Evaluation of Maxillary Supernumerary Teeth for Pediatric Dental Patients by Cone Beam Computed Tomography

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Abstract

Aim: The study is to evaluate the number, location and morphologic characteristics of pediatric supernumerary teeth in the maxilla using cone beam computed tomography (CBCT).

Materials and methods: There are 244 patients with a total of 328 supernumerary teeth examined by CBCT in the pediatric dental department of Chang Gung Memorial Hospital (CGMH), Taiwan between 2009 and 2013. Patient’s demographic data was collected, and the number, location, shape and eruption direction were analyzed.

Results: The age of patients ranges from 3 to 14 years with a mean age of 7.7 years. There are 66.39% of patients exhibited one single supernumerary tooth, while 33.20% had two and 0.41% had three supernumerary teeth. Male patients were more than females with a ratio of 3.7 : 1. Among these supernumerary teeth, 73.48% were located at palatal side and between the maxillary incisors. The conical shape was the predominant type (74.16%) and most axis was inverted (52.74%).

Conclusions: The occurrence of supernumerary teeth is mostly single, conical in shape and inverted. CBCT imaging provided significant and accurate information for pretreatment evaluation of supernumerary tooth.

Key words: Supernumerary tooth, Maxilla, Cone beam computed tomography, Impaction.

INTRODUCTION

Supernumerary tooth, also called hyperdontia, is defined as tooth in excess of the normal number of teeth\(^{1-3}\). Supernumerary tooth is sometimes unintentionally discovered
and diagnosed on a radiograph or as the cause of an impacted central incisor. The most common supernumerary tooth, which appears between the maxillary central incisors, is called a mesiodens. Approximately 90–98% of all supernumerary teeth are located in the anterior maxillary area. The etiology of supernumerary teeth remains unknown, but hyperactivity of the dental lamina is the most widely accepted cause of the development of supernumerary teeth\(^1\)\(^-\)\(^11\). Genetic and environmental factors are also believed to be an important etiological factor in the occurrence of supernumerary tooth\(^1\)-\(^3\),\(^6\),\(^8\).

The prevalence of supernumerary tooth ranges between 0.3–2.1% (0.3–0.8% in the primary dentition and 0.1–3.8% in the permanent dentition), and there is racial variation reported\(^2\),\(^3\),\(^9\),\(^11\),\(^12\). Supernumerary tooth has been reported to occur more frequently with a 2 : 1 ratio in men versus women\(^2\),\(^3\),\(^7\),\(^11\),\(^13\),\(^14\). Supernumerary tooth can be found in almost any region of the dental arch, but they are most commonly located in the anterior maxilla, followed by the mandibular premolar region\(^2\),\(^3\),\(^7\),\(^9\),\(^15\).

The presence of a single supernumerary tooth occurs in 76–86% of cases, two supernumerary teeth occur in 12–23% and only 1% of individuals have three or more supernumerary teeth\(^2\). Multiple supernumerary teeth are rare, and have been found in conjunction with diseases such as cleido-cranial dysostosis, Gardner’s syndrome, Fabry-Anderson’s syndrome or chondroectodermal dysplasia (Ellis-van Creveld syndrome), and cleft lips and palates\(^2\),\(^7\),\(^11\),\(^15\)-\(^17\).

Supernumerary tooth may induce disturbance of eruption, crowding, displacement, root resorption of adjacent teeth, or cyst formation\(^1\),\(^9\),\(^11\),\(^12\),\(^16\). The most commonly reported is delayed eruption of upper central incisors with or without diastema\(^2\),\(^4\),\(^9\).

Supernumerary tooth can remain asymptomatic. Most patients were diagnosed during routine clinical and radiographic examinations\(^3\),\(^9\),\(^17\). Accurately orientation of the supernumerary tooth is very important for diagnosis, treatment planning, and surgical removal\(^1\),\(^7\),\(^9\),\(^17\)-\(^19\). Traditional radiographic examinations such as periapical films, occlusal films, and panoramic films play important roles in locating tooth and identifying morphology\(^3\),\(^7\). However, these are limitations in 2–Dimensional (2D) images. On the contrary, computed tomography (CT) can provide 3–Dimensional (3D) views of supernumerary tooth in all standard planes\(^3\),\(^20\),\(^21\). Nevertheless, there are disadvantages in conventional CTs, such as metal artifacts, limited resolution capacity, relatively high costs and high radiation doses. Thus, conventional CTs are not an ideal tool for imaging the details of supernumerary tooth\(^17\),\(^18\),\(^22\).

An alternate method, Cone Beam Computed Tomography (CBCT) can provide more details on the 3D relationship of supernumerary, adjacent teeth and neighboring structures without superimpositions\(^17\),\(^18\),\(^20\)-\(^23\). Other benefits of CBCT include volumetric data acquisition with relatively fast scan time, digital data saving, navigation opportunities, high image definition and resolution for all views\(^17\),\(^18\),\(^20\),\(^21\). CBCT has also been widely used in implant surgeries, endodontic surgeries, jaw bone fractures, craniofacial anomalies, maxillofacial neoplasm, temporomandibular reconstruction, and impaction teeth\(^18\)-\(^20\),\(^23\).

The management of supernumerary tooth depends on their position, type, and effect on adjacent hard and soft tissues. The physician must obtain a precise preoperative assessment
to choose the appropriate surgical approach and avoid iatrogenic damages to neighboring anatomical structures, especially developing permanent tooth buds that are adjacent to supernumerary tooth in pediatric patients\textsuperscript{17-20}. The aim of this study is to evaluate the characteristics of supernumerary tooth using cone beam computed tomography in a hospital-based pediatric dental clinic.

**MATERIALS AND METHODS**

The retrospective study was conducted in the pediatric dental department of Chang Gung Memorial Hospital (CGMH) during 2009 and 2013. There were 244 patients included with maxillary supernumerary teeth previously diagnosed with conventional radiography. All patients were evaluated by CBCT for orientation. The data of the supernumerary tooth were assessed by the same senior dentist (TY, the first author). The study was approved by the Human Research Ethics Committee of CGMH. (IRB number: 103-7052B)

The CBCT device used in the study was i-CAT\textsuperscript{\textregistered}, imaging Sciences International, Hatfield, PA USA. The CBCT consists of a standard high-frequency fixed anode X-ray tube (120 kVp, 3–8 mA) and 20 x 25 cm amorphous silicone (a-Si) flat panel image detector, and uses a cone-shaped x-ray collimator with a 15-degree aperture centered on an x-ray area detector. It acquires raw data with a single, 20-second, and 360° rotation around the patient’s head (child). The x-ray emission time was 3.5 seconds. A reconstruction time of 1 minute was applied. The voxel size was 0.25 mm. The radiation dose of 10 seconds scan was 34 uSv.

The age and the gender of the patient were collected and analyzed. The characteristics of supernumerary teeth listed below were assessed and analyzed using the Windows Excel and SPSS 19.0 statistical package (SPSS Inc., Chicago, Illinois, USA).

- 1. Number of teeth: one, two, or more than three supernumerary teeth.
- 2. Bucco-palatal position: labial/buccal, median/within arch, or palatal/lingual.
- 3. Type of supernumerary teeth: mesiodens, central incisors (labial/palatal to central incisors), lateral incisors, other. (Fig. 1)
- 4. Eruptive direction: normal vertical, inverted, horizontal. (Fig. 2)
- 5. Shape of teeth: conical, tuberculate, supplemental, odontoma\textsuperscript{1,16}. (Fig. 3)
- 7. Disturbance of eruption: primary dentition (primary dentition and all adjacent permanent teeth near the supernumerary teeth are unerupted), uneruption (other anterior permanent teeth have erupted and only the tooth near supernumerary teeth shows delayed eruption or impact due to supernumerary teeth), malposition (the supernumerary teeth induce adjacent teeth malposition as diastema or crowding), no disturbance.

**RESULTS**

**Patient characteristics**

Among the 244 patients, 192 (78.69\%) were male and 52 (21.31\%) were female. The ratio of the gender is 3.7 : 1 (male/female). The age of the patients ranged from 3 to 14 years with a mean of 7.7±1.65 years. Most of the patients (86/244, 35.25\%) were 7 years old with 183 patients between 6 to 8 years old (75.00\%) (Fig. 4).
Fig. 1. Type of supernumerary teeth.
(a) mesiodens.
(b) central incisors (palatal to central incisor).
(c) *mesiodens, #lateral incisor.

Fig. 2. Eruptive direction. (a) normal vertical. (b) inverted. (c) horizontal.
(d) *inverted, #horizontal.
Fig. 3. Shape of teeth.
(a) conical.
(b) tuberculate.
(c) supplemental.
(d) odontoma.
(e) *supplemental,#tuberculate.

Fig. 4. Age distribution of the patients.
**Supernumerary tooth**

1. Number of teeth:

Table 1 shows the gender of the patients and number of supernumerary tooth. There were 328 supernumerary teeth with an average of 1.34 teeth per patient. 162 (66.39%) patients had one supernumerary tooth, 81 (33.20%) patients had 2 supernumeraries, and only one had three (0.41%).

2. Bucco-palatal position:

The position, type, eruptive direction, shape, eruptive states of supernumerary tooth and the disturbance of eruption were summarized in Table 2. There were 241 supernumerary teeth on the palatal/lingual side (241/328, 73.48%), 71 were in median position within the arch (21.65%),

<table>
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<th>Table 1. Gender of the patients and number of supernumerary teeth</th>
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<th>Number of supernumerary teeth</th>
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<tr>
<td>1</td>
<td>162</td>
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<td>2</td>
<td>81</td>
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<th>Table 2. Position, type, eruptive direction, shape, eruptive states of supernumerary tooth and the disturbance of eruption.</th>
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<td><strong>Bucco-palatal position</strong></td>
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<td><strong>Type of the supernumerary tooth</strong></td>
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<td>Mesiodens</td>
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<td>Central incisor</td>
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<td>Near nasal floor</td>
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<td>Nasal cavity</td>
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<td><strong>Eruptive direction</strong></td>
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<td>Odontoma</td>
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<td><strong>Shape</strong></td>
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<td><strong>State of eruption</strong></td>
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<td><strong>Disturbance of eruption</strong></td>
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<td>Primary dentition</td>
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<td>No disturbance</td>
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<td>Uneruption</td>
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and 16 were on the labial/buccal side (4.88%).

3. Type of supernumerary teeth:
The most common type of supernumerary tooth was mesiodens (170/328, 51.83%), followed by labial/palatal to central incisors (124/328 37.80%), then lateral incisors (28/328, 8.54%). There were another 5 teeth just beneath the nasal floor and 1 in the nasal cavity.

4. Eruptive direction:
The position of the supernumerary tooth was inverted: 52.74% (173/328), horizontal: 25.00% (82/328), and normal vertical: 21.04% (69/328). The remaining 4 (1.52%) were odontoma.

5. Shape of teeth:
Conical supernumerary was the most common type. 244 out of 328 teeth (74.16%) were conical, followed by 50 tuberculate (15.24%), 30 supplemental (9.12%), and only 4 odontoma (1.52%).

6. State of eruption:
There were 294 (89.63%) of the supernumerary teeth unerupted and 34 (10.37%) were erupted.

7. Disturbance of eruption:
The most common local disturbances on adjacent teeth were displacement of neighboring permanent incisors, causing diastema and crowding of dentition (107/328, 32.62%). There were 84 (25.61%) supernumerary teeth in primary dentition and all adjacent permanent teeth near the supernumerary teeth unerupted. Seventy-two (21.95%) supernumerary teeth had no disturbance to nearby teeth. Sixty-five (19.82%) caused only the adjacent teeth delayed eruption or impacted and other anterior permanent teeth have erupted.

**DISCUSSION**

The number, location, prevalence, shape, and disturbances of teeth adjacent to maxillary supernumeraries in 244 patients were assessed by CBCT. The prevalence of supernumerary teeth, or hyperdontia of the permanent dentition ranges from 0.1% to 3.8% in the Caucasian\(^\text{17}\), whereas a higher prevalence, ranging from 2.7% to 3.4%, has been reported in the Asian. Previous studies have reported sexual dimorphism\(^7\), with males being more common. The male-to-female ratio in Caucasians varies from 1.3–2.5 : 1\(^7, 17\). In the present study, the male:female ratio was 3.7 : 1, which is less than the reported 5.5 : 1 for Japanese children and 6.5 : 1 for Hong Kong children\(^17, 24\). This gender disparity may be due to racial or sampling differences. Kinirons’ study of unerupted premaxillary supernumerary teeth reported no significant gender distribution in primary supernumerary teeth; however, males were affected approximately twice as often as females in permanent dentition\(^13\). CBCT was mostly utilized to evaluate the orientation and plan the appropriate surgical approach. In the study, most of the patients were in the mixed dentition stage. Our results provided the precious information about the prevalence of supernumerary tooth, their positions, types, eruptive direction, shapes, states and disturbances of eruption. The study can be specifically referred to the clinic for further diagnosis and management of supernumerary tooth, especially in the children that we should meticulously plan and perform the operation due to the tiny anatomy and sensitivity of nearby tooth bud.

The occurrence of supernumerary teeth may be single or multiple, unilateral or bilateral, erupted or impacted, and in one or both jaws\(^2\). Multiple supernumerary teeth rarely occur, but more than 20 syndromes and developmental abnormalities have been found in association
with an increased prevalence of supernumerary teeth, including cleft lip and palate, cleidocranial dysplasia, and Gardner syndrome\(^2,\,7,\,11,\,15-17\). In our study, 66.39% of patients had one supernumerary tooth, 33.20% had 2 supernumerary teeth and only 1 (0.41%) patient had 3 supernumerary teeth. The patient with 3 supernumerary teeth did not suffer from those syndromes associated with predisposition to supernumerary teeth. The occurrence of multiple supernumeraries (3 or more) in this study was less than reported by Eilberman et al. and Rajab and Hamdan\(^7\).

In our investigation, 241 teeth (73.48%) were located in the palatal side, 71 teeth (21.65%) were in median position within arch, and 16 teeth (4.88%) were located at the buccal side. According to a recent CBCT study by Mossaz et al, 49% of the mesiodens were located at palatal side, whereas 46.9% were within arch and 4.1% were at buccal region\(^3\). This difference in results may be a racial variation.

According to the transaxial sagittal tomography and 3D images, the sagittal location of the supernumerary teeth in the anterior maxillary area was clearly assessed. The most common type of supernumerary was mesiodens (51.83%), which are located between the maxillary incisors. This confirms the previous conventional radiographic studies in which mesiodens accounted for approximately 45–67% of all supernumerary teeth\(^17\). In our study, five teeth (1.52%) were found to be in intimate contact with the cortex of the nasal cavity. CBCT utilization improves the diagnosis and treatment plan for high-situated supernumerary tooth because it provides better visualization in 3D planes and in relation to neighboring structures, which is important for an accurate surgical intervention.

The direction and inclination of supernumerary tooth are usually categorized as normal, inverted, and horizontal\(^9,\,14\). More than 52% of the supernumeraries in this study were the inverted type, corroborating the data previously reported\(^2-3,\,6,\,7,\,10\). In a study of Mossaz et al, normal or inclined vertical position (61.4%) was the most common. A possible explanation for differences in results is that some erupted supernumerary teeth were diagnosed with conventional radiography and were extracted and therefore not referred for CBCT evaluation.

Four different morphological types of supernumerary teeth have been described: normal (or supplemental), conical, tuberculate and odontoma\(^3\). In this study, conical shape was the predominant type (74.16%), followed by tuberculate (15.24%), normal (9.12%), and odontoma (1.52%). Koch et al reported a 56% incidence of conical–shape supernumerary teeth, 12% tuberculate, 11% normal–shaped, and 12% of other configurations among their group of patients using radiographic detection\(^25\). Liu et al studied supernumerary teeth among 487 Chinese cases using CBCT had similar findings\(^17\). Conical shaped supernumerary teeth are generally located between the central incisors. Due to its shape and position, this type of supernumerary tooth may not cause delayed eruption of other teeth, but often causes malpositioning\(^3,\,17-21\).

### Conclusion

The study revealed that supernumerary teeth occurred most often in the anterior maxilla and was conical in shape. CBCT provided three-dimensional images showing the type, shape, and position of the supernumerary tooth as well as its relation to the adjacent dental and bony structures. CBCT analyses provide a more
precise location and aid in better treatment planning for the surgical intervention of supernumerary teeth.

REFERENCES

18. Kim KD, Ruprecht A, Jeon KJ, Park CS. Personal computer-based three-dimensional computed tomographic images of the teeth for evaluating supernumerary or ectopically
以錐狀射束電腦斷層分析兒童上顎贅生齒之特徵

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摘要
本研究目的為利用錐狀射束電腦斷層分析上顎區贅生齒之數目、位置、外型等特徵。

研究對象為林口長庚醫院牙科2009~2013年間因贅生齒並且因治療為目的拍攝電腦斷層之244位病患，共328顆贅生齒。蒐集病患基本資料及贅生齒數目、位置、形狀及萌發方向，將資料整理並分析。

研究結果顯示病患年齡介於三到十四歲之間，平均年齡為7.7歲。66.39%病患有一顆贅生齒，33.20%有兩顆贅生齒且0.41%有三顆。男性較好發，男女比為3.7：1。73.48%是位於顎側並且最常見於兩顆正中門齒之間。圓錐狀最常見(74.16%)且大部分是反向萌發(52.74%)。

贅生齒大多是單一顆，圓錐狀且反向萌發。錐狀射束電腦斷層可以在術前提供贅生齒高解析且準確的位置，幫助我們進行治療。

關鍵詞：贅生齒，上顎，錐狀射束電腦斷層，阻生。