

Analyses of 1100 supernumerary teeth in a nonsyndromic Turkish population: A retrospective multicenter study

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Abstract

Purpose: The aim of this study was to analyze the clinical and radiological features of supernumerary teeth (ST), record the related complications, and discuss different forms of treatment.

Materials and Methods: A total of 111,293 patients were examined over a 3-year period. The patients' ages and genders, in addition to the number, morphology, location, position, shape, developmental stage, and eruption status of ST and associated complications, were recorded.

Results: Among the 111,293 patients, there were 851 (0.76%) patients with 1100 ST. Of these patients, 478 (56.2%) were males, and 373 (43.8%) were females, with a mean age of 22.71. Most of the 1100 ST were located in the maxilla, 437 (39.72%) were a conical shape, with 82.81% of these including a fully developed tooth. A mesiodens was the most common type of supernumerary tooth ($n = 284$, 33.37%), followed by distomolars ($n = 204$, 23.97%) and parapremolars ($n = 146$, 17.16%). Among the 1100 ST, 422 (38.36%) were associated with complications.

Conclusions: No previous studies in the literature have examined in detail so many cases with ST. The demographic profile of the patients with ST presented herein provides useful additional epidemiological information.

Key words: Distomolar, mesiodens, paramolar, parapremolar, supernumerary teeth

Date of Acceptance: 02-Mar-2015

Introduction

Supernumerary teeth (ST) are defined as “any tooth or odontogenic structure that is formed from a tooth germ in excess of the usual number in any given region of the dental arch.”^[1] Some authors prefer the term hyperdontia to describe dentition that contains >20 deciduous and 32 permanent teeth.^[2] The etiology of ST is not completely understood, and several theories have been proposed to explain their development.^[3,4] ST may develop from a dichotomy of the tooth bud. If the tooth bud splits into two equal parts, this results in a supplemental tooth resembling the normal series.^[5] However, if it splits into two unequal parts, the additional tooth may become malformed and conical.^[5] It has also been suggested that ST are the result of hyperactivity of the dental lamina, characterized by

embryogenic aberrations during facial development, and by excessive proliferative activity of epithelial remnants of the dental lamina induced by pressure from the permanent dentition.^[6] ST have also been attributed to atavism.^[3] This hypothesis proposes a reversion to ancestral human dentition that contains a large number of teeth. However, due to the predominantly solitary occurrence and ectopic development of ST, this theory has been rejected. An alternative theory is that a tooth germ may undergo DNA mutations, which result in maxillofacial anomalies, such as a cleft lip and palate, cleidocranial dysplasia, and Gardner's syndrome, and that these lead to the formation of ST.^[6] Rao and Chidzonga^[7]

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Access this article online

Quick Response Code:



Website: www.njcponline.com

DOI: 10.4103/1119-3077.154213

stated that the etiology of ST is multifactorial and due to a combination of environmental and genetic factors.

Supernumerary teeth have been found in all areas of the dental arches and may be present in both the permanent and primary dentition, but they are 5 times less frequent in the primary dentition.^[5] They may be single, multiple, unilateral, or bilateral in their distribution. The prevalence of ST in permanent teething has been estimated at a range of 0.5–3.8%, in comparison to 0.3–0.6% in the primary dentition.^[8,9]

Supernumerary teeth are classified according to the morphology and location of the teeth. In primary dentition, the morphology is usually normal or conical. A greater variety of forms is found in the permanent dentition. Four different morphological types of ST have been described: Conical, tuberculate, supplemental, and odontome.^[10-12] Although these teeth can be found in any location, they appear have a predilection for distal third molars and the maxillary central incisors. Such ST are called mesiodens. They are more frequently observed in the upper than the lower arch (ratio of 10:1).^[11]

Other than esthetic issues, the most frequent complications generated by the presence of ST are prolonged retention of deciduous teeth, delayed eruption of permanent teeth, ectopic eruption, malocclusion, spaces between incisors, cyst development, and root resorption of adjacent teeth.^[12] The treatment depends on the type and position of the supernumerary tooth and its potential effect on adjacent teeth. The management of ST should form part of a comprehensive treatment plan and should not be considered in isolation.^[11]

To our knowledge, the present study is the first retrospective analysis of the largest number of ST cases in the literature. The aim of this study was to analyze the clinical and radiological features of ST, record the related complications, and discuss different forms of treatment.

Materials and Methods

This retrospective study utilized data from seven different cities in Turkey (Samsun, Bolu, Tokat, Karaman, Konya, Kayseri, and Gaziantep). The medical records and panoramic radiographs of 111,293 patients' between 2009 and 2011 years were evaluated including those of children with both mixed the permanent dentition and adults. These patients were from the middle and Western Black Sea regions, central Anatolia, and Southern East regions of Turkey. Subjects with poor quality radiographs, incomplete records and/or radiographs, a history of trauma, missing teeth adjacent to the ST, and medical conditions and syndromes known to be associated with ST were excluded from the final analysis. The patients' ages and genders, in addition to the number, morphology, location, position,

shape, developmental stage, and eruption state of the ST and associated complications were analyzed. This study followed the declaration of Helsinki on medical protocols and ethics, and the regional Ethical Review Board approved the study.

Radiographic and macroscopic examinations were used to evaluate the morphology of the ST, and eumorphic and heteromorphic ST were classified as conical, tuberculate, infundibular, or unclassified.^[13] Odontomas were excluded from the study because they are not universally considered ST. The development of the ST was evaluated visually and recorded as only crown formation, a full tooth and partial root formation, or complete tooth formation.

Sagittal positions were described as labial/buccal, palatal/lingual, and within the arch. Regarding the orientation of the ST in relation to the permanent teeth, the ST were classified as: Vertical, mesioangular, distoangular, horizontal, inverted, vestibulo, or linguallly angular. The radiographic diagnoses were independently made by four examiners, and a consensus was reached when a disagreement occurred. The Chi-square test was used to analyze sex differences.

Results

A detailed distribution of the cases according to the jaw, region, position, shape, treatment, associated pathology, eruption status, and types is given in Table 1.

Distribution of the samples according to their sex and age

Among these 111,293 patients, there were 851 (0.76%) patients with 1100 ST. Of these patients, 478 (56.2%) were males, and 373 (43.8%) were females. The age of the patients ranged from 4 to 76 years (mean age: 22.71).

Distribution of the samples according to the types

Of the 1100 ST, 335 (30.45%) were mesiodens, 246 (22.36%) were distomolars, 222 (20.18%) were parapremolars, 145 (13.18%) were paramolars, 98 (8.9%) were lateral, 48 (4.36%) were canines, and 6 (0.54%) were fifth supernumerary molars.

Distribution of the different types of supernumerary teeth according to sex and age

The distribution of the ST according to sex, age and patient number was shown in Table 2.

Distribution of the samples according to the position and localization of the supernumerary teeth

Most of the 1100 ST were located in the maxilla ($n = 858$, 78%) with the remaining 242 (22%) in the mandible. In the maxilla, the rate of ST in the right side was 26.36% ($n = 290$). The rate of ST in the left side was 25.81% ($n = 284$), whereas

Table 1: A detailed distribution of the cases according to the jaw, region, position, shape, treatment, associated pathology, eruption status, and types

Type of supernumerary	Mesiodens	Lateral	Canine	Premolar	Para molar	Disto molar	Fifth molar	Total	Jaws
The number of ST	335	98	48	222	145	246	6	1100	
Localization of ST									
Maxilla									
Right	20	48	14	21	62	121	4	290	858
Left	27	45	18	21	70	101	2	284	
Midline	284	0	0	0	0	0	0	284	
Mandible									
Right	1	4	7	84	7	6	0	109	242
Left	0	1	9	96	6	18	0	130	
Midline	3	0	0	0	0	0	0	3	
Position of ST									
Vertical	140	52	28	139	113	182	4	658	
Mesioangular	12	5	8	59	8	26	0	118	
Distoangular	8	3	3	6	9	13	2	44	
Horizontal	31	22	4	13	5	7	0	82	
Inverted	43	3	0	1	1	5	0	53	
Buccolingual	101	13	5	4	9	13	0	145	
ST associated pathology									
Asymptomatic	166	53	22	165	45	221	6	678	
Inclusion of permanent teeth	68	13	10	8	84	12	0	195	
Cyst formation	3	3	0	0	0	1	0	7	
Diastema/rotation	92	15	11	14	2	1	0	135	
Caries/pericoronitis	1	0	0	6	2	5	0	14	
Root resorption	0	0	0	9	5	1	0	15	
Crowding	5	14	5	20	7	5	0	56	
Shape of ST									
Eumorphic	16	32	21	199	28	39	0	335	
Heteromorphic									
Conic	270	57	25	23	19	42	1	437	
Tuberculated	33	5	1	0	96	162	5	302	
Infundibular	13	2	0	0	0	0	0	15	
Another	3	2	1	0	2	3	0	11	
Proposed treatment									
Surgical	246	70	29	130	124	147	6	752	
Surgical/orthodontic	49	18	10	15	1	0	0	93	
Observation or refused treatment	40	10	9	77	20	99	0	255	
Eruption status									
Occlusion	83	23	12	15	27	34	0	194	
Infraocclusion	23	10	5	23	23	29	1	114	
Partially impacted	43	9	7	18	46	31	0	154	
Fully impacted	186	56	24	166	49	152	5	638	
Development stage of ST									
Only crown	329	86	46	139	114	194	3	911	
Partial crown	1	2	1	60	15	31	0	110	
Partial root	5	10	1	23	16	21	3	79	

ST=Supernumerary teeth

it was 25.81% ($n = 284$) in the midline. In the mandible, the rate of ST in the right side was 9.90% ($n = 109$). In the left side and midline, it was 11.81% ($n = 130$) and 0.27% ($n = 3$), respectively [Figure 1]. Of the ST in 851 patients, 690 were unilateral, and 161 were bilateral.

Of the 1100 ST, 658 (59.81%) were located vertically, 118 (10.72%) were located mesioangular, 44 (4%) were located distoangular, 82 (7.45%) were located horizontally, 53 (4.8%) were located inverted, and 145 (13.18%) were located buccolingually.

Table 2: The distribution of the ST according to sex, age, and patient number

Type of ST	Mesiodens	Distomolar	Parapremolar	Paramolar	Lateral	Canine	Fifth molar
Number of ST (male/female)	229/106	126/120	130/92	55/90	65/33	22/26	2/4
Total	335	246	222	145	98	48	6
Number of patients (male/female)	190/94	105/99	84/62	46/76	59/33	22/26	1/3
Total	284	204	146	122	92	48	4
Mean age (male/female)	19.8/19.2	26.6/24.8	24.8/23.7	23.6/24.4	21.9/21.5	21.4/18.6	20/22.3
Total mean age	19.60	25.77	24.37	24.1	21.76	19.87	21.75

ST=Supernumerary teeth; M=Male; F=Female

Table 3: The distribution of the number of ST according to sex

	Single	Two	Three	Four	Five	Six	Seven	Affected patients total
Male	364	93	12	6	1	0	2	478
Female	295	64	8	6	0	0	0	373
Affected patients total	659	157	20	12	1	0	2	851

ST=Supernumerary teeth



Figure 1: The panoramic radiograph showing mandibular mesiodens



Figure 2: The panoramic radiograph showing multiple supernumerary teeth (*) located on the different areas of the jaws

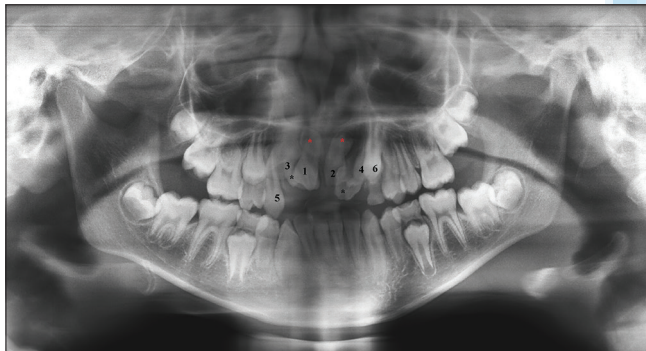


Figure 3: The radiographic image showing multiple enclosed supernumerary teeth (ST) in the maxillary anterior region (*tuberculated ST, *inverted ST, 1, 2 central incisor teeth, 3, 4 lateral incisor teeth, 5, 6 canine teeth)

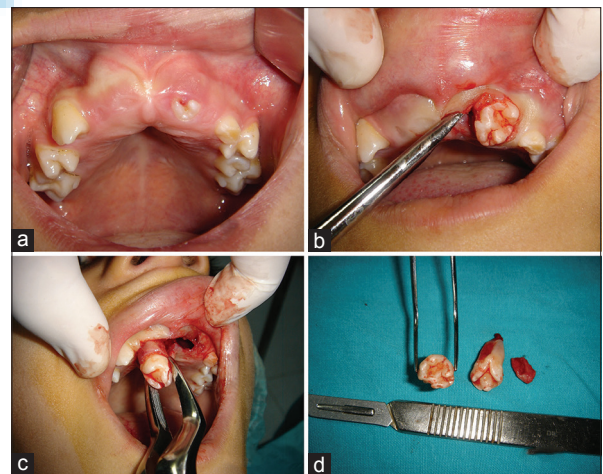


Figure 4: (a) The intraoperative clinical images showing multiple supernumerary teeth (ST). A Partially impacted tuberculated ST. (b and c) Removal of the tuberculated ST. (d) Tuberculated ST's

A single supernumerary tooth was most common (77.438%), followed by 2 (18.44%), 3 (2.35%), 4 (1.41%), 5 (0.117%), and 7 (0.235%) ST [Figure 2 and Table 3]. The rates of single ST and two or more ST were higher in males than females. There was no statistically significant difference ($P > 0.05$) in the number of ST according to gender.

Distribution of the samples according to eruption status, development stage, shape, and associated pathology

With regard to the eruption status of the 1100 ST, 194 (17.6%) were occlusal, 114 (10.36%) were infraocclusions, 154 (14%)

were partially impacted, and 638 (58%) were fully impacted. Of the 1100 ST, 82.81% of cases included a fully developed tooth. The crown was fully developed in 10% of cases, and a partially developed root was present in 7.18% of cases. With regard to the shape of the ST, 335 (30.45%) were supplemental, 437 (39.72%) were conical, 302 (27.45%) were tuberculate [Figures 3 and 4a-d], 15 (1.36%) were infundibular, and 11 (1%) were unclassified.

Of the 1100 ST, 422 (38.36%) were associated with complications, and the remaining 678 (61.63%) had no complications. Of the 422 ST with complications, 195 (17.72%) were delayed eruptions, 7 (0.63%) were cyst formations, 135 (12.27%) were diastemas/rotations, 14 were dental caries and pericoronitis, 15 were due to root resorption, and 56 (5.09%) were caused by crowding. The management of the 1100 ST included surgical removal alone in 68.36% of cases, surgical removal followed by orthodontic therapy in 8.45% of cases, and clinical follow-up in 23.18% of cases.

Discussion

A supernumerary tooth is an uncommon dental entity. Internationally, the prevalence of ST varies between 0.1% and 3.8% according to published studies, reaching from 22.2% to 28% in patients with a harelip and cleft palate.^[14-17] This variability is probably because of the different age groups and ethnic backgrounds. A higher prevalence of ST was reported among Chinese children than white children.^[5] The prevalence of ST is not well-documented in a Turkish population.^[18] To our knowledge, the present investigation is the first multicenter retrospective study examining the largest group of subjects with ST.

Several reports emphasized the importance of examinations of panoramic films for an accurate diagnosis of numeric anomalies.^[19] Studies with only visual examinations can overlook ST, and ST cannot be confirmed without a radiographic survey.^[20,21] Undoubtedly, it would be more valuable if randomly selected patients were evaluated with panoramic radiographs.^[18] Due to the retrospective nature of this study and ethical reasons, our study consisted of a referred population. Therefore, the frequency of ST (0.76%) in our study might not represent that of the general Turkish population.

Supernumerary teeth are more common in the first three decades of life.^[16] In accordance with the literature, the mean age of our patients was 22.7.^[16] We found a higher prevalence of ST among males, and the ratio (1.28:1) was in accordance with that reported in other studies of ST in males.^[6,22-25] However, the ratio in the present study was lower than that reported by Rajab and Hamdan^[22] and Yassin and Hamori.^[14] Leco Berrocal *et al.*,^[16] observed no difference in the ratio of ST between the sexes. Rajab and Hamdan^[22] proposed that differences in sampling and

racial variation might explain the higher male prevalence of ST.

Regarding the location of the ST, the maxilla is well-known to be the most frequent site.^[11,9,16] De Oliveira Gomes *et al.*,^[6] found 91.3% of ST in the maxilla, mainly in the premaxilla (86.7%). In addition, they observed that ST were rarely located in mandibular incisor and canine regions. A few studies reported that they were located in the mandibular region.^[15,17,21] In common with other studies,^[6,9,26,27] the ST were mostly located in the maxilla (78%) region and rarely in the mandibular incisor and canine regions (22%) in the present study.

Mesiodens have been reported as the most common ST, followed by supernumerary premolars and distomolars.^[28] With regards the distribution of ST in different dental series, most authors have reported that ST are more frequent in premolar series.^[29-35] Rajab and Hamdan^[22] showed that premolars were the second most frequent type of ST in their study population. Nevertheless, other authors, such as Gay Escoda and Aytés Berini^[36] and Menardía-Pejuan *et al.*,^[37] stated that ST of the molar group were the most prevalent type in the general population. In contrast to previous studies,^[36,37] mesiodens were the most frequent type of ST (30.45%) in the present study, followed by supernumerary distomolars (22.36%) and supernumerary premolars (20.18%). A possible reason for this difference may be racial and sampling differences.

Supernumerary teeth are usually single and unilateral and rarely multiple. In our study, mostly single ST were observed (77.43%), followed by 2 (18.44%), 3 (2.35%), 4 (1.41%), 5 (0.117%), and 7 (0.235%) ST. Our findings are in agreement with those of Yassin and Hamori,^[14] who reported that 78.3% patients had a single supernumerary tooth, 21.6% patients had two ST, and 2.9% had three or more ST. ST were observed unilaterally in 81% of our patients. Anthonappa *et al.*,^[5] showed that 70.7% of 283 ST were unilateral and that 29.3% were bilateral.

The position of ST is important for their management. De Oliveira Gomes *et al.*,^[6] demonstrated that 84.1% of ST were located in the palatal/lingual location. Primo *et al.*,^[9] and Rajab and Hamdan^[22] stated that ST were frequently normally orientated. In contrast, Asaumi *et al.*,^[24] found that 67% of all mesiodens were in an inverted position. In the present study, most of the ST were normally (vertically) orientated. The normal position facilitates eruption of ST and erupted ST usually have a supplemental shape.^[6] In this study, the frequency of erupted ST was 27.96%, which is lower than that reported by Primo *et al.*,^[9] who reported that the frequency of erupted ST was 47.17%.

A conical shape was the most frequently observed morphology in our study, followed by supplemental

and tuberculate shapes. These results are in agreement with those of previous studies, which reported that the frequencies of conical, tuberculate, and supplemental ST varied from 31% to 75%, 12% to 28%, and 4% to 33%, respectively.^[21,22,24,27,38,39] Anthonappa *et al.*,^[5] reported that 202 (71.5%) supernumeraries were conical shaped, 33 (11.6%) were supplemental, and 31 (10.9%) were tuberculate. Fernández Montenegro *et al.*,^[8] Giancotti *et al.*,^[38] Seddon *et al.*,^[39] and Kim and Lee.^[23] reported that conical morphology and a palatine position were the most common characteristics of ST. Other authors, including Mitchell and Bennett,^[40] Mason *et al.*,^[29] and Patchett *et al.*,^[41] attempted to find a correlation between conical or tuberculate morphologies and the retention of permanent teeth. Mitchell and Bennett^[40] were unable to establish such a relationship, and the latter two postulated that teeth with tuberculate morphology were more likely to be retained than those with a conical shape.

The development stage of ST has not been well-documented in the literature. Anthonappa *et al.*,^[5] reported that 41.3% of ST were fully developed. In our study, 82.81% of the ST were fully developed. It has been suggested that the developmental stage of ST is directly related to eruption, as all erupted ST are fully developed, but unerupted ST occur in various development stages. In addition, the developmental stage may be linked to morphology because fully developed ST are conical, and supplemental shapes are more frequently observed among erupted ST.^[13] Furthermore, the developmental stage has implications for the surgical management of ST in the mandibular premolar region. ST found in this region must be preferentially removed at certain stages (i.e. fully developed, a fully developed crown with root formation, and a fully developed crown) because the surgery will be easier at these stages.^[25] In contrast, ST with crown formation is difficult to remove surgically, which may lead to recurrence.

In general, ST, particularly in the maxillary anterior region, may cause the following clinical problems: Failure of eruption, displacement or rotation, crowding, abnormal diastema or premature space closure, dilaceration, delayed or abnormal root development of permanent teeth, cystic formation, and eruption into the nasal cavity.^[26] In the upper labial segment, Mitchell and Bennett^[40] advised checking for the presence of ST before embarking on treatment for any rotated incisor or diastema. Displacement and failure of eruption are clinical complications frequently observed (88.5%) in patients with ST.^[8,9,11,20,22,42,43]

In a study by Anthonappa *et al.*,^[5] approximately 54% of patients with ST exhibited crowding, including rotations, changes in the orientation of the long axis of the adjacent permanent teeth, and/or shifts of the maxillary centerline. They stated that the ST caused no symptoms in 38.9% of

their patients, in contrast to the literature, which reported a higher rate. Leco Berrocal *et al.*,^[16] reported that the presence of mechanical accidents was the most frequent complication (54%) – the displacement of adjacent teeth being the most common finding – along with the presence of follicular cysts. Regarding the presence of follicular cysts of Leco Berrocal *et al.*,^[16] studies, the observed incidence was 19%, that is, slightly higher than the values previously reported. Delayed eruption or noneruption of permanent teeth, and malformation of the neighboring teeth are the most commonly reported complications.^[44]

Açikgöz *et al.*,^[30] reported a complication rate of 21.6% caused by ST. In a series studied by Yagüe-García *et al.*,^[45] eruptive alterations of four upper molars occurred due to the presence of four paramolars, representing a complication rate of 11.76%. In contrast to the general opinion that cysts are only rarely associated with ST, Hopcraft^[46] found such lesions in 9% of all cases with ST. Yagüe-García *et al.*,^[45] found no cysts or enlarged dental follicles in their series. In our study, there were no complications with 61.6% of the ST. The remaining 38.4% ST had associated complications. Of the ST with complications, 46.20% were delayed eruptions, 31.99% were diastemas/rotations, 13.27% were crowding, 3.55% were root resorption, 3.31% were dental caries and pericoronitis, and 1.65% were cyst formation. It was interesting to note that 38.4% of our cases were symptomatic. This figure is higher than that previously reported.

Early diagnosis and appropriate intervention can limit possible future ST-related complications. The finding that supernumeraries occur more frequently in the primary or mixed dentition is probably more a reflection of the time of diagnosis than a real difference in their time of development. The removal of ST is recommended if the eruption of the adjacent teeth has been delayed or inhibited, and the eruption pattern has been altered. Removal is also recommended if there is displacement of the adjacent teeth and associated pathology if active orthodontic treatment in close proximity to the supernumerary is envisaged, and if the tooth has spontaneously erupted into the arch.^[5]

There is no consensus in the literature on the optimum time for the surgical removal of unerupted ST. Some authors support early intervention and the removal of ST in an attempt to prevent future complications and because it is easier to remove bone in young children. Additional reasons proposed for early intervention are less extensive surgery and the need to avoid resorption, ankylosis, and associated pathology. However, others support late or delayed removal of ST to prevent damage to tooth buds and/or adjacent teeth, decrease the surgical burden for a child, and avoid repetitive surgery. Most recommendations for early or late removal of ST are based on anecdotal findings rather than evidenced based.^[9,13,14]

Rao and Chidzonga^[7] asserted that ST should ideally only be extracted after the roots of adjacent permanent teeth have developed fully. Liu^[47] stated that the comprehensive images in three planes provided by cone-beam computed tomography help surgeons determine the appropriate surgical approach, identify the ST, and reduce the amount of surgical trauma on the adjacent hard and soft tissues. ST cases without any clinical complications are usually followed up. In the majority of cases in Yassin and Hamori's study,^[14] the offending ST were extracted. In their study, approximately three-quarters of patients needed orthodontic treatment, and two-thirds had erupted ST. They asserted that earlier removal was associated with a better prognosis.

In this study, clinical follow-up was indicated for 23.18% of the patients. Whenever ST are surgically removed, clinical judgment should determine the need and type of radiographic images for evaluation and/or monitoring.^[27] In our study, 68.36% of the ST were treated with only surgical removal, and 8.45% were treated with surgical removal followed by orthodontic therapy.

Conclusion

To our knowledge, no other study in the literature has examined in detail so many cases with ST. The demographic profile of the patients with ST in this study can provide useful additional epidemiological information. A wide range of factors should be considered when evaluating ST. In addition, it is essential to detect ST as early as possible to avoid possible complications and to assure successful management. Even after treatment, patients must be followed up periodically.

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How to cite this article: Bereket C, Çakir-Özkan N, Şener İ, Bulut E, Baştan A&. Analyses of 1100 supernumerary teeth in a nonsyndromic Turkish population: A retrospective multicenter study. *Niger J Clin Pract* 2015;18:731-8.
Source of Support: Nil, **Conflict of Interest:** None declared.

