Side	Midline	Not included		Not included		Not included	
	Unilaterally						
	Bilaterally						
Dentition	Primary	Not included		Not included		Not included	
	Mixed						
	Permanent						
Root formation	Fully formed	Not included		Not included		Not included	
	Partially formed						
	Crown only						
Location	Max ant	132.819 (13.870-1271.827)	< 0.001	22.946 (3.879-135.736)	0.001	1.975 (0.583–6.692)	0.274
	Mand ant	Reference		Reference		Reference	
Eruption status	Erupted	Not included		Not included		Not included	
	Impacted						
Treatment status	No	Not included		Not included		Not included	
	Yes						
No complication	No	Not included		Not included		Not included	
	Yes						
Cyst formation	No	Not included		Not included		Not included	
	Yes						
Diastema	No	Not included		Not included		Not included	
	Yes						
Dilaceration	No	3.871 (0.397–37.773)	0.244	2.013 (0.197–20.573)	0.555	2.584 (0.210-31.796)	0.459
	Yes	Reference		Reference		Reference	
Crowding	No	0.211 (0.047–0.946)	0.042	1.184 (0.229–6.133)	0.840	0.128 (0.028–0.588)	0.008
	Yes	Reference		Reference		Reference	
Delayed eruption	No	Not included		Not included		Not included	
	Yes						
Displacement	No	3.126 (0.913–10.712)	0.070	1.757 (0.487–6.340)	0.389	1.406 (0.397–4.985)	0.597
	Yes	Reference		Reference		Reference	
OR: Odds ratio, CI: Confidence interval. The reference category is odontoma. Bold values indicate statistically significant differences (p < 0.05).							

Table 5 presents multinomial logistic regression analysis for root development stage. Midline location was significantly associated with higher odds of fully formed and partially formed roots compared to bilateral cases (p < 0.001 for both). Mixed dentition was associated with lower odds of fully and partially formed roots (p < 0.001 and p = 0.023, respectively). Treatment status and the absence of delayed eruption were significantly associated with higher odds of

both complete and partial root development ($p < 0.05$ for all). Compared with teeth associated with crowding, those without crowding had lower odds of complete root formation relative to crown-only formation (OR = 0.344, 95% CI: 0.135–0.876; $p = 0.025$). Other variables were not statistically significant.

Table 5
Multiple logistic regression model assessing the predictors of root development stage of supernumerary teeth (final model)

Categorical variables		Multivariate logistic regression for root development			
		Fully formed		Partially formed	
		OR (CI95%)	P	OR (CI95%)	P
Gender	Male	Not included		Not included	
	Female				
Morphology	Conical	Not included		Not included	
	Tuberculate				
	Supplemental				
	Odontoma				
Direction	Vertical	Not included		Not included	
	Horizontal				
	Inverse				
Side	Midline	20.735 (7.797–55.142)	< 0.001	5.295 (2.107–13.306)	< 0.001
	Unilaterally	1.439 (0.701–2.954)	0.322	0.919 (0.496–1.702)	0.787
	Bilaterally	Reference		Reference	
Dentition	Primary	0.157 (0.018–1.387)	0.096	0.622 (0.073–5.325)	0.665
	Mixed	0.160 (0.071–0.358)	< 0.001	0.415 (0.194–0.886)	0.023
	Permanent	Reference		Reference	
Location	Anterior maxilla	2.801 (0.637–12.326)	0.173	0.942 (0.289–3.067)	0.921
	Anterior mandible	Reference		Reference	
Eruption status	Erupted	Not included		Not included	
	Impacted				
Treatment status	No	Reference		Reference	
	Yes	14.744 (2.912–74.653)	0.001	8.221 (1.503–44.966)	0.015
No complication	No	Not included		Not included	
	Yes				
Cyst formation	No	Not included		Not included	
	Yes				
Diastema	No	Not included		Not included	
	Yes				
Dilaceration	No	1.367 (0.190–9.850)	0.757	1.245 (0.217–7.145)	0.806
	Yes	Reference		Reference	
Crowding	No	0.344 (0.135–0.876)	0.025	0.468 (0.188–1.166)	0.103
	Yes	Reference		Reference	
Delayed eruption	No	153.091 (48.775–480.506)	< 0.001	23.449 (7.574–72.593)	< 0.001
	Yes	Reference		Reference	
Displacement	No	1.491 (0.610–3.644)	0.381	0.977 (0.426–2.241)	0.956
	Yes	Reference		Reference	

OR: Odds ratio, CI: Confidence interval. The reference category is crown-only formation. Bold values indicate statistically significant differences ($p < 0.05$).

Binary logistic regression analysis for CBCT use is presented in Table 6. Midline and unilateral side distribution were associated with lower odds of CBCT use compared to bilateral cases ($p = 0.003$ and $p = 0.001$, respectively). Primary and mixed dentition showed significantly lower odds compared to permanent dentition ($p = 0.001$ and $p = 0.013$, respectively). Erupted teeth were associated with lower odds of CBCT use ($p < 0.001$). Absence of delayed eruption was also associated with lower odds of CBCT use ($p = 0.001$). Other variables were not significant.

Table 6
Binary logistic regression model assessing the predictors of CBCT use (final model)

Categorical variables		Binary logistic regression	
		Model 1	
		OR (CI95%)	P
Gender	Male	Not included	
	Female		
Morphology	Conical	Not included	
	Tuberculate		
	Supplemental		
	Odontoma		
Direction	Vertical	Not included	
	Horizontal		
	Inverse		
Side	Midline	0.400 (0.218–0.734)	0.003
	Unilaterally	0.404 (0.234-0.700)	0.001
	Bilaterally	Reference	0.002
Dentition	Primary	0.118 (0.032–0.432)	0.001
	Mixed	0.469 (0.258–0.853)	0.013
	Permanent	Reference	0.002
Root	Fully formed	Not included	
	Partially formed		
	Crown only		
Location	Max ant	Not included	
	Mand ant		
Eruption status	Erupted	0.139 (0.082–0.237)	< 0.001
	Impacted	Reference	
Treatment status	No	Not included	
	Yes		
No complication	No	Reference	0.992
	Yes	0.994 (0.331–3.177)	
Cyst formation	Yes	Not included	
	No		
Diastema	Yes	Reference	0.244
	No	2.035 (0.616–6.723)	
Dilaceration	Yes	Reference	0.258
	No	0.312 (0.041–2.351)	
Crowding	Yes	Reference	0.964
	No	0.986 (0.530–1.834)	
Delayed eruption	Yes	Reference	0.001
	No	0.372 (0.202–0.683)	
Displacement	Yes	Reference	0.492
	Yes	0.736 (0.307–1.763)	
CBCT: Cone-beam computed tomography, OR: Odds ratio, CI: Confidence interval. The reference category is no CBCT. Bold values indicate statistically significant differences (p < 0.05).			

Discussion

In this retrospective study, the characteristic features of ST, associated complications, and the relationships among these parameters were evaluated in paediatric patients using panoramic radiographs. The findings demonstrated that supernumerary tooth morphology, root development stage, and CBCT use were significantly associated with several clinical and radiographic variables, as shown in the multivariable regression analyses. Morphology was significantly related to location and crowding patterns, while root development stage showed strong associations with dentition type, side of occurrence, treatment status, crowding, and delayed eruption. In addition, CBCT use was significantly associated with multiple clinical parameters, including side of occurrence, dentition type, eruption status, and delayed eruption. Accordingly, the null hypotheses were rejected for the associations identified in the multivariable analyses.

An overview of the demographic, radiographic, and clinical findings related to ST reported in the present study and previous studies in the literature is presented in Table 7.

Table 7
Comparison of demographic, radiographic, and clinical findings of supernumerary teeth across different studies in the literature

Study	Department	Age	Gender	Teeth number	Side	Localization	Morphology	Eruption status	Direction of eruption	Root development
[20]	Pediatric Dentistry Clinic	7.3±2.7 ^a 2.1–15.2 ^b	75.5% M	283 ST 208 patients	70.7% Unilaterally	79.1% Palatinally	71.5% Conical	83.1% Impacted	47.7% Inverted	-
[28]	Cheng Kung University Hospital	12.4 ^a 4–71 ^b	77% M	241 ST 165 patients	-	77% Maxilla	56.8% Conical	94.6% Impacted	30.2% Vertical	87.1% Partially developed
[21]	Oral Diagnosis and Radiology	14.6±2.5 ^a 8–18 ^b	61.5% M	26 ST 26 patients	50% Midline	84.6% Palatinally	57.7% Conical	92.3% Impacted	38.5% Normal	-
[24]	Pediatric Dentistry	2–14 ^b	69.7% M	1093 ST 782 patients	-	94% Maxilla	73.7% Conical	80.1% Impacted	49.7% Inverted	47.6% Fully developed
[29]	Radiology	36.92±20.58 ^a 5–92 ^b	58.4% F	30 patients	56.7% Unilaterally	53.3% Mandible	76.7% Supplemental	70% Unerupted	46.7% Normal	-
[22]	Pediatric Dentistry	8.21±3.89 ^a 3–24 ^b	79.3% M	618 ST 309 patients	-	100% Maxilla	72.2% Irregular (43.7% con-tub)	56.3% Both unerupted	66% Inconsistent	62.8% Fully developed
[27]	Pediatric Oral Surgery Service	9.3±2.3 ^a 4–16 ^b	68.2% M	460 ST 305 patients	-	93.1% Maxilla	48.7% Conical	-	51.7% Normal	32.6% Fully developed
[26]	Pediatric Dentistry	9.29 ± 1.39 ^a in M 9.37 ± 1.4 ^a in F 8–15 ^b	63.7% M	77 ST 69 patients	40.3% Midline	88.3% Maxilla	-	-	-	-
[32]	Diagnostic Sciences	≥ 6 ^b	-	28 patients	-	-	46.1% Conical	76.9% Impacted	33.3% Inverted	-
[25]	Stomatological Hospital	54.4%, 6–12 13.8%, 13–18 31.8%, ≥ 19 ^b	72.4% M	306 ST 217 patients	-	-	77.1% Conical	-	-	-
Present study	Pediatric Dentistry	9.07±2.08 ^a 5–16 ^b	70.2% M	514 ST 386 patients	47.7% Unilaterally	94.6% Maxilla	53.1% Conical	59.5% Impacted	85.1% Normal	48.1% Fully developed

^a Mean age, ^b Age range, M: male, F: female, ST: supernumerary teeth, ^c Most common type of complication.

The prevalence of ST is generally higher in males than in females, and X-linked inheritance has been proposed as a possible theory to explain this male predominance [19]. The findings of the present study support the male predominance reported in the literature, as 70.2% of the patients with ST were male, with a male-to-female ratio of 2.4:1. Similar findings have been reported in previous studies, with the prevalence of ST in males ranging from 61.5% to 79.3% [20–22]. In addition, male-to-female ratios ranging from 1.4 to 2.6 have also been reported [23–27]. In contrast, a few studies have reported a higher prevalence of ST in females, with Chen et al. demonstrating a female predominance in a Taiwanese population and Anny et al. reporting similar findings in a Thai population [28, 29]. These inconsistent findings may be associated with ethnic and genetic differences, as well as region-specific environmental factors.

Various imaging techniques, including periapical, occlusal, panoramic radiographs, lateral cephalometric radiographs, and CBCT, are used for the evaluation and localisation of ST [9, 10]. CBCT provides a more comprehensive evaluation than conventional radiographs and therefore plays an important role in diagnosis and treatment planning [12]. In the present study, all ST were initially diagnosed using panoramic radiographs, and CBCT was used in only a portion of the patients (42.5%). Therefore, radiographic evaluation was primarily based on panoramic radiographs. In many cases, particularly those not requiring surgical intervention, panoramic radiography is considered sufficient for diagnosis and treatment planning. In addition, because CBCT involves higher radiation exposure compared with panoramic radiography, its use is generally avoided unless it is considered essential for diagnosis and treatment planning.

Single ST are more common than multiple ST, which are frequently associated with syndromic conditions. In the present study, a single supernumerary tooth was detected in 73.3% of the patients. Similar findings have been reported in previous studies, with the prevalence of single ST ranging from 49.8% to 96.6% [20, 21, 24, 25, 27–29].

ST are most commonly observed in the anterior maxillary region, which may be associated with the complex developmental pattern of the maxilla and its close interaction with other craniofacial structures [30]. In the present study, 94.6% of the patients had ST exclusively in the anterior maxillary region, and 95.3% of all ST were located in the maxilla. Similar findings have been reported in previous studies, with 77% to 94% of ST occurring in the maxilla, particularly in the anterior region [24, 26–28, 31].

In the present study, conical morphology was the most frequently observed type (53.1%), followed by supplemental (21.6%), tuberculate (20.6%), and odontoma (4.7%) morphologies. Similar findings have been reported in previous studies, with conical morphology being the most common and odontoma morphology generally being the least common type of supernumerary tooth [20, 21, 24, 25, 27, 28, 32].

In the present study, 59.5% of the ST were impacted, although higher frequencies (70%–94.6%) have generally been reported in the literature [20–22, 24, 28, 29, 32]. Normal orientation was the predominant pattern (85.1%), consistent with several previous studies [21, 27, 29], whereas others reported inverted orientation as the most common pattern [20, 24, 28, 32].

Evaluation of root development stages revealed that fully developed roots were most frequently observed (48.1%), followed by crown-only formation (30.5%) and partially developed roots (21.4%). Similar findings have been reported in previous studies, with complete root formation observed in 32.6% to 87.1% of ST [22, 24, 27, 28].

ST may lead to various complications, and the pattern of complications may vary according to age and the number of ST [25]. In the present study, displacement was the most frequent complication (80.4%), followed by delayed eruption (48.6%) and crowding (26.3%), whereas root resorption was not observed. Similar findings have been reported in previous studies, with displacement being the most commonly reported complication [23, 24, 27, 29]. In contrast, Anthonappa et al. reported crowding as the most common complication [20].

Treatment approaches for ST include orthodontic treatment, surgical removal, combined surgical-orthodontic treatment, or follow-up observation [7, 33]. The preferred treatment approach may vary depending on patient age, localisation, tooth type, eruption status, and associated complications [34–36]. Although early removal has been recommended to improve orthodontic outcomes and reduce complications [7, 33, 34], some authors have suggested delaying surgical intervention until root formation of the adjacent permanent tooth is completed [37]. Therefore, the optimal timing of treatment remains controversial. In the present study, 94% of the ST were treated by extraction, whereas the remaining asymptomatic impacted teeth were managed by follow-up.

In the morphology model, anterior maxillary location was associated with higher odds of conical and tuberculate morphologies relative to odontoma. The absence of crowding was associated with lower odds of conical and supplemental morphologies. Previous studies have similarly reported differences in complication patterns according to supernumerary tooth morphology, although most used bivariate analyses [23, 38, 39].

In the model assessing root development stage, significant associations were identified with side of occurrence, dentition stage, treatment status, crowding, and delayed eruption. Midline ST showed markedly higher odds of both complete and partial root development, whereas mixed dentition stage was associated with reduced odds of complete and partial root formation compared with permanent dentition. However, the observed association between the location of ST and root development stage should be interpreted with caution, as root development is inherently age-dependent and differences in the timing of diagnosis may have influenced this association. Compared with teeth associated with crowding, those without crowding had lower odds of complete root formation relative to crown-only formation. This suggests that crowding was associated with complete root development; however, no significant association was observed between crowding and partial root development. Significant associations were also identified between root development stage and delayed eruption. These findings suggest that root development stage may influence both the complication type and treatment status of ST. Xue et al. reported significant differences in complication patterns according to root development stage, with ST associated with malposition frequently exhibiting incomplete root development [24]. Furthermore, Asaumi et al. suggested that ST with more advanced root development may occupy greater space within the jaw and therefore may be more likely to interfere with adjacent teeth and surrounding anatomical structures [40].

In the model assessing CBCT use, side of occurrence, dentition stage, eruption status, and delayed eruption of permanent teeth were identified as significant predictors. Bilateral occurrence, permanent dentition stage, impacted eruption status, and delayed eruption of permanent teeth were independently

associated with increased CBCT use. These findings suggest that CBCT evaluation may be particularly valuable in complex cases, especially when ST are impacted, occur bilaterally, or are associated with delayed eruption.

This study has several limitations. As this study focused on complications associated with ST and was conducted in a university dental hospital, the study population may have included a greater proportion of complex cases. Although this may have facilitated a more detailed evaluation of factors associated with complications, it may also have contributed to the relatively high prevalence of complications observed in the present study. Due to ethical concerns regarding radiation exposure in paediatric patients for research purposes, the study was designed retrospectively. Because of the retrospective design, patients were evaluated only through radiographic records, and the findings could not be supported by clinical examination. Although panoramic radiographs provide a wide field of view, they have several limitations, including distortion, overlap, and relatively low resolution, particularly in the anterior region. To minimise these limitations, available periapical radiographs were also reviewed when necessary to support and clarify radiographic diagnoses. In addition, because CBCT records were not available for all patients in the archive, a more comprehensive three-dimensional evaluation could not be performed. Because the decision to obtain CBCT was made during routine clinical care, CBCT use may have been influenced by clinician judgement, case complexity, imaging availability, and changes in clinical practice over the study period. Therefore, the observed associations should be interpreted as patterns of CBCT utilization rather than objective indications for CBCT. Furthermore, due to the cross-sectional design of the study, follow-up data were not available. Finally, as this was a single-centre study, the findings may not be fully generalisable to other populations and clinical settings.

Nevertheless, the relatively large sample size, restriction of the sample population to paediatric patients only, and evaluation of associated factors using advanced statistical analyses represent important strengths of the present study.

Future multicentre longitudinal studies including CBCT imaging may provide more comprehensive assessment of ST.

Conclusions

Careful evaluation of the anterior maxillary region during panoramic radiographic examination is important for early detection of ST and prevention of associated complications. In the present study, ST were most commonly observed as single, impacted, conical teeth located in the anterior maxillary region. The presence of ST should be suspected, especially in cases presenting with displacement, delayed eruption, or crowding of permanent teeth. Furthermore, the current study demonstrated significant associations between complication types and supernumerary tooth morphology, root development stage, and CBCT use. Therefore, treatment planning should be based on careful evaluation of the characteristics of ST and their potential relationship with complication development.

Abbreviations

CBCT Cone
beam computed tomography

Declarations

Ethics approval and consent to participate

This study was approved by the Clinical Research Ethics Committee of Marmara University Faculty of Dentistry (Decision No. 2025-43; 29 May 2025). All procedures performed were in accordance with the ethical standards of the institutional research committee and with the Declaration of Helsinki and its later amendments. The requirement for informed consent was waived by the Ethics Committee due to the retrospective nature of the study.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

AI declaration

In the preparation of this manuscript, ChatGPT (GPT-5.6, OpenAI) was used solely for language editing and grammar improvement. After using this tool, the authors reviewed and edited the content and take full responsibility for the final version of the manuscript.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author Contribution

EK contributed to conceptualization, methodology, data curation, investigation, writing – original draft, writing – review & editing. BSY contributed to methodology, data curation, validation, formal analysis, writing – review & editing. SY contributed to data curation, investigation, resources. SEY contributed to data curation, investigation, resources. AM contributed to conceptualization, methodology, data curation, investigation, validation, supervision, project administration, resources, writing – review & editing. All authors read and approved the final manuscript.

Acknowledgements

Not applicable.

Data Availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

References

1. Wojda M, Wielgosz A. Hypodontia and hyperdontia as examples of developmental disorders in tooth number: literature review and clinical case reports. *Qual Sport*. 2024;23:54660.
2. Omer RS, Anthonappa RP, King NM. Determination of the optimum time for surgical removal of unerupted anterior supernumerary teeth. *Pediatr Dent*. 2010;32:14–20.
3. de Oliveira Gomes C, Drummond SN, Jham BC, Abdo EN, Mesquita RA. A survey of 460 supernumerary teeth in Brazilian children and adolescents. *Int J Paediatr Dent*. 2008;18:98–106.
4. Lu X, Yu F, Liu J, Cai W, Zhao Y, Zhao S, et al. The epidemiology of supernumerary teeth and the associated molecular mechanism. *Organogenesis*. 2017;13:71–82.
5. Hua W, Gan Z, Wu Y, Zhao L. Identification of a novel missense mutation in non-syndromic familial multiple supernumerary teeth. *Arch Oral Biol*. 2022;143:105542.
6. Scheiner MA, Sampson WJ. Supernumerary teeth: a review of the literature and four case reports. *Aust Dent J*. 1997;42:160–5.
7. Seehra J, Mortaja K, Wazwaz F, Papageorgiou SN, Newton JT, Cobourne MT. Interventions to facilitate the successful eruption of impacted maxillary incisor teeth due to the presence of a supernumerary: a systematic review and meta-analysis. *Am J Orthod Dentofac Orthop*. 2023;163:594–608.
8. Khalaf K, Brook AH, Smith RN. Genetic, epigenetic and environmental factors influence the phenotype of tooth number, size and shape: anterior maxillary supernumeraries and the morphology of mandibular incisors. *Genes*. 2022;13:2232.
9. Nowak AJ, Christensen JR, Mabry TR, Townsend JA, Wells MH. *Pediatric dentistry: infancy through adolescence*. 6th ed. St Louis: Elsevier; 2019.
10. Gavel V, Dermaut L. The effect of changes in tooth position of unerupted canines on cephalograms. *Eur J Orthod*. 2003;25:49–56.
11. Frederiksen NL. Guidelines for prescribing dental radiographs. United States Food and Drug Administration. *Tex Dent J*. 1995;112:63–7.
12. Mallineni SK, Anthonappa RP, Jayaraman J, King NM. Radiographic localization of supernumerary teeth: a narrative review. *Front Dent Med*. 2025;6:1495025.
13. Park SY, Jang HJ, Hwang DS, Kim YD, Shin SH, Kim UK, et al. Complications associated with specific characteristics of supernumerary teeth. *Oral Surg Oral Med Oral Pathol Oral Radiol*. 2020;130:150–5.
14. Neville BW, Damm DD, Allen CM, Chi AC. *Oral and maxillofacial pathology*. 4th ed. St Louis: Elsevier; 2016.
15. Uyar T, Uyar DS. Assessment of using transfer learning with different classifiers in hypodontia diagnosis. *BMC Oral Health*. 2025;25:68.
16. Public Health England, Faculty of General Dental Practice (UK). *Guidance notes for dental practitioners on the safe use of X-ray equipment*. 2nd ed. London: PHE and FGDP (UK); 2020.
17. Mossaz J, Suter VG, Katsaros C, Bornstein MM. Supernumerary teeth in the maxilla and mandible—an interdisciplinary challenge. Part 1: epidemiology, etiology, classification and associated complications. *Swiss Dent J*. 2016;126:131–49.
18. Demirjian A, Goldstein H, Tanner JM. A new system of dental age assessment. *Hum Biol*. 1973;45:211–27.
19. Kuchler EC, Costa AG, Costa Mde C, Vieira AR, Granjeiro JM. Supernumerary teeth vary depending on gender. *Braz Oral Res*. 2011;25:76–9.
20. Anthonappa RP, Omer RSM, King NM. Characteristics of 283 supernumerary teeth in southern Chinese children. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2008;105:e48–54.
21. Lykousis A, Pouliezou I, Christoloukas N, Rontogianni A, Mitsea A, Angelopoulos C. Supernumerary teeth in the anterior maxilla of non-syndromic children and adolescents: a retrospective study based on cone-beam computed tomography scans. *Pediatr Rep*. 2025;17:52.
22. Liu X, Ren Q, Liu W, Feng X, Du W, Ren G. Clinical analysis of 309 patients with 2 supernumerary teeth in the upper incisor area. *Shanghai J Stomatol*. 2025;34:303–9.
23. Gunes Y, Borahan MO. Evaluation of complications related to supernumerary teeth with cone beam computer tomography. *Eur J Res Dent*. 2024;8:110–5.
24. Xue X, Wang H, Zhang T, Li W, Li X, Sun S, et al. Retrospective analysis of 1093 non-syndromic supernumerary teeth from 782 patients in northwest China: clinical, radiographic and epidemiological insights. *Int Dent J*. 2025;75:103951.

25. Li M, Mao J, Huang Y, Liu H, Wang G. Cone-beam CT-based age-specific risk prediction model for maxillary anterior supernumerary teeth. *Sci Rep.* 2026;16:8384.
26. Guner Z, Yuceturk B, Mutlutepe SN, Gundogar Ucar Z. Prevalence of dental number anomalies in 4140 cases: retrospective cross-sectional study conducted in Gaziantep. *J Health Sci Med.* 2026;9:52–9.
27. Gomes CO, Nogueira LB, Goulart PC, Drumond VZ, de Arruda JAA, Abreu LG, et al. Factors associated with single versus multiple supernumerary teeth in a paediatric population: a cross-sectional study. *Eur Arch Paediatr Dent.* 2026;27:937–44.
28. Chen KC, Huang JS, Chen MY, Cheng KH, Wong TY, Huang TT. Unusual supernumerary teeth and treatment outcomes analyzed for developing improved diagnosis and management plans. *J Oral Maxillofac Surg.* 2019;77:920–31.
29. Anny AF, Fakhruddin KS, Fontenele R, Porntaveetus T. Radiographic evaluation of orodental anomalies in a Thai population: prevalence, supernumerary teeth characteristics, and associated factors. *BMC Oral Health.* 2025;25:1310.
30. Sella Tunis T, Sarne O, Hershkovitz I, Finkelstein T, Pavlidi AM, Shapira Y, et al. Dental anomalies' characteristics. *Diagnostics (Basel).* 2021;11:1161.
31. Katanaki N, Makrygiannakis MA, Kaklamanos EG. The prevalence of supernumerary teeth in a sample of non-syndromic young patients from Greece. *Dent J (Basel).* 2025;13:317.
32. Kolarkodi SH, Alshawy E. Prevalence and radiographic characteristics of supernumerary teeth in a Saudi population: a retrospective CBCT-based study. *Pak J Med Sci.* 2026;42:66–76.
33. Cortés-Bretón-Brinkmann J, Martínez-Rodríguez N, Barona-Dorado C, Martín-Ares M, Sanz-Alonso J, Suárez-García MJ, et al. Clinical repercussions and epidemiological considerations of supernumerary canines: a 26 case series. *Med Oral Patol Oral Cir Bucal.* 2019;24:e615–20.
34. Mittal M, Sultan A. Clinical management of supernumerary teeth: a report of two cases. *J Indian Soc Pedod Prev Dent.* 2010;28:219–22.
35. Smailiene D, Kavaliauskiene A, Pacauskiene I, Zasciurinskiene E, Bjerklin K. Palatally impacted maxillary canines: choice of surgical-orthodontic treatment method does not influence post-treatment periodontal status. A controlled prospective study. *Eur J Orthod.* 2013;35:803–10.
36. Suljkanovic N, Balic D, Begic N. Supernumerary and supplementary teeth in non-syndromic patients. *Med Arch.* 2021;75:78–81.
37. Ashkenazi M, Greenberg BP, Chodik G, Rakocz M. Postoperative prognosis of unerupted teeth after removal of supernumerary teeth or odontomas. *Am J Orthod Dentofac Orthop.* 2007;131:614–9.
38. Ma X, Jiang Y, Ge H, Yao Y, Wang Y, Mei Y, et al. Epidemiological, clinical, radiographic characterization of non-syndromic supernumerary teeth in Chinese children and adolescents. *Oral Dis.* 2021;27:981–92.
39. Hadziabdic N, Haskic A, Mujkic A, Hasic-Brankovic L, Dzankovic A, Korac S, et al. Epidemiological, clinical and radiographic features of supernumerary teeth in nonsyndromic Bosnian and Herzegovinian population: a monocentric study. *Med Arch.* 2022;76:348–53.
40. Asaumi JI, Shibata Y, Yanagi Y, Hisatomi M, Matsuzaki H, Konouchi H, et al. Radiographic examination of mesiodens and their associated complications. *Dentomaxillofac Radiol.* 2004;33:125–7.