

# Epidemiological Features and Clinical Repercussions of Supernumerary Teeth in a Multicenter Study: A Review of 518 Patients with Hyperdontia in Spanish Population

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## Abstract

**Objectives** The aim of this study was to establish the prevalence of supernumerary teeth (ST) in a sector of the population of Madrid, as well as possible complications associated with the presence of these teeth.

**Materials and Methods** The study investigated patients ( $n = 28,114$ ) who sought dental care at the Oral Surgery Service of three different centers between May 2005 and April 2018. Cases that did not present this numeric dental developmental variation were discarded, registering only those presenting ST.

**Statistical Analysis** Statistical analysis consisted of univariate analysis (mean, standard deviation, median, etc.), bivariate analysis applying the chi-squared test, whereby statistical significance was established with a confidence interval (CI) of 95% ( $p < 0.05$ ), and multivariate analysis by means of classification and decision trees.

**Results** The study found ST in 518 patients, representing a prevalence of 1.84%. The 518 patients presented a total of 726 ST. Distomolars were the most common, representing 37.7% of the sample, followed by premolars (20.1%). About 70.5% of the sample were located in the maxilla and 78% of ST were impacted. Radiographs revealed that 39.7% of STs were associated with disorders. Supplementary morphology appeared in 52.1% of the sample.

**Conclusions** Although mesiodens is considered the most common ST, the present study found distomolars and supernumerary premolars to be the most frequently occurring. Pathology was associated with 39.7% of the ST sample. Early diagnosis allows optimal patient management and treatment planning, with intervention at an appropriate time to prevent complications in development and so reduce later treatment need.

## Keywords

- ▶ clinical repercussions
- ▶ epidemiological features
- ▶ multicenter study
- ▶ Spanish population
- ▶ pathology
- ▶ supernumerary teeth

## Introduction

Hyperdontia, hypergenesis, or the presence of supernumerary teeth (ST) is defined as the existence of a number of teeth exceeding the normal dental formula.<sup>1-3</sup> Orhan et al<sup>4</sup> consider that ST are present when they exceed 20 in temporary dentition and 32 in permanent dentition. However, it is important to specify any increase in a particular dental group as ST may coexist with dental agenesis, although this is an extremely rare developmental disorder, named by Camilleri<sup>5</sup> as concomitant hypo-hyperdontia.

ST are a relatively common developmental variation<sup>6-9</sup> with a prevalence between 0.15% and 3.9% in permanent dentition, which appears to have increased in recent years.<sup>10-12</sup> In addition to racial variations, age differences among patients, varying study protocols, and diagnostic methods may explain the wide range of prevalence cited in the literature. Different authors mention a higher frequency of ST in East Asian racial groups<sup>13,14</sup> or racial groups of African origin<sup>15,16</sup> in comparison with whites.

The etiology of ST within the population is multifactorial with evidence of chromosomal, polygenic, single gene, and major environmental influences in this complex etiology; different factors may exert a major influence on different individuals.<sup>17</sup> Variation in outcome in a developmental process, such as the formation of the dentition, enables adaptation to different environments. Tooth number, size, and shape are determined during the initiation and morphogenetic stages of dental development. The molecular evidence of repetitive signaling throughout initiation and morphogenesis is reflected clinically in the association of anomalies of number, size, and shape.

This study set out to determine the prevalence of ST in a sector of the population of Madrid, as well as possible complications associated with the presence of these hypergenetic teeth. In addition, the results were compared statistically with the data obtained in similar studies conducted around the world.

## Materials and Methods

This descriptive, retrospective-casuistic, multicenter study investigated a patient population in Madrid (Spain), all seeking dental care at the Oral Surgery Service of the Faculty of Dentistry at the Complutense University of Madrid (Spain), and at the oral surgery and implantology services of two hospitals: Virgen de La Paloma Hospital and Madrid Hospital.

The Complutense University of Madrid Ethics Committee approved the study protocol (Ref. 17/050E).

The study included all patients (a total of 28,114 individuals) who sought dental care at the oral surgery services of one of these three centers between May 2005 and December 2017 and whose medical notes included a panoramic radiograph, as well as a periapical or occlusal radiograph taken by the radiodiagnostic services of the same center. In those cases where the information was not accurate, additional information was requested in the form of a cone beam computed tomography scan; these findings were verified after surgical extraction of the ST.

Cases that did not present ST were discarded; the study sample was made up of patients who did present this developmental anomaly.

As exclusion criteria, patients presenting any genetic syndrome or congenital craniofacial anomaly generally associated with hyperdontia were excluded.

A clinical protocol was created for each patient registering the following data: medical record number, age, and sex; type of each ST: mesiodens, premolar, distomolar, or paramolar; location of ST: maxilla or mandible; eruption state: impacted or erupted; associated clinical or radiographic complications: mechanical obstructive pathology (MOP) or follicular sac enlargement (FSE) >3 mm; ST morphology: supplementary (when the ST adopt the same shape and size as the other teeth of the group it belongs to) or heteromorphic.

The radiographic tests were analyzed by the same researcher. Doubts arising were resolved by discussion and consensus among the team members of the research project.

All data were entered on a spreadsheet (Ms-Excel) and subsequently imported into the SPSS version 25.0 for Windows statistical software package.

Statistical analysis consisted of univariate analysis (mean, standard deviation, median, etc.), bivariate analysis applying the chi-squared test, whereby statistical significance was established with a confidence interval of 95% ( $p < 0.05$ ), and multivariate analysis by means of classification and decision trees.

## Results

### Univariate Analysis

The study's results showed the existence of ST in 518 patients, representing a prevalence of 1.84% of the total study population.

As for distribution by patient sex, 314 cases were male (60.62%) and 204 were females (39.38%), with a proportion M/F of 1.54/1. Patients' ages ranged from 5 to 75 years, with a mean age of 24.28 years.

Of these 518 patients, a total of 726 ST were found with the following distribution: 71.8% of patients presented a single ST, 23.2% presented two STs, and 5% of patients presented multiple hyperdontia with three or more STs, without any association with some complex syndrome (any such patients having been discarded as a result of the application of exclusion criteria).

Distomolars (37.7%) were the most frequent ST, followed by premolars (20.1%), mesiodens (19.8%), and paramolars (9.9%).

As for the distribution of ST (maxilla or mandible), maxillary distomolars were the most common (30.3%), followed by mesiodens (19.8%), and mandibular premolars (17.9%). Out of the whole sample, 512 STs were located in the maxilla (70.5%) and only 214 in the mandible (29.5%).

Seventy-eight percent of STs were impacted and 22% erupted.

Radiographic observation identified associated pathology in 288 STs, representing 39.7% of all the STs included in the study. FSE >3 mm was found in 13.5% of the sample and MOP

in 25.1%. A small number (1.1%) were associated with both ESF >3 mm and MOP.

In analysis of ST morphology, 378 STs (52.1%) presented supplementary morphology and 348 STs (47.9%) heteromorphic morphology.

### Bivariate Analysis

Bivariate analysis indicated a 95% statistically significant relationship ( $p = 0.000$ ) between the type of ST and maxillary or mandibular location. Most distomolars (80.3%; 220 out of 274) were found in the maxilla, while 89% of supernumerary premolars were located in the mandible.

A 95% statistically significant relation ( $p = 0.000$ ) was also observed between the type of ST and associated pathology (►Table 1). In this way, 26% of supernumerary premolars were associated with FSE  $\geq 3$  mm, premolars being the ST with the greatest capacity to provoke follicular degeneration, followed by distomolars (19%) and canines (15.4%). Meanwhile, the paramolar showed the greatest association (58.3%) with MOP, followed by lateral incisors (42.9%), canines (38.5%), and mesiodens (36.1%).

A statistically significant relationship was observed (95%;  $p = 0.000$ ) between the location of STs (maxillary or mandibular) and associated pathology (►Table 2). More FSE  $\geq 3$  mm were located in the mandible (23.4%), while maxillary STs were more often associated with MOP (30.5%). At the same manner, a statistically significant relation was observed (95%;  $p = 0.000$ ) between ST type and morphology. A 91.7% of paramolars and 86.1% of mesiodens presented

heteromorphic morphology. Meanwhile, a 100% of upper lateral incisors and 90.4% of supernumerary premolars had identical shapes to their homologous teeth

### Discussion

The presence of ST is usually discovered casually in the course of routine radiographic observation. Clinically, STs may manifest in the form of eruptive disorders of the adjacent teeth, in which case radiological examination will be conducted, leading to their discovery.

Although their prevalence is low—1.84% according to the present results conducted among a Caucasian (Spanish) population—prevalence may reach 2.2% or even 3.5%, as affirmed by Peltola,<sup>18</sup> studying a Finnish population, and Ezoddini et al<sup>10</sup> studying a Middle Eastern population, respectively.

Differences in prevalence in relation to sex are not in question, as most authors have found a clear male predominance. In the present study, the ratio of male to female was 1.54/1, which concurs with results obtained by Salcido-García et al<sup>9</sup> and Rajab and Hamdan,<sup>19</sup> among others.

The present study differed from other similar studies in the predominance of ST type. In most similar works, mesiodens occupies first place as the most frequently occurring ST type, usually followed by distomolars or premolars. According to Danalli et al,<sup>20</sup> mesiodens represents 80% of all ST. Other authors such as Anthonappa et al,<sup>21</sup> Liu et al,<sup>22</sup> and De Oliveira Gomes et al<sup>23</sup> affirm that around 95% of ST are situated in the premaxilla.

**Table 1** Contingency table. Type of supernumerary teeth versus associated pathology

			Associated pathology				Total number
			No of pathology	Mechanical pathology	FSE $\geq 3$ mm	FSE $\geq 3$ mm + mechanical pathology	
Type	Canines	Recount	10	10	4	2	26
		% within the type	38.5	38.5	15.4	7.7	100.0
Primary teeth	Primary teeth	Recount	16	0	0	0	16
		% within the type	100.0	0.0	0.0	0.0	100.0
Distomolars	Distomolars	Recount	158	58	52	6	274
		% within the type	57.7	21.2	19.0	2.2	100.0
Lower incisives	Lower incisives	Recount	16	4	0	0	20
		% within the type	80.0	20.0	0.0	0.0	100.0
Lateral incisores	Lateral incisores	Recount	16	12	0	0	28
		% within the type	57.1	42.9	0.0	0.0	100.0
Mesiodens	Mesiodens	Recount	92	52	0	0	144
		% within the type	63.9	36.1	0.0	0.0	100.0
Paramolars	Paramolars	Recount	27	42	4	0	73
		% within the type	36.1	58.3	5.6	0.0	100.0
Premolars	Premolars	Recount	103	4	38	0	145
		% within the type	71.2	2.7	26.	0.0	100.0
Total	Total	Recount	438	182	98	8	726
		% within the type	60.3	25.1	13.5	1.1	100.0

Abbreviation: FSE, follicular sac enlargement.

**Table 2** Contingency table. Location of supernumerary teeth versus associated pathology

			Associated pathology				Total number
			No of pathology	Mechanical/obstructive pathology	FSE ≥ 3 mm	FSE ≥ 3 mm + mechanical/obstructive pathology	
MAXMAND	MAND	Recount	130	26	50	8	214
		% within MAXMAND	60.7	12.1	23.4	3.7	100.0
	MAX	Recount	308	156	48	0	512
		% within MAXMAND	60.2	30.5	9.4	0.0	100.0
Total		Recount	438	182	98	8	726
		% within MAXMAND	60.3	25.1	13.5	1.1	100.0

Abbreviations: FSE, follicular sac enlargement; Mand, mandibular; Max, maxillary.

In the present study, the most frequent STs were distomolars (representing 37.7%), followed by premolars (20.1%), mesiodens (19.8%), paramolars (9.9%), lateral incisors (3.9%), canines (3.6%), lower incisors (2.8%), and temporary teeth (2.2%). The low percentage of mesiodens registered in the present study is remarkable (only 19.8%).

If the STs appearing in molar regions are counted, regardless of they are disto/paramolars, the percentage increases to 47.6% of the sample. It should be taken into account that the present study was conducted among patients attending three oral surgery/implantology services where third molar extraction is the treatment in most demand. Given that the mean age of the 28,114 patients included in the study was 34.65 years, a higher prevalence of late-developing ST such as distomolars or premolars could be expected. At the same time, it could be that the percentage of mesiodens was lower (19.8%) than in other studies conducted among children, as it is possible (together with other factors) that these teeth had already been extracted.

This might also have a bearing on the fact that there was a statistically significant relationship between patient age and ST type. Mesiodens were the most frequently occurring STs among patients aged under 20 years (42.1%), while distomolars were the most frequently found in older age ranges. In the 20 to 30 years range distomolars represented 52.3% of all ST; in patients aged over 30 years, distomolars made up 35.7% of the sample, while premolars increased to 29.8% of the sample in this age range.

This agrees with Leco Berrocal et al<sup>24</sup> who also considered that upper distomolars were the most frequently occurring ST (38%), followed by mesiodens (28.6%) and lower premolars (14.2%). Burgess<sup>25</sup> found that 37.5% of STs were distomolars, Bereket et al<sup>26</sup> 22.36%, while Fernández Montenegro et al<sup>27</sup> and Dauder et al<sup>28</sup> obtained approximately 18%, and Tochiara<sup>29</sup> 15.6%.

The maxillary presents a higher frequency of ST than the mandible in a proportion that varies between 5 to 1 and 10 to 1 depending on the results obtained by different researchers.

Liu et al<sup>22</sup> obtained a very high incidence of STs in the maxillary, in detail 97.12%. De Oliveira Gomes et al<sup>23</sup> found 91.3% of STs in the maxilla. In the present study, 70.5% of STs were located in the maxilla and 29.5% in the mandible, results that concur with Celikoglu et al,<sup>30</sup> who found 68.8% of STs in the maxilla.

We also identified a statistically significant relationship ( $p = 0.000$ ) between ST type and maxillary or mandibular location. It was found that 80.3% of distomolars included in the study (220 out of 274) were located in the maxilla (► Fig. 1), while 89% of supernumerary premolars were located in the mandible (► Fig. 2). If paramolars are added to this analysis ( $n = 72$ ), the percentage of supernumerary molars in the maxilla rises to 84%. Grimanis et al<sup>31</sup> found that 79.7% of supernumerary molars were located in the maxilla. Tochiara<sup>29</sup> observed an even higher percentage of maxillary location: 93.82%.

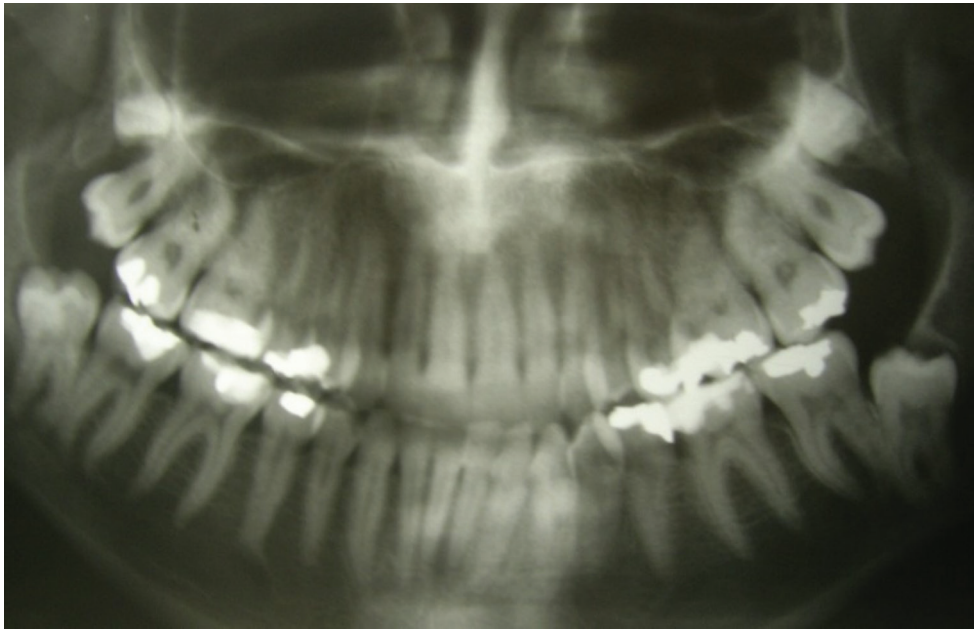
Supernumerary premolars, unlike other types of ST, are more frequent in the mandible than the maxilla making them the most prevalent mandibular ST.<sup>32-34</sup> In the present study, 89% of supernumerary premolars were located in the mandible; these mandibular premolars ( $n = 130$ ) represented 60.5% of all mandibular STs ( $n = 214$ ).

According to the literature, almost one-third of patients present more than one ST.<sup>35,36</sup> About 71.8% of patients in this study presented a single ST, while 23.2% of all cases presented two STs, and 5% of cases presented more than two (multiple hyperdontia) (► Fig. 3).

Liu et al<sup>22</sup> obtained single STs in 72% of patients, two STs in 27%, and cases of multiple hyperdontia in only 0.6%. Bereket et al<sup>26</sup> found cases of single STs in 77.4% of their study population, while multiple hyperdontia was observed in 4.12%.

Yusof<sup>37</sup> claimed that multiple hyperdontia is most commonly located in the mandibular premolar region (45% of cases). The present study obtained a very similar percentage, as supernumerary premolars represented 45.6% of STs in multiple hyperdontia; as might be expected, mandibular premolars were much more frequent (40%) than maxillary





**Fig. 1** Panoramic radiograph showing distomolars in upper right and left quadrants. Both of them impacted and presenting supplementary morphology.



**Fig. 2** Panoramic radiograph showing three impacted supernumerary premolars in mandible; one in quadrant three and two in quadrant four. The supernumerary premolars shapes are nearly identical to their homologous teeth.

premolars. Distomolars were the second most common type of ST (33.3%) in cases of multiple hyperdontia.

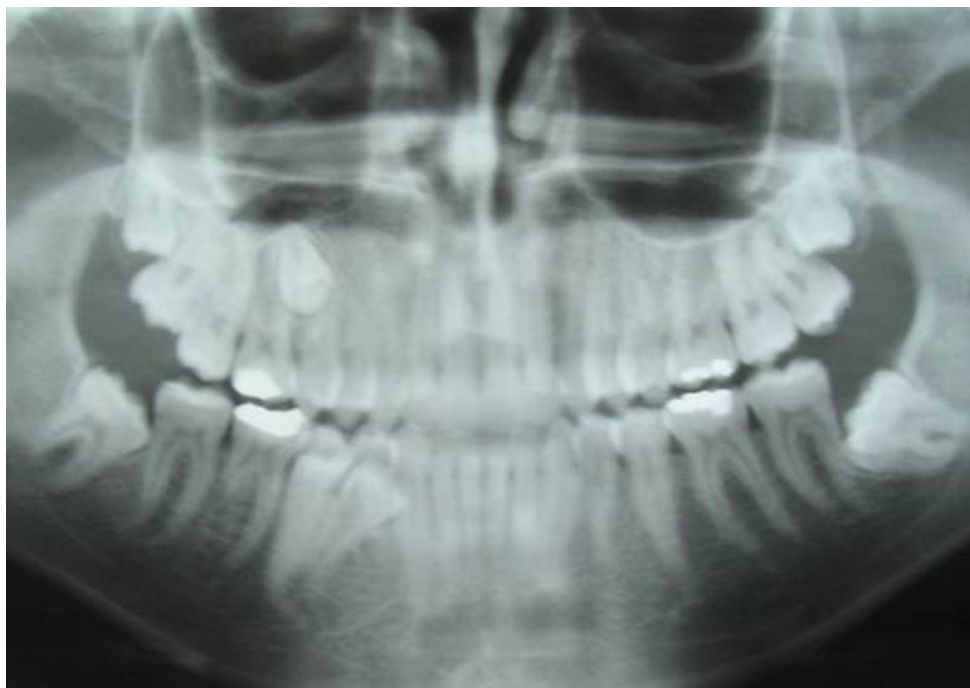
According to the literature, STs are usually impacted. In fact, only 25% of STs erupt, the rest remain impacted, which means that early diagnosis can be important.<sup>1</sup>

Out of the 726 STs included in the present study, 566 were impacted (78%) and 160 had erupted (22%). Rajab and Hamdam<sup>19</sup> and De Oliveira Gomes et al<sup>23</sup> among others affirm that the impaction of STs occurs in some 75% of cases.

Meanwhile, authors such as Salcido-García et al<sup>9</sup> and Leco Berrocal et al<sup>24</sup> have obtained higher percentages of over 90%.

Analyzing the morphology of the STs identified in the present study, 378 teeth (52.1%) presented supplementary morphology and 348 teeth (47.9%) showed heteromorphic morphology.

Determining dental morphology from panoramic and intraoral (periapical and/or occlusal) radiographs presents inherent difficulties. For this reason, the present study



**Fig. 3** Panoramic radiograph showing multiple impacted supernumerary teeth. One distomolar in quadrant one and another distomolar in quadrant two. Both presented supplementary morphology. Besides 3 supernumerary premolars, one in quadrant one and two in quadrant four. All of them presented supplementary morphology.

attempted to standardize the classification of morphology; however, these findings were verified after surgical extraction of the ST.

Anthonappa et al<sup>21</sup> obtained supplementary morphology in 10.9% of STs, heteromorphic morphology being much more frequent (89.1%). Fernández Montenegro et al<sup>27</sup> found heteromorphic morphology to be the most usual tooth shape (75.8% of cases). De Oliveira Gomes et al<sup>23</sup> observed supplementary morphology in 16.7% of the STs analyzed in their study, while Rajab and Hamdan<sup>19</sup> obtained an even lower percentage of STs with supplementary morphology (6.9%), with 93.1% presenting heteromorphic morphology.

The present study identified a statistically significant relationship ( $p = 0.000$ ) between ST type and morphology; 91.7% of paramolars and 86.1% of mesiodens presented heteromorphic morphology, while 100% of upper lateral incisors and 90.4% of supernumerary premolars had identical shapes to their homologous teeth.

One of the objectives in the present study was to analyze clinical complications associated with STs. It was observed that 39.7% ( $n = 288$ ) of the STs analyzed presented some associated pathology. While 25.1% ( $n = 182$ ) of cases presented MOP, 13.5% ( $n=98$ ) of STs presented FSE  $>3$  mm. Eight STs (1.1%) were associated with both pathologies. Authors such as Eliasson et al<sup>38</sup> and Sewerin and von Wowern<sup>39</sup> have investigated FSE  $>3$  mm in patients with impacted third molars. The results showed that this enlargement is not frequent (6.0% and 5.45% respectively) but when enlargement does appear, the results of histological analysis were compatible with follicular cysts.

The present results concur with those of Bereket et al<sup>26</sup> and Celikoglu et al<sup>30</sup> who found a percentage of pathology

associated with STs of 38.36 and 45.83%, respectively, mechanical pathology being more common. Bereket et al<sup>26</sup> observed cystic degeneration in 0.63% of cases, while Celikoglu et al<sup>30</sup> did not find any cases of this pathology.

De Oliveira Gomes et al<sup>23</sup> found a higher percentage of associated pathology; 88.5% of the 460 STs included in their study were associated with some type of pathology. Nevertheless, it should be noted that the percentage of cystic pathology was low (0.6%).

An observational study by Leco Berrocal et al<sup>24</sup> of the frequency of STs in a population of 2,000 patients found associated pathology in 73% of STs; 54% were mechanical and 19% presented associated follicular cysts

In the present sample, a statistically significant relation ( $p = 0.000$ ) was found between ST type and the presence of associated pathology. Twenty-six percent of supernumerary premolars were associated with FSE  $\geq 3$  mm, this being the ST type most frequently associated with this pathology. In order of frequency, premolars were followed by distomolars (19%), canines (15.4%), and paramolars (2.7%). At the same time, paramolars were the tooth type most frequently associated with mechanical pathology (58.3%); paramolars were followed by lateral incisors (42.9%), canines (38.5%), mesiodens (36.1%), distomolars (21.2%), lower incisors (20%), and premolars (2.7%).

The high percentage of FSE  $\geq 3$  mm (26%) associated with supernumerary premolars found in the present study is noteworthy, and contrasts sharply with results obtained by Bodin et al<sup>40</sup> who only observed this pathology in 2% of supernumerary premolars.

However, the mesiodens analyzed in the present study ( $n = 144$ ) presented a slightly lower percentage of associated

complications than the overall mean obtained (36.1 vs. 39.7%). No mesiodens was found to be associated with FSE  $\geq 3$  mm.

Bivariate analysis also revealed a statistically significant relationship ( $p = 0.000$ ) between ST location and associated pathology. In spite of the absence of general differences in percentages between the upper and lower arches (39.3% in the mandible and 39.8% in the maxilla), when differences were analyzed in terms of the type of associated pathology, FSE  $\geq 3$  mm was more frequent in the mandible (23.4% but only 9.4% in the maxilla). Meanwhile, mechanical pathology was more frequent in the maxilla (30.5% compared with 12.1% in the mandible). Bearing in mind that supernumerary premolars represent over 50% (60.75%) of all mandibular STs in the present study and that 26% of these premolars presented FSE  $\geq 3$  mm, then this type of pathology showed a high incidence in the mandible. As far as we are aware, the literature does not include any previous study that has analyzed these variables together.

## Conclusions

This study analyzed the epidemiological characteristics and clinical repercussions of 726 ST. Although mesiodens is considered the most common ST, the present study found distomolars and supernumerary premolars to be the most frequently occurring. Pathology was associated with 39.7% of the ST sample. However, early diagnosis allows optimal patient management and treatment planning, with intervention at an appropriate time to prevent complications in development and so reduce later treatment need

### Conflict of Interest

None declared.

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