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

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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.” Some authors prefer the term hyperdontia to describe dentition that contains >20 deciduous and 32 permanent teeth. The etiology of ST is not completely understood, and several theories have been proposed to explain their development. 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. However, if it splits into two unequal parts, the additional tooth may become malformed and conical. 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. ST have also been attributed to atavism. 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.
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. They may be single, multiple, unilateral, or bilateral in their distribution. The prevalence of ST in permanent teeth has been estimated at a range of 0.5–3.8%, in comparison to 0.3–0.6% in the primary dentition.

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. Although these teeth can be found in any location, they appear to 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).

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. 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.

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. 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 linguually 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

<table>
<thead>
<tr>
<th>Type of supernumerary</th>
<th>Mesiodens</th>
<th>Lateral</th>
<th>Canine</th>
<th>Premolar</th>
<th>Para molar</th>
<th>Disto molar</th>
<th>Fifth molar</th>
<th>Total</th>
<th>Jaws</th>
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<td>98</td>
<td>48</td>
<td>222</td>
<td>145</td>
<td>246</td>
<td>6</td>
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<tr>
<td>Localization of ST</td>
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<td></td>
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<td>Right</td>
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<td>124</td>
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<td>0</td>
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<td>9</td>
<td>77</td>
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<td>27</td>
<td>34</td>
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<td>Infraocclusion</td>
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<td>10</td>
<td>5</td>
<td>23</td>
<td>23</td>
<td>29</td>
<td>1</td>
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<td>46</td>
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<td>0</td>
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<td>Fully impacted</td>
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<td>56</td>
<td>24</td>
<td>166</td>
<td>49</td>
<td>152</td>
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<tr>
<td>Only crown</td>
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<td>86</td>
<td>46</td>
<td>139</td>
<td>114</td>
<td>194</td>
<td>3</td>
<td>911</td>
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<tr>
<td>Partial crown</td>
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<td>1</td>
<td>60</td>
<td>15</td>
<td>31</td>
<td>0</td>
<td>110</td>
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</tr>
<tr>
<td>Partial root</td>
<td>5</td>
<td>10</td>
<td>1</td>
<td>23</td>
<td>16</td>
<td>21</td>
<td>3</td>
<td>79</td>
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</tr>
</tbody>
</table>

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.
Bereket, et al.: Retrospective analyses of 1100 supernumerary teeth

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

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

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

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<th>Type of ST</th>
<th>Single</th>
<th>Two</th>
<th>Three</th>
<th>Four</th>
<th>Five</th>
<th>Six</th>
<th>Seven</th>
<th>Affected patients total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>364</td>
<td>93</td>
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<td>6</td>
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<td>0</td>
<td>2</td>
<td>478</td>
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<tr>
<td>Female</td>
<td>295</td>
<td>64</td>
<td>8</td>
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<td>Affected patients total</td>
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<td>20</td>
<td>12</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>851</td>
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</tbody>
</table>

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...
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 diestemas/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. 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. The prevalence of ST is not well-documented in a Turkish population. 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. Studies with only visual examinations can overlook ST, and ST cannot be confirmed without a radiographic survey. Undoubtedly, it would be more valuable if randomly selected patients were evaluated with panoramic radiographs. 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. In accordance with the literature, the mean age of our patients was 22.7. 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. However, the ratio in the present study was lower than that reported by Rajab and Hamdan and Yassin and Hamori. Leco Berrocal et al. observed no difference in the ratio of ST between the sexes. Rajab and Hamdan 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. De Oliveira Gomes et al. 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. In common with other studies, 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. With regards the distribution of ST in different dental series, most authors have reported that ST are more frequent in premolar series. Rajab and Hamdan 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 and Menardía-Pejuan et al., stated that ST of the molar group were the most prevalent type in the general population. In contrast to previous studies, 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 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. 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. demonstrated that 84.1% of ST were located in the palatal/lingual location. Primo et al. and Rajab and Hamdan stated that ST were frequently normally orientated. In contrast, Asaumi et al. 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. In this study, the frequency of erupted ST was 27.96%, which is lower than that reported by Primo et al. 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.[8,9,11,20,22,42,43] 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.:[19] and Kim and Lee:[13] 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.:[19] 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.[12] 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.[20] 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.:[10] 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.[10] 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]

Açıkgoz et al.[10] 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 diestemas/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 supernumary is envisaged, and if the
tooth has spontaneously erupted into the arch.[10]

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\textsuperscript{[1]} asserted that ST should ideally only be extracted after the roots of adjacent permanent teeth have developed fully. Liu\textsuperscript{[41]} 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,\textsuperscript{[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.\textsuperscript{[21]} 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.

### References

36. Seddon RP, Johnstone SC, Smith PB. Mesiodentes in twins: A case report and clinical judgment should determine the need and type of radiographic images for evaluation and/or monitoring. 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.

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