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Evaluation of Complications Related to Supernumerary Teeth with Cone Beam Computer Tomography

Süpernümere Dişlerle İlişkili Komplikasyonların Konik Işınlı Bilgisayarlı Tomografi ile Değerlendirilmesi

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ABSTRACT

Objectives: The aim of this retrospective study was to evaluate the complications associated with supernumerary teeth (ST) using cone beam computed tomography (CBCT).

Materials and Methods: CBCT images of patients in all age groups who applied to Marmara University Faculty of Dentistry, Department of Oral and Maxillofacial Radiology, between 2018-2023, were retrospectively evaluated. Images with ST were detected and complications related to ST were evaluated based on the presence of resorption, malposition, impaction of the adjacent teeth and pathological formations (such as cysts or tumors). The relationship between ST-related complications and ST morphology was evaluated. Statistical analyzes of the data were evaluated using the SPSS package program. Statistical significance was accepted as $p<0.05$.

Results: SD were found to cause malposition (%39,3), impaction (%13), resorption (%3,8) and pathological formations (%1,3) of adjacent teeth at different rates. A statistically significant relationship was found between the morphology and complications ($p<0,001$).

Conclusions: The risk of complications was higher in tuberculate and supplemental morphologies, dentists should pay attention in prognosis and treatment planning in these morphologies of ST. The most common complications associated with ST were malposition and impaction of adjacent teeth. This indicates a high need for orthodontic treatment in patients with ST.

Keywords: Supernumerary teeth, cone beam computer tomography, complications, morphology, radiology

ÖZ

Amaç: Bu retrospektif çalışmanın amacı, süpernümere dişlerle (SD) ilişkili komplikasyonları konik ışınlı bilgisayarlı tomografi (KIBT) ile değerlendirmektir.

Gereç ve Yöntemler: 2018-2023 yılları arasında Marmara Üniversitesi Diş Hekimliği Fakültesi Ağız, Diş ve Çene Radyolojisi Anabilim Dalı'na başvuran tüm yaş gruplarındaki hastaların KIBT görüntüleri retrospektif olarak değerlendirildi. SD içeren görüntüler tespit edildi ve SD ile ilişkili komplikasyonlar; komşu dişlerde rezorpsiyon, malpozisyon, gömülü kalma ve patolojik oluşumların (kist, tümör gibi) varlığına göre değerlendirildi. SD ile ilişkili komplikasyonlar ve SD morfolojisi arasındaki ilişki değerlendirildi. Verilerin istatistiksel analizleri SPSS programı kullanılarak değerlendirildi. İstatistiksel anlamlılık $p<0,05$ olarak kabul edildi.

Bulgular: SD'nin komşu dişlerde farklı oranlarda malpozisyona (%39,3), gömülü kalmaya (%13), rezorpsiyona (%3,8) ve patolojik oluşumlara (%1,3) neden olduğu bulundu. Morfoloji ile komplikasyonlar arasında istatistiksel olarak anlamlı bir ilişki bulundu ($p<0,001$).

Sonuç: Tüberkülat ve suplemental morfolojideki dişlerde komplikasyon riski daha yüksektir, diş hekimleri bu SD morfolojilerine prognoz ve tedavi planlamasında dikkat etmelidir. SD ile ilgili en yaygın komplikasyonlar, malpozisyon ve komşu dişte gömülü kalmadır. Bu durum SD'li hastalarda ortodontik tedavi ihtiyacının yüksek olduğunu gösterir.

Anahtar Kelimeler: Süpernümere dişler, konik ışınlı bilgisayarlı tomografi, komplikasyonlar, morfoloji, radyoloji

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INTRODUCTION

Supernumerary teeth (ST) are dental number anomaly defined as the presence of more than twenty deciduous teeth or thirty-two permanent teeth (Seremet, 1974). ST may be unilateral or bilateral; impacted or erupted; single or multiple; and seen in one or both jaws (Anthonappa et al., 2013). ST can occur in non-syndromic individuals or be associated with syndromes such as Ehler-Danlos syndrome, Gardner syndrome or Cleidocranial Dysostosis, and often multiple ST are associated with syndromes (Anthonappa et al., 2008; Cammarata-Scalisi et al., 2018). The etiology of ST is not clearly known and many theories have been proposed regarding the etiology of ST, such as atavism, reversion, dichotomy and dental lamina hyperactivity. Among these, the dental lamina hyperactivity theory is the most widely accepted theory (Fleming et al., 2010; Mallineni, 2014; Primosch, 1981; Rajab & Hamdan, 2002). In addition, genetic and environmental factors may play a role in the etiology of ST (Shah et al., 2008). The prevalence of ST are between 0.2%-0.8% in the deciduous dentition and 0.5%-5.3% in the permanent dentition and are more common in males (Fardi et al., 2011; Garcés-Ortíz et al., 2012; Leco Berrocal et al., 2007).

ST are usually asymptomatic and are recognised incidentally during routine panoramic evaluation (Fernández Montenegro et al., 2006; Liu et al., 2007; Subasioglu et al., 2015). Although the likelihood of ST-related complications are low, they may cause impaction, malposition, resorption of the adjacent teeth and crowding, diastema, dilaceration, cystic or tumoural lesions (Garvey et al., 1999; Mossaz et al., 2014; Park et al., 2020; Syriac et al., 2017). In addition, semi-impacted or erupted ST may cause subacute pericoronitis, gingival inflammation, periodontal abscess, plaque retention and dental caries in inaccessible areas (Parolia et al., 2011).

ST are diagnosed with clinical and radiological examination. Panoramic, periapical and occlusal radiographs, which are two-dimensional imaging methods, are used in the first stage of radiological evaluation (Rajab & Hamdan, 2002). However, traditional 2-dimensional radiography images are unable to precisely determine the positions of teeth and their spatial relationships with surrounding teeth and structures. Therefore, cone beam computed tomography (CBCT), which provides three-dimensional imaging, is recommended for detailed evaluation (Jiang et al., 2020; Liu et al., 2007).

CBCT provides detailed information for clearly determining the location and relationship of ST with important structures such as the nasopalatine canal, nasal cavity floor, maxillary sinus or mandibular canal, as well as their relationship with adjacent teeth (Scarfe et al., 2006). CBCT provides precise and accurate information about complications of ST, such as malposition, root resorption and impaction of adjacent teeth, cystic or tumoral lesions (Jiang et al., 2020; Kapila et al., 2011; Ma et al., 2021). In many studies, the clinical and radiographic features of ST were evaluated using CBCT imaging method, and it was recommended in the diagnosis and treatment planning of ST (Gurgel et al., 2012; Liu et al., 2007; Mossaz et al., 2014; Nematolahi et al., 2013). However, due to the high cost and high radiation dose of CBCT compared to two-dimensional imaging methods, its use is recommended in cases requiring detailed examination rather than routine use in the diagnosis of ST (Liu et al., 2007).

This study aimed to evaluate in detail the complications associated with ST in non-syndromic patients of all age groups with CBCT.

MATERIALS AND METHODS

In this study, CBCT images of 13.030 patients of all ages who applied to the Department of Oral and Maxillofacial Radiology at Marmara University Faculty of Dentistry for various reasons between January 2018 and April 2023 were evaluated. Images with insufficient diagnostic quality, as well as those from patients with systemic conditions or craniofacial syndromes such as cleft lip and palate, cleidocranial dysostosis, or Gardner syndrome, were excluded.

The CBCT images were obtained by an operator using a ProMax 3D Mid imaging device (PlanmecaOy, Helsinki, Finland) operated with different and avaible FOV area, 90 kVp and 10 mA, at a time of 36 s. The CBCT scans were analyzed in multiplanar reconstructions (coronal, axial and sagittal), using Romexis 2.92 software (PlanmecaOy, Helsinki, Finland). They were evaluated using a monitor screen (Monitor 23-inch Acer 1920 × 1080 pixel HP Reconstruction PC).

Ethical approval for this retrospective study was granted by the Marmara University Faculty of Medicine (Protocol No: 09.2023.63313.030).

Study Variables

Complications related to ST were evaluated based on the presence of resorption, malposition, impaction of the adjacent teeth and pathological formations (such as cysts or tumors). Resorption was considered to be present in cases where there was loss of hard tissues of the adjacent teeth roots and the continuity of the lamina dura could not be observed (Fig. 1). Malposition was diagnosed when the adjacent teeth were not in their normal position in three dimensions (Fig. 2). Impaction was diagnosed when ST prevent to eruption of adjacent teeth (Fig. 3). Pathological formations such as follicular enlargements (more than 3mm), cyst or tumours caused by ST were evaluated (Fig. 4). All these complications were evaluated as present or absent. Also ST that were not adjacent to the teeth were evaluated separately.

Figure 1: Representative CBCT images of ST-related root resorption A. Root resorption of premolar tooth in the coronal section B. Root resorption of premolar tooth in the sagittal section.

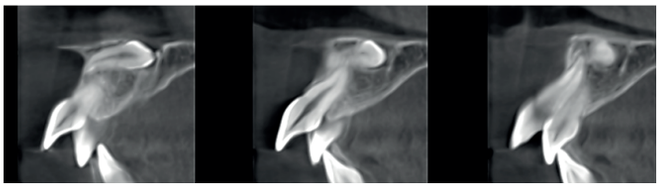

Figure 2: Representative CBCT images of ST-related malposition of maxillary incisor teeth.

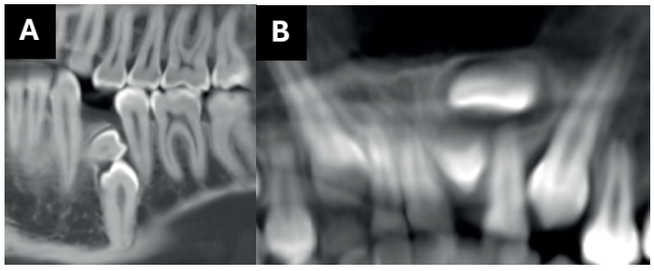

Figure 3: Representative CBCT images of ST-related impaction. A. Impaction of mandibular premolar teeth in the panoramic reconstruction. B. Impaction of maxillary central incisor teeth in the panoramic reconstruction.

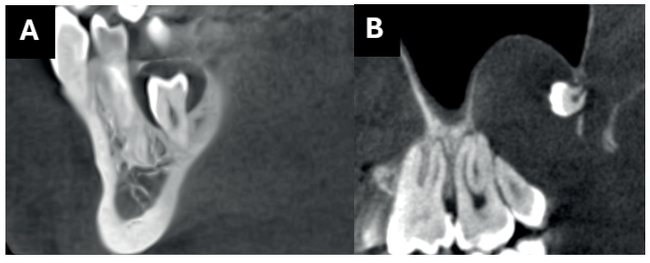

Figure 4: Representative CBCT images of ST-related cystic formations A. Cystic formation in the mandibular premolar region in the sagittal section B. Cystic formation in the maxillary molar region in the sagittal section.

Statistical Analysis

Data were analyzed by using the SPSS statistical software version 23.The frequencies among the groups were compared by using the Chi-Square Test. Multiple comparisons were made using the Bonferroni Corrected Z test and Fisher Freeman Halton test. P values less than 0,05 were considered statistically significant.

RESULTS

In this study, 400 ST detected in 217 patients, 90 (41.5%) female and 127 (58.5%) male, aged between 7 and 71, were evaluated. ST most frequently (39,3%) caused malposition of adjacent teeth, followed by impaction of adjacent teeth (13%) but they found to result in pathological formation at a very low rate (1,3%) (Table 1).

Table 1. Frequency of resorption, malposition, impaction of adjacent teeth and pathological formation.

	Number	%
Resorption of adjacent teeth		
Present	15	3.8
Absent	372	93
No adjacent teeth	13	3.3
Malposition of adjacent teeth		
Present	157	39.3
Absent	230	57.5
No adjacent teeth	13	3.3
Impaction of adjacent teeth		
Present	52	13
Absent	335	83.8
No adjacent teeth	13	3.3
Pathological formation		
Present	5	1.3
Absent	395	98.8

A statistically significant relationship was found between the morphology and resorption of adjacent teeth (p=0.005). However, the significant difference observed here was in the rates of those ST not adjacent to teeth. No relationship was found between morphology and resorption in the areas that were adjacent to teeth and were primarily evaluated in terms of resorption. However, the resorption rate (4.9%) was found to be higher in supplemental morphology than in the others (Table 2).

Table 2. Relationship between ST-related complications and ST morphology

	Morphology				Test statistics	p*
	Conical	Tuberculate	Supplemental	Germ		
Resorption of adjacent teeth						
Present	1 (1.3)	0 (0)	14 (4.9)	0 (0)		
Absent	70 (88.6)	30 (100)	268 (93.4)	4 (100)	18.504	0.005
No adjacent teeth	8 (10.1)[a]	0 (0)[ab]	5 (1.7)[b]	0 (0)[ab]		
Malposition of adjacent teeth						
Present	23 (29.1)[a]	23 (76.7)[b]	111 (38.7)[a]	0 (0)[ab]		
Absent	48 (60.8)[a]	7 (23.3)[b]	171 (59.6)[a]	4 (100)[a]	36.679	<0.001
No adjacent teeth	8 (10.1)[a]	0 (0)[ab]	5 (1.7)[b]	0 (0)[ab]		
Impaction of adjacent teeth						
Present	11 (13.9)[a]	12 (40)[b]	29 (10.1)[a]	0 (0)[ab]		
Absent	60 (75.9)[a]	18 (60)[a]	253 (88.2)[b]	4 (100)[ab]	37.238	<0.001
No adjacent teeth	8 (10.1)[a]	0 (0)[ab]	5 (1.7)[b]	0 (0)[ab]		
Pathological formation						
Present	2 (2.5)	0 (0)	3 (1)	0 (0)	1.579	0.664
Absent	77 (97.5)	30 (100)	284 (99)	4 (100)		

*Pearson's chi-squared test, a-b: There is no difference between groups with the same letter

A statistically significant relationship was found between the morphology and malposition of adjacent teeth ($p<0.001$). Tuberculate morphology was observed to contribute to the malposition more frequently (76.7%) than conical (29.1%), supplemental (38.7%) and germ (0%) morphologies (Table 2).

A statistically significant relationship was found between morphology and impaction of adjacent teeth ($p<0.001$). This complication was found to be more common and significantly higher in tuberculate morphology (40%) than conical (13.9%), supplemental (10.1%) and germ (0%) morphologies. Also no statistically significant relationship was found between morphology and the presence of pathological formations ($p=0.664$) (Table 2).

DISCUSSION

ST are a dental anomaly characterized by more teeth than the normal dentition of twenty primary teeth or thirty-two permanent teeth (Seremet, 1974). ST are usually asymptomatic and are often detected incidentally on routine examination (Fernández Montenegro et al., 2006). Although the likelihood of complications associated with ST are low, they may cause problems such as crowding, diastema, rotation, resorption, impaction and malposition of adjacent teeth. Additionally, they may lead to pathological formations such as cysts and tumors (Garvey et al., 1999; Mossaz et al., 2014; Park et al., 2020; Syriac et al., 2017). Early diagnosis and timely treatment of ST are essential to prevent such complications (Hadziabdic et al., 2022).

In the radiological evaluation of ST, two-dimensional imaging methods such as panoramic, periapical, and occlusal radiographs are generally used (Rajab & Hamdan, 2002). However, these imaging methods are often insufficient in determining the exact location of ST, their relationships with neighboring structures, and in evaluating associated complications. Therefore, CBCT, a three-dimensional imaging method, is recommended for a definitive evaluation of the radiological features of ST (Ata-Ali et al., 2014). In this study, the advantages of CBCT over other imaging methods were taken into consideration, and the complications associated with ST were evaluated in detail using CBCT.

In this study, ST were found to cause malposition (39.3%), impaction (13%), resorption (3%) of adjacent teeth and ST-related cystic formations (1.3%). Contrary to other studies, diastema, rotation and crowding caused by ST were not evaluated separately; instead, they were analyzed under a single category, malposition, in this study (Bereket et al., 2015; Hadziabdic et al., 2022; Liu et al., 2007; Ma et al., 2021; Park et al., 2020). Malposition is an indicator of the need for orthodontic treatment and it was thought that analyzing these conditions under one heading would yield more holistic results in terms of the treatment approach for ST. Consistent with most studies in the literature, malpositions (diastema, rotation, crowding) were the most common problem associated with ST. Secondly, ST were most frequently found to cause impaction of adjacent teeth (Liu et al., 2007; Ma et al., 2021; Mossaz et al., 2014; Park et al., 2020). Similar to this study, most studies in the literature, the rate of root resorption was found to be lower than malposition and impaction (Bereket et al., 2015; Hadziabdic et al., 2022; Jiang et al., 2020; Liu et al., 2007). However, pathological formations associated with ST were observed at a lower rate (1.3%) in this study compared to other studies (Demiriz et al., 2015; Hadziabdic et al., 2022; Jiang et al., 2020; Liu et al., 2007; Mossaz et al., 2014; Park et al., 2020). In a study by Jiang et al. (2020) evaluating 1149 ST in the Chinese population, the cystic formation rate was found to be 8%. This difference may be due to variations in patient populations and the timing of intervention in ST.

Previous studies have evaluated the relationship between ST morphology and complications such as malposition, resorption, impaction of adjacent teeth and pathological formations. (Hadziabdic et al., 2022; Jiang et al., 2020; Ma et al., 2021; Mossaz et al., 2014; Park et al., 2020). Ma et al. (2021) analyzed 2786 ST and found that 25% of teeth with supplemental morphology, 12.6% of teeth with conical morphology, 11.7% of teeth with tuberculate morphology and 2.7% of teeth with germ morphology caused malposition. A statistically significant relationship was found between ST morphology and malposition ($p<0.05$). Hadziabdic et al. (2022) evaluated 138 ST and found that conical morphology caused malposition of the adjacent teeth in 6.4%, tuberculate morphology teeth in 2.4% and supplemental teeth in 2%. However, no statistically significant relationship was found. In this study, consistent with Ma et al. (2021), the rate of malposition with tuberculate morphology (76.7%) was found to be significantly higher than conical (29.1%), supplemental (38.7%) and germ (0%) morphology ($p<0.001$).

The relationship between ST morphology and resorption has been investigated previously . Mossaz et al., (2014) evaluated CBCT images of 101 ST and found a significant correlation between ST morphology and resorption of the adjacent teeth ($p = 0.001$). They reported that ST with supplemental morphology caused resorption more frequently (Mossaz et al., 2014). Similarly, Jiang et al., (2020) reported that supplemental morphology (10.75%) was the most common cause of resorption and that there was a significant relationship between morphology and resorption in the adjacent teeth ($P <0.001$). Park et al., (2020) revealed that tuberculate morphology has a two times higher risk of resorption of the adjacent teeth compared to other morphologies.

In a study by Hadziabdic et al., (2022) evaluated on panoramic images of 138 ST, it was reported that only the supplemental morphology caused 2% resorption, while tuberculate and conical morphologies did not cause resorption of the adjacent teeth. No statistically significant relationship was found (Hadziabdic et al., 2022). CBCT is known to give more precise and accurate results than panoramic radiography in detecting root resorption (Wang et al., 2017). For this reason, it is

known that the studies conducted with cbct showed more reliable results about resorption.

In this study, no significant relationship was found between ST morphology and resorption in the maxillary and mandibular arch regions. However, similar to the study of Mossaz et al., (2014), Jiang et al., (2020) and Hadziabdic et al., (2022) the resorption rate of ST with supplemental morphology was found to be higher. This findings should be taken into consideration when evaluating the prognosis of teeth with supplemental morphology.

In the study by Jiang et al., (2020), the relationship between ST morphology and impaction of adjacent teeth was evaluated and no statistically significant relationship was found. However, they reported that germ morphology (10%) most frequently caused the impaction of adjacent teeth (Jiang et al., 2020). Hadziabdic et al., (2022) concluded that conical morphology caused impaction most frequently (25.5%), while tuberculate morphology caused impaction least frequently (2.4%). However, no statistically significant relationship was found (Hadziabdic et al., 2022).

In this study, a statistically significant correlation was found between ST morphology and impaction of adjacent teeth (p<0.001). The rate of tuberculate morphology impaction of adjacent teeth (40%) was found to be higher than the others. This finding was thought to be due to the larger size of tuberculate morphology, similar to the relationship observed with malposition of adjacent teeth.

Jiang et al., (2020) analyzed 1149 ST using CBCT and found a statistically significant relationship between the morphology of ST and the formation of cystic lesions. Although ST are unlikely to form cystic lesions, the lesion rate associated with tuberculate morphology was found to be the highest (15%), while no pathological formation was found in relation to germ morphology (Jiang et al., 2020). Hadziabdic et al., (2022) evaluated the relationship between follicular enlargement and ST morphology on panoramic images. However, no statistically significant relationship was found (Hadziabdic et al., 2022). Similarly, in this study, no significant correlation was found between ST morphology and pathological formations (p=0.664). Pathological formations can be re-evaluated by examining more ST with CBCT.

CONCLUSION

CBCT evaluation of complications related to supernumerary teeth is guiding dentists in terms of treatment approach. Complication risks were higher in tuberculate and supplemental morphologies, dentists should be more careful with these morphologies of ST. The most common complication was malposition of adjacent teeth, indicating that patients with ST have a high need for orthodontic treatment.

Conflict of Interest

The authors declare that they have no conflict of interest.

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