DOI: 10.1111/j.1365-263X.2007.00862.x

A survey of 460 supernumerary teeth in Brazilian children and adolescents

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International Journal of Paediatric Dentistry 2008; 18: 98–106

Objective. This study aimed to survey the demographic profile of supernumerary teeth (ST) in Brazilian children and adolescents.

Methods. A retrospective analysis was carried out of all nonsyndromic patients with ST attended at the Pediatric Oral Surgery Service of the Universidade Federal de Minas Gerais between 1995 and 2004. Diagnosis of ST was based on clinical and radiographic examination. Chi-squared test was used for statistical analysis.

Results. This study included 460 ST found in 305 patients. Radiographic assessment (32.1%) was the main care-seeking reason and also the means through which most (97.6%) permanent ST were identified. Most cases were single (63.0%), conical (44.6%), and unerupted (76.8%) ST. Most teeth were fully developed (41.3%), normally orientated (78.9%), placed in a palatal/lingual-sagittal position (84.1%), adjacent to the crown of permanent teeth (50.2%) ($P < 0.001$). The most frequent clinical complication was permanent teeth displacement (36.0%). Treatment was surgical removal followed by orthodontics (61.6%).

Conclusions. The demographic profile of ST herein presented will be useful to provide 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 complications and to assure successful management. Even after treatment, patients must be followed up.

Introduction

Supernumerary teeth (ST) are described as those formed additionally to the normal dentition[1,2]. They have been found in both permanent and primary dentition, although less commonly in the latter[1,3,4]. The aetiology of ST is not completely understood and several theories have been proposed to explain their development[5]. ST could develop from a dichotomy of the tooth bud[5–7]. It has also been suggested that ST are a 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[1,5]. In addition, DNA mutations, including maxillofacial anomalies such as cleft lip and palate, cleidocranial dysplasia, and Gardner's syndrome, may give rise to ST. Rao and Chidzonga[7] state that the aetiology of ST is multifactorial, being a combination of environmental and genetic factors.

The prevalence rate of ST ranges between 1% and 3% in the general Caucasian population[4]. The incidence is higher among East Asians, patients with cleft lip and palate, and in cleidocranial dysplasia[8,9]. Salcido-Garcia *et al.*[10] studied 2241 Mexican subjects and observed that 3.2% had ST. A survey of 2000 British individuals found ST in 2.1% of the patients[11]. Primo *et al.*[12] verified a prevalence of 2.96% when studying a Brazilian population sample from the state of Rio de Janeiro.

The most frequent locations of ST are the premaxilla and the mandibular premolar regions. The morphology of ST observed in the primary dentition is usually normal or conical, whereas ST found in the permanent dentition

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show a variable morphological pattern, namely conical or peg-shaped, tuberculate, and molariform. ST displaying normal size and shape are referred to as supplemental[7]. The clinical complications more frequently associated with ST include failure of eruption, displacement or rotation of adjacent teeth, crowding, malocclusion, root resorption, dilaceration, delayed or abnormal root development of permanent teeth, nasal cavity eruption, cystic formation, and fistulas[5,7,13].

Clinical examination followed by a comprehensive radiographic screening are required to achieve an accurate diagnosis of ST and optimal management[7,13]. In addition, management will depend on ST location and morphology, and presence or absence of clinical complications. Treatment may be surgical or the patient may be followed up without surgical intervention[5,13].

The aim of this study is to assess the demographic profile of ST in Brazilian children and adolescents. In addition, patient management and monitoring is discussed.

Materials and methods

This study was approved by the Committee of Bioethics in Research of the Universidade Federal de Minas Gerais (UFMG, protocol no. 363/05). This descriptive, retrospective analysis investigated ST in nonsyndromic patients attended at the Pediatric Oral Surgery Service of the UFMG, between 1995 and 2004. Subjects involved were comprehensive care patients of the service, as well as individuals referred by general dentists. ST diagnosis was achieved through detailed clinical and radiographic examinations performed by a single observer (C.O.G.), who has an extensive experience in pediatric dentistry, including ST.

Patients' data were collected from their charts and included age, gender, care-seeking reasons, and management procedures. The following ST features were described: primary or permanent, single or multiple, location, eruption, morphology, sagittal position, orientation, vertical position in relation to permanent teeth, developmental stage, and clinical complications. Radiographic and macroscopic examination was used to describe morphological patterns, namely conical, tuberculate, and supplemental. Odontomas were excluded from the study since they are not universally considered ST[5]. Sagittal positions described were: labial/buccal, palatal/lingual, and within arch. Regarding orientation in relation to permanent teeth, ST were classified as: normal (normally orientated), inverted (opposed-orientated), inclined (45-degree-orientated), and horizontal (90-degree-orientated). Vertical position in relation to permanent teeth was classified as: incisal (located adjacent to the incisal), adjacent to the crown, adjacent to the root, and apical (located adjacent to the apex). ST development stages were described as: crown under formation, fully developed crown, fully developed crown with root under formation, and fully developed tooth. The chi-squared test was applied for statistical analysis, using raw frequency data. Statistical significance was considered at the 5% level (BioEstat 3.0, Belém, Pará, Aires, Brazil).

Results

This study included 460 ST in 305 patients. Fourth, fifth, sixth or seventh molars were not diagnosed in our sample. Mean age was 9.3 years with a range of 3.7 to 16 years. Most cases were found in 9- and 10-year-old patients (37.1%) (Table 1). We found 67.9% males and 32.1% females subjects, with a male : female ratio of 2.1 : 1 (Tables 1 and 2). The main care-seeking reason was radiographic assessment (32.1%), followed by ST eruption (26.9%), failure of permanent teeth eruption (19.3%), clinical retention of primary teeth (14.4%), and permanent teeth displacement (6.6%).

Table 1. Age and gender of 305 patients with supernumerary teeth.

Age (years)	Gender		
	Male	Female	Total
3–6	13 (6.3%)	9 (9.2%)	22 (7.2%)
7–8	62 (29.9%)	18 (18.4%)	80 (26.2%)
9–10	72 (34.8%)	41 (41.8%)	113 (37.1%)
11–12	34 (16.4%)	21 (21.4%)	55 (18.0%)
13–14	20 (9.7%)	4 (4.1%)	24 (7.9%)
15–16	6 (2.9%)	5 (5.1%)	11 (3.6%)
Total	207 (100%)	98 (100%)	305 (100%)

*Chi-squared test = 9.5, d.f. = 5, $P > 0.1$.

Table 2. Relation between patients' gender and occurrence of supernumerary teeth as single or multiple.

		Multiple							
	Single	**Two**	**Three**	**Four**	**Five**	**Six**	**Eight**	**Nine**	**Total**
Male	125 (60.4%)	68 (32.8%)	8 (3.8%)	2 (1.0%)	3 (1.5%)	–	–	1 (0.5%)	207 (100%)
Female	67 (68.4%)	26 (26.5%)	2 (2.1%)	1 (1.0%)	–	1 (1.0%)	1 (1.0%)	–	98 (100%)
Total	192 (63.0%)	94 (30.8%)	10 (3.3%)	3 (1.0%)	3 (1.0%)	1 (0.3%)	1 (0.3%)	1 (0.3%)	305 (100%)

Table 3. Relation between eruption and morphology of supernumerary teeth.

	ST morphology			
	Conical	**Tuberculate**	**Supplemental**	**Total**
Erupted	57 (27.8%)	21 (11.8%)	29 (37.7%)	107 (23.2%)
Unerupted	148 (72.2%)	157 (88.2%)	48 (62.3%)	353 (76.8%)
Total	205 (100%)	178 (100%)	77 (100%)	460 (100%)

*Chi-squared test = 24.43, d.f. = 2, $P < 0.001$.

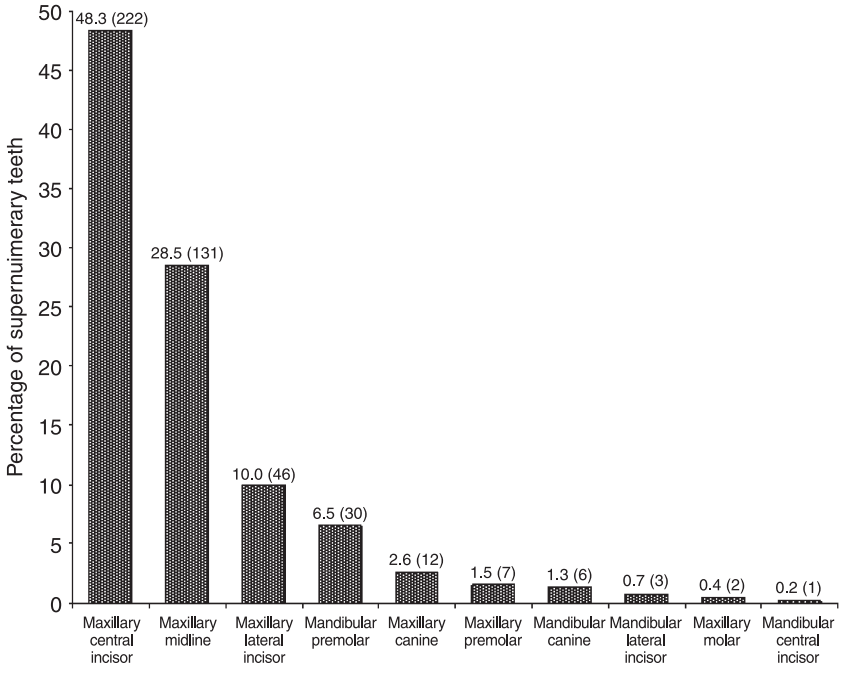

Fig. 1. Location of supernumerary teeth (Pediatric Oral Surgery Service of the Universidade Federal de Minas Gerais, 2007).

Permanent ST accounted for the majority of the cases (97.6%), while only 2.4% were primary ST. Single ST (63.0%) were more common and occurred in 60.4% of male patients and 68.4% of female patients (Table 2). Interestingly, one boy developed nine ST while one girl had eight ST. When analysing ST location, we found 91.3% affecting the maxilla and 86.7% involving the premaxilla. ST located in the mandible accounted for 8.7% of the cases. A detailed description of ST location is shown in Figure 1.

Conical morphology was observed in 44.6% of the cases (Fig. 2), followed by tuberculate ST in 38.7% (Fig. 3c), and supplemental ST in 16.7% (Fig. 3b). Unerupted ST occurrence was more frequent, regardless of teeth morphology. Table 3 shows that supplemental ST were more frequently erupted than conical and tuberculate ST ($P < 0.001$). The most common sagittal position was palatal/lingual (84.1%), followed by within the arch (11.1%) and labial/buccal (4.8%). Most ST were normally

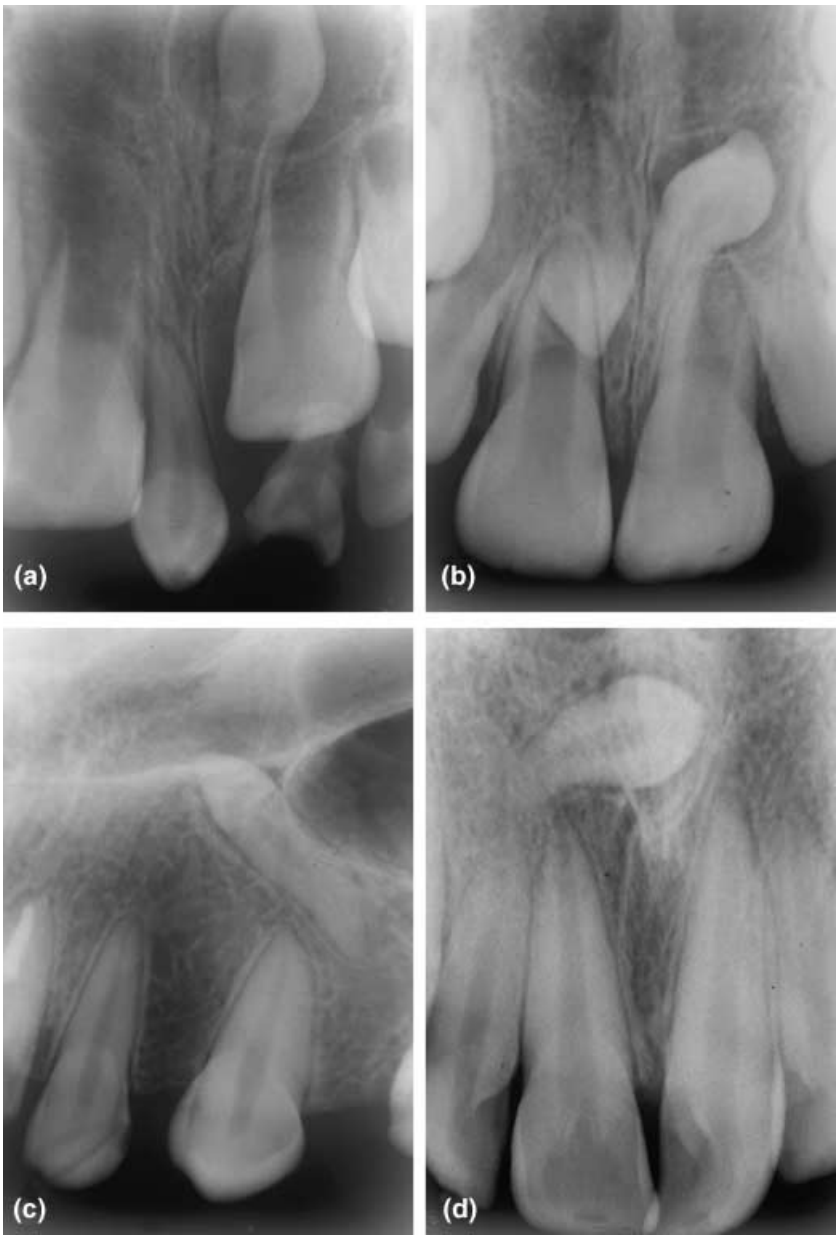

Fig. 2. (a) Two supernumerary teeth (ST): one erupted and another unerupted. Maxillary central incisor eruption disturbance and clinical retention of primary tooth are also observed. (b) Two ST: both unerupted, apically placed in relation to permanent teeth. (c) Single unerupted ST, inclined and apically located. (d) Single unerupted ST, horizontally and apically located.

orientated (78.9%) (Table 4). All erupted ST were normally orientated. On the other hand, unerupted ST were normally orientated in 72.5% of the cases (Figs 1a and 3), inverted in 22.7% (Figs 1a,b), inclined in 4.0% (Fig. 1b), and horizontal in 0.8% (Fig. 1c). The relation between ST orientation and morphology is shown in Table 4.

Regarding vertical position, 50.2% of the cases were adjacent to the crown (Fig. 3b), 17.4% to the root (Fig. 3c), 16.5% to the incisal (Fig. 1a), and 15.9% apically located in relation to the permanent tooth (Fig. 1d) (Table 5). Erupted ST were vertically positioned adjacent to the crown in 68.2% of the cases, and incisal in 31.8%. The vertical location of unerupted ST was adjacent to the crown in 44.8%, to the root in 22.6%, apical in 20.7%, and incisal in 11.9% of the cases. When considering all morphological shapes, the most common vertical position was adjacent to the crown ($P < 0.001$, Table 5). All erupted ST were fully developed. The relation between developmental stage and morphology of ST is shown in Table 6. Conical and supplemental ST were more frequently seen as fully developed

Fig. 3. (a) Two unerupted, normally orientated supernumerary teeth (ST), located adjacent to the root of the permanent teeth, one with crown under formation. (b) Single, normally orientated, supplemental ST, with fully developed crown. Displacement and failure of eruption of the mandibular premolar are also present. (c) Two ST with fully developed crown and root under formation. A diastema is present.

Table 4. Relation between orientation and morphology of supernumerary teeth.

	ST morphology			
	Conical	**Tuberculate**	**Supplemental**	**Total**
Normal	119 (58.0%)	167 (93.8%)	77 (100%)	363 (78.9%)
Inverted	76 (37.1%)	4 (2.3%)	–	80 (17.4%)
Inclined	7 (3.4%)	7 (3.9%)	–	14 (3.0%)
Horizontal	3 (1.5%)	–	–	3 (0.7%)
Total	205 (100.0%)	178 (100.0%)	77 (100.0%)	460 (100%)

Table 5. Relation between vertical position and morphology of supernumerary teeth.

	ST morphology			
	Conical	**Tuberculate**	**Supplemental**	**Total**
Incisal	26 (12.7%)	31 (17.4%)	19 (24.7%)	76 (16.5%)
Crown	73 (35.6%)	122 (68.6%)	36 (46.7%)	231 (50.2%)
Root	47 (22.9%)	20 (11.2%)	13 (16.9%)	80 (17.4%)
Apex	59 (28.8%)	5 (2.8%)	9 (11.7%)	73 (15.9%)
Total	205 (100%)	178 (100%)	77 (100%)	460 (100%)

*Chi-squared test = 74.8, d.f. = 6, $P < 0.001$.

teeth, while tuberculate ST normally had a fully developed crown ($P < 0.001$, Table 6).

Clinical complications were observed in 88.5% of the patients. Permanent teeth displacement was seen in 55.7% of the cases (Fig. 2b,c), failure of eruption in 50.8% (Figs 1a and 2b,c), abnormal diastema in 21.0% (Fig. 3c), rotation in 18.7%, clinical retention of primary teeth in 7.9% (Fig. 1a), root resorption in 0.3%, and crown resorption in 0.3%. Management of the 305 patients included surgical removal followed by orthodontic therapy in 61.6% of the cases, surgical removal and clinical follow-up in 15.1%, and surgical removal alone in 9.9%. Clinical follow-up was solely indicated for 13.4% patients.

Discussion

The aim of this paper was to investigate the profile of 460 ST found in 305 Brazilian children and adolescents; thus, being one of the largest series of ST described in the English literature. Current data show that permanent ST are observed in 0.8% to 3.2% of the general population[4,8,10,11,14]. Primary ST have a lower frequency, varying from 0.3% to 0.8%[1]. Primo *et al.*[12] studied a Brazilian population sample and verified 2.96% of permanent ST. We were unable to determine the overall frequency of ST since the sample was obtained at a paediatric oral surgery service, which treats patients that already have some type of jaw disease, thus not representing the general child population.

Table 6. Relation between developmental stage and morphology of supernumerary teeth.

	ST morphology			
	Conical	**Tuberculate**	**Supplemental**	**Total**
Crown under formation	3 (1.5%)	11 (6.2%)	11 (14.3%)	25 (5.4%)
Fully developed crown	5 (2.4%)	77 (43.3%)	19 (24.7%)	101 (22.0%)
Fully developed crown with root under formation	64 (31.2%)	65 (36.5%)	15 (19.5%)	144 (31.3%)
Fully developed tooth	133 (64.9%)	25 (14.0%)	32 (41.5%)	190 (41.3%)
Total	205 (100%)	178 (100%)	77 (100%)	460 (100%)

*Chi-squared test = 154.4, d.f. = 6, $P < 0.001$.

In our survey, it was observed that the majority of ST occurred in males with a male : female ratio of 2.1 : 1. Other studies confirm that the occurrence of ST is higher in boys[1,15–20]. Nonetheless, possible variation in gender ratios may be seen and could be related to ethnic factors or sample differences. Age of patients with ST ranges from 5 to 70; however, most cases are observed between 7 and 10 years[1,4,17,20,21]. Likewise, we found most cases among 9- and 10-year-old children and affecting the permanent dentition (97.6%). This is in agreement with Rajab and Hamdan[1], who verified that most patients were 9 and 10 years old. Importantly, these authors also studied a population of children and adolescents. We found that ST are found preferentially in the permanent dentition, as previously reported[22]. It is well established that ST are more frequently single tooth[1,4,6,8,12,14,17,19,21,23], while multiple ST appear frequently as two teeth.[1,4,6,12,14,17,19,21,23] Thus, this might be the first study describing patients developing 5, 7, 8 and even 9 ST in nonsyndromic patients.

Some care-seeking reasons have been described in the literature; however, they have not been measured[1,7]. Quantitatively, we observed that radiographic assessment was the main care-seeking reason, followed by ST eruption, failure of permanent teeth eruption, primary tooth clinical retention, and permanent teeth displacement. Two points are emphasized by our findings: (i) the usefulness of radiographic examination as a tool in ST diagnosis and (ii) clinical complications related to ST are one of the major reasons why patients seek care. Thus, radiographs should ideally be used in ST diagnosis and follow-up, as stated in the 'Prescribing Dental Radiographs for Infants, Children, Adolescents, and Persons with Special Health Care Needs Guidelines' of the American Academy Pediatric Dentistry[24].

Regarding location, the maxilla is well known to be the most frequent site of ST[1,6,12,25,26]. Similarly, we found 91.3% of the cases located in the maxilla, mainly in the premaxilla (86.7%). In addition, we verified that the mandibular incisor and canine regions are rare locations for the occurrence of ST.

When analysing eruption status, we found that 23.3% of the cases were erupted ST. Likewise, Rajab and Hamdan[1] found a 26.5% frequency of erupted ST. Similar frequencies have been reported by other authors[14,17]. It was verified that all erupted ST were normally orientated, more often supplemental-shaped and vertically positioned adjacent to the crown. As previously reported[1,27], we also observed that most tuberculate ST were not erupted and that teeth with supplemental morphology had a statistically significant higher eruption frequency. Liu[14] also showed that supplemental teeth had a higher frequency of eruption.

When assessing vertical position, we verified that erupted ST were more commonly vertically positioned adjacent to the crown. This was expected, since whenever ST eruption occurs, their location will be adjacent to the crown or to the incisal of permanent teeth. Although unerupted ST were more frequently positioned adjacent to the crown, they were also found positioned adjacent to the root and apex. In the case of unerupted ST, vertical position is especially important for optimal surgical management, since ST vertically positioned near the root or apex are potentially more difficult to be removed.

Conical shape was the most frequently observed morphology in our study, followed by tuberculate and supplemental shape. These results are in agreement with the literature. Other authors observed conical ST at frequencies varying between 31% and 75%, tuberculate between 12% and 28%, and supplemental between 4% and 33%.[1,12,14,17,18,21,25,28] Unerupted ST presented a similar frequency of conical, tuberculate, and supplemental shapes, whereas erupted ST were mainly supplemental, conical, and tuberculate, in that order. A possible explanation is that supplemental and conical morphologies facilitate ST eruption. Another finding was that fully developed ST more frequently had supplemental and conical morphologies – this complements the fact that all erupted ST were fully developed teeth, and that supplemental and conical ST were more frequently found erupted.

Our study showed that 84.1% of ST were placed in the palatal/lingual location, confirming findings by other authors showing between 54% and 89% of ST in the same position[1,19,21]. Sagittal position is an important feature when evaluating surgical access, thus directly related to management.

Liu[14], Primo *et al.*[12], and Rajab and Hamdan[1] state that ST are frequently normally orientated. In contrast, Tay *et al.*[4] studied unerupted maxillary anterior ST and observed that most cases are in an inverted position (77.6%). Similarly, Assaumi *et al.*[19] found that 67% of all mesiodens were in an inverted position. In contrast, in our study the inverted position was not the most frequently observed orientation. All supplemental ST were normally orientated, this finding being in accordance with eruption status. The normal position facilitates eruption of ST and, as seen in our study, erupted ST usually have a supplemental shape.

Development stage of ST has not been well described by other studies. In this study, 41.3% of the ST was fully developed. This suggests that the developmental stage of ST is directly related to eruption, considering that all erupted ST were fully developed, whereas unerupted ST occurred in various development stages. In addition, developmental stage may be linked to morphology, since fully developed ST were conical and supplemental, the shapes more frequently observed among erupted ST. Furthermore, it should be pointed out that developmental stage is important for surgical management of ST in the mandibular premolar region; ST found in this region must be preferentially removed at certain stages – namely, fully developed, fully developed crown with root under formation, and fully developed crown – since at these stages surgery will be easier. In contrast, ST with crown under formation are difficult to be removed surgically, which may lead to recurrence[29,30].

Clinical complications were seen in 88.5% of the patients with ST, with displacement and failure of eruption being the most frequent. Likewise, other authors have shown that displacement is a clinical complication frequently observed[1,4,5,7,12,13,17,19,22,23]. Moreover, a possible relationship between ST and other developmental anomalies, such as dens evaginatus and talon cusps, has been proposed. ST premolars appeared to be more prevalent in Chinese children with dens evaginatus than in the general population[31]. In addition, when there is a talon cusp on a primary maxillary lateral incisor, there is a high chance that the underlying permanent successors will exhibit a supplemental ST[32].

While analysing ST management approach, we verified that the most common treatment of choice was surgery followed by orthodontic therapy (62.0%). Surgical removal of ST is indicated whenever clinical or radiographic complications are found, a consensus in the literature[1,3,7,12,13,17,21,23]. In the case of ST in the premaxilla, optimal time for surgical intervention is when the patient is between 8 and 10 years old, when the lateral and central incisors are fully developed[1,4,5,17,21]. In addition, patients older than 8 years are also more receptive to surgical management under local anaesthesia and thus easier to manage. Since ST located in the mandibular premolar region frequently require lingual surgical access, surgery should be postponed until the patient is older. ST should ideally be surgically removed only when already fully developed, regardless of the morphology type. Accordingly, conical and supplemental ST, which are more frequently fully developed teeth, are easier to be surgically removed. Inverted teeth are

frequently apically positioned, thus requiring more complex surgery, with osteotomy and flap. In addition, in the case of apically positioned ST, the developmental stage of the apex of adjacent permanent teeth must be considered prior to surgical management. Indeed, Rao and Chidzonga[7] claim that ST extraction must be ideally performed only after the roots of adjacent permanent teeth have developed fully. In addition, Liu *et al*.[33] state that the comprehensive pictures in three planes provided by cone-beam computed tomography help surgeons determine the appropriate surgical approach, identifying the ST, and reducing the amount of surgical trauma on the adjacent hard and soft tissues. ST cases without any clinical complications are usually followed up. In this study, clinical follow-up was indicated for 13.4% of the patients. Whenever ST are surgically removed, clinical judgement should determine the need and type of radiographic images for evaluation and/or monitoring[24]. In our service, follow-up is performed annually.

What this paper adds

- This is one of the largest series of ST described in the English medical literature.
- The demographic profile of ST herein presented will be useful as baseline data for additional epidemiological information.

Why this paper is important to paediatric dentists

- Pediatric dentists should be able to detect ST as early as possible to avoid complications and guarantee successful management.
- Pediatric dentists should be aware that patients must be followed up on a long-term regular basis, even after definitive treatment of ST.

Acknowledgements

The authors thank Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) (484974/2006), Fundaçâo de Amparo à Pesquisa do Estado de Minas Gervais (FAPEMIG) (895/05) and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) for the financial support. R.A.M. gratefully acknowledges CNPq research fellowship. B.C.J. is supported by a doctoral scholarship from CNPq-Brazil (201590/2006-9).

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