

# Cone beam CT and stereolithographic model in primary dentition

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## Abstract

There are many recognized dental anomalies, among the least common being the “triple tooth”, with a prevalence of 0.02% in the primary dentition. However, such malformation can more easily lead not only to carious pathology, due to dental dysmorphisms, and pulpal lesions, but also to rhizalysis and agenesis of the permanent elements, causing eruption alterations and malocclusions. Therefore, techniques such as CBCT and 3D anatomical replicas have been proposed to be able to study complex clinical situations such as the triple tooth in its entirety, in order to analyze anatomical structures and identify the best treatment plan. In this paper we propose a clinical case of a triple tooth in a 6-year-old child in the left mandible with fusion of incisor with a supernumerary tooth associated with the lateral incisor fusion.

**Keywords:** Cone Beam; Stereolithography; Orthodontics; 3D printing.

## Introduction

Teeth malformations can be classified in size abnormalities (microdontics and macrodontics), shape (such as dens in dente, dens invaginatus, fusion or gemination), number (such as agenesis, oligodontia, hypodontia or hyperodontia), position (ectopia, heterotopia or transposition) or structure (dysplasia and hypoplasia). Primary dentition abnormalities are frequently pathogenetic of cosmetic and functional, transient or permanent problems such as abnormal eruption or development of the permanent teeth either in the chronology or site of eruption.

“Double teeth”, resulting from fusion or gemination, are relatively frequent with an incidence between 0.1% and 1.55%<sup>1</sup>, while the union of the three teeth, or “triple tooth” is rarely reported in the primary dentition<sup>2-7</sup>. The etio-

pathogenesis of triple tooth can be traced to fusion, gemination or concrescence<sup>5</sup>. Bennett described the first case in the late 1880s<sup>6</sup> and only five cases were reported until 1984 when Knapp and McMahon reported one case and reviewed the topic<sup>2-5</sup> and coined the term describing this anomaly in children. Shilpa and Nuvvula<sup>8</sup> proposed the first classification<sup>9-11</sup> recognized by the international scientific community:

- Type I: three pulpal chambers and three root canals due to fusion:
  - Type Ia: fusion of two normal teeth with one supernumerary tooth;
  - Type Ib: fusion of three normal teeth.
- Type II: two pulpal chambers and two root canals:
  - Type IIa: a combination of a twin tooth (double tooth) and a supernumerary tooth;
  - Type IIb: one twinned tooth (double tooth) and one normal tooth.

In order to study complex dental situations, 3D printed anatomical replicas, already widely used in other medical fields (such as orthopedics, cardiac and oncologic surgery, neurosurgery and transplants), have been proposed. Thanks to stereolithography (SLA), an additive manufacturing technology<sup>12</sup> anatomical structures visible in radiological images can be reproduced<sup>13</sup>. The latest technologies can be useful to study complex preoperative treatment plans, reducing surgery duration with fewer complications using intra-operative surgical guides, improving doctor-patient communication and reducing medical-legal conflicts<sup>14</sup>. SLA would also find a wide horizon in the medical training for simulation techniques. Bioprinting<sup>15</sup> represents the desirable advancement of such technology, with no longer anatomical replicas in resin but in tissues and/or organs created “ad personam,” starting from the same cells as the recipient individual.

This paper aims to make an accurate grading of the triple tooth anomaly and obtain a complete anatomical and morphological evaluation for a correct prognosis and a suitable treatment plan minimizing iatrogenic risks. The clinical oral examination alone is not adequate for a correct and complete treatment program, while CBCT radiodiagnostic techniques,

## Methods

We report a case of “triple tooth” of a 6-year-old child in the left mandible (fusion of incisors with supernumerary tooth) associated with the lateral incisor succedant fusion. The patient was evaluated in the Department of Surgical and Biomedical Sciences, Section of Orthodontics and Reconstructive Dentistry. History of trauma or special pathology and family history were not relevant. Examination showed irregular tooth morphology in the patient’s anterior region, and there was fusion of the left

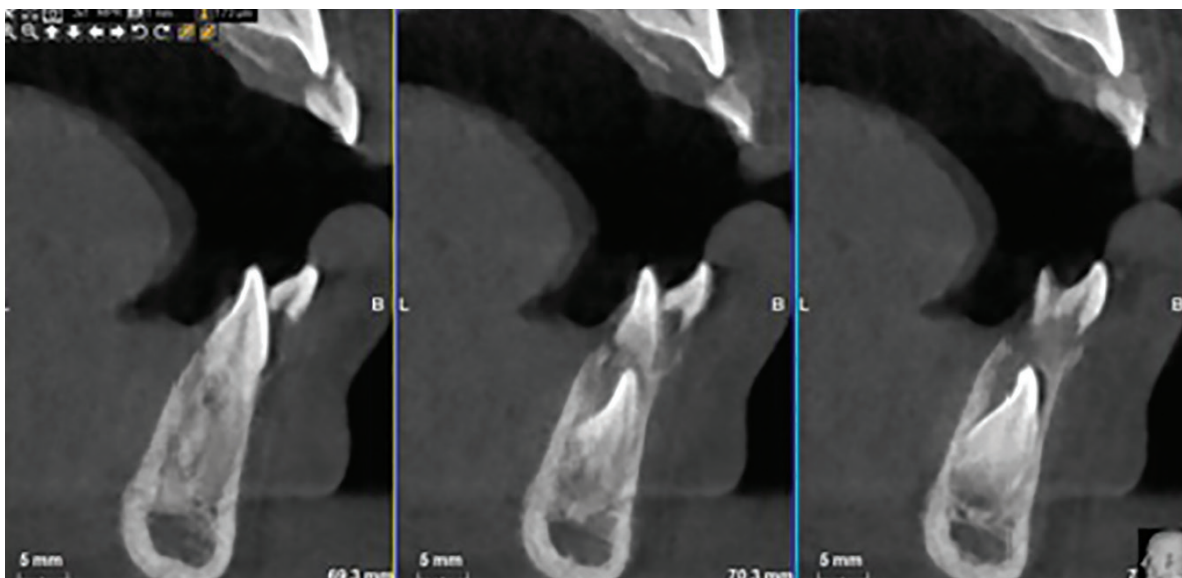
maxillary central incisor with a supernumerary tooth and of this with the lateral incisor (Figure 1). The fused teeth were caries-free, the succedant tooth 3.1 was partially erupted but placed in a lingualized location. Based on the clinical and radiological features, we can describe our present case as Type IIa according to the classification of Shilpa and Nuvvula<sup>8</sup>, a case of fusion of two normally developed teeth with a supernumerary tooth and an endodontic anatomy characterized by two pulpal chambers and two root canals. The remaining primary teeth in both arches were normal. Periapical radiography revealed fusion of the central and supernumerary tooth with the deciduous lateral incisor without a clear distinction of the root canal in the supernumerary tooth with the central canal. A cone beam CT scan was performed to make a prognostic assessment of the subsequent clinical picture and to evaluate the correct presence of the permanent elements, their morphological structure, and the relationships between the triple tooth roots and the permanent tooth buds in relation to the planning of the triple tooth extraction (Figure 2).

## Results

CT scan enabled a 3D reconstruction that highlights various anatomical structures, such as the course of the inferior alveolar nerve and the site of the chin foramen and the realization of the stereolithographic replica (Figure 3). The parents were informed about the abnormality of the triple tooth and reassured that element 3.1 was erupting and already visible in the arch, even if lingualized, and the germ of lateral incisor 3.2 was developing normally. Considering the clinical examination and the CT findings, the triple tooth was extracted. Parents were also made aware of the concomitant problems and advised to perform regular follow up, consult an orthodontist for potential eruption alterations. The dysmorphism of the tooth can make it more subjected to carious lesions, with possible pulpopathy-related problems that may interfere with permutation, inducing malocclusion or agenesis of the permanent succedant as reported in the literature <sup>5,6,10,11,16</sup>. The examinations showed a physiological rhizolysis, the presence of permanent tooth 3.2, and sufficient distance



**Figure 1.** Triple tooth in the left mandible with a fusion of incisor and a supernumerary tooth associated with the lateral incisor succedant fusion.



**Figure 2.** Cone beam CT scan of the triple tooth.



**Figure 3.** Anatomic replica of the 6-years-old child mandible situation.

between the roots of the triple tooth and the underlying permanent teeth; this allowed us to confidently schedule the extraction of the pathological element without any complications. At the follow-up visit one month after the extraction, the soft tissues were in good trophic condition and 3.1 had spontaneously repositioned in the arch.

## Discussion

The few cases reported does not allow a meaningful assessment, but it can be stated that the prevalence of triple teeth in the primary dentition is rare (0.02%)<sup>2</sup> and more frequent in the male sex and Asian populations as reported by M. Lagarde et al.<sup>17</sup> stating how “triple tooth” is more frequent in males than females (2:1), and that the age of affected children ranged from 1 year and 11 months to 10 years (mean age 4.9 years). Regarding the site, maxillary triple teeth are more common than mandibular ones<sup>18</sup>. There is a preponderance in the left side compared to the right side (4:3), while Shultz-Weidner also reported the presence of a bilateral maxillary triple tooth<sup>11</sup>. Few cases in the literature evaluated the anatomy of chamber and root endodontium, however Knapp and McMahon described how each tooth element of the triple tooth possessed its own root canal but converged into a shared chamber<sup>4</sup>. Deepti et al.<sup>16</sup> presented a case in which the pulpal canals of 6.2 and a supernumerary tooth are largely fused with an hourglass figure, the canal of 6.1 is deformed and a communication or otherwise dysplasia of dentin between 6.1 and the supernumerary can be glimpsed. Aguilo L. et al.<sup>10</sup> in a CT histology and morphology study of a triple tooth highlighted an endodontic anatomy showing three autonomous pulpal chambers whose canals however merge into a single canal within the three fused roots. Other Authors have described cases of fused crowns and roots presenting three separate

but progressively fused endodontic units at the apex<sup>19</sup>. It is clear that the presence of an apical lesion makes endodontic therapy very hostile, considering endodontic variability and dysmorphisms, orienting therapy toward extraction<sup>20</sup>. It should be noted that the literature concordantly reported a high prevalence of agenesis of replacement permanents<sup>8,9,19,21</sup>, this leads to the fact that it is essential to perform a CBTC examination in order to make a correct prognostic and identify a suitable treatment plan.

Currently, there is no agreement among researchers on the mechanism by which triple dentition develops. Some believed that it is the derivation of three dental buds of the primary dental lamina fused together<sup>6,8</sup>, however, most cases described a union between a supernumerary tooth and the central or lateral incisor. Additional hypotheses are related to gemination events associated with fusion of primary and secondary lamina and the high prevalence of permanent tooth agenesis<sup>5,8,19,22</sup>. Performing a CBTC is essential for a 3D and/or stereolithographic reconstruction of the loco-regional situation in order to assess not only the size of the roots and the resulting anatomical relationships with the bud of the underlying permanent, but also potential agenesis and rhizalysis<sup>23</sup>. With these information an intervention can be planned, which may include an immediate extraction or a period of observation using preventive techniques, fluoroprophylaxis and topical fluoride therapy of dysmorphic grooves<sup>9,24,25</sup>. However, triple-tooth cases require collaboration between conservative dentist, orthodontist and oral surgeon to achieve a complete resolution and avoid cosmetic and functional complications<sup>26,27</sup>.

## Conflict of Interest Statement

None Declared.

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