

Identification of Supernumerary Teeth in 2D and 3D: Review of Literature and a Proposal

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Abstract: Supernumerary teeth occur in both syndromic and nonsyndromic patients, and dental professionals are likely to encounter such teeth in their professional careers. There are three main numbering systems used to identify teeth today: the Universal/National, the Palmer/Zsigmondy notation, and the Federation Dentaire Internationale (FDI) numbering systems. However, a review of the literature suggests that none of these three consistently addresses the identification of supernumerary teeth. Being able to communicate the location of supernumerary teeth is important for dental professionals, especially in interdisciplinary situations. This article proposes a guideline to locate and identify supernumerary teeth in two and three dimensions, which may reduce treatment errors and improve communication among health care providers and third-party administrators.

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Supernumerary teeth occur in addition to the normal dental formula of one central incisor, one lateral incisor, one canine, two premolars, and three molars in each quadrant of the oral cavity.^{1,2} It is important to realize that supernumerary teeth can occur concurrently with hypodontia, and thus a surplus can also be accompanied by the deficit of other teeth.^{3,4} For example, thirty-two permanent teeth may be present with five lower incisors and only three lower premolars.⁵ Supernumerary teeth may occur singly, in multiples, unilaterally, or bilaterally, and in one or both jaws.^{2,6-8}

The prevalence of permanent supernumerary teeth varies depending on geographic locations and ranges from 0.5 to 5.3 percent.^{2,6,8-10} The prevalence of supernumerary teeth and their frequent occurrence^{8,11} imply a good chance that a dental professional will have to treat or make a decision regarding (an) extra tooth/teeth. Males are affected more than females at a frequency of approximately 2:1^{2,7,9,12} and as high as 5.5-6.5:1 in Asians.¹⁰ Multiple supernumerary teeth

are usually observed in patients with developmental disorders, such as cleft lip and palate, cleidocranial dysplasia, Ehlers-Danlos type IV, Ellis-Van Creveld, Fabry disease, familial adenomatous polyposis (formerly known as Gardner's syndrome), and incontinentia pigmenti.^{9,13,14} In contrast, nonsyndromic or nondiseased patients with multiple supernumerary teeth are rare.^{2,6,7,9,12}

The etiology of supernumerary teeth is still uncertain, perhaps because there are multiple mechanisms. Most cases of supernumerary teeth are isolated,^{6,15,16} although familial trends are not rare.^{6,7,12,17} Several researchers suggest that the overproliferation or prolonged survival of dental lamina epithelial cells may cause supernumerary teeth.^{2,15,16,18} Another possible origin for supernumerary units, according to the tooth germ dichotomy theory, is a division of dental lamina occurring during odontogenesis and resulting in multiple teeth.²

Supernumerary teeth can be classified based on their morphology and generally fall into one of

the following types: conical type, tuberculate type, molari-form, supplemental teeth, and odontomas.^{19,20} Commonly known as mesiodens, the conical types are usually found approximating the upper anterior midline between the central incisors. The tuberculate types have more than one cusp or tubercle and are usually barrel shaped. The molari-form types have complete root development and occur singly or in pairs.²⁰ A supplemental tooth is not rudimentary in shape or size and presents as a duplicate of a normal tooth.¹² An odontoma implies a tumor of odontogenic origin (hence, some do not accept odontomas as supernumerary teeth), but most authorities agree that it is a hamartomatous malformation of tooth structure rather than a true neoplasm.¹⁹

Another way to classify supernumerary teeth is by their location: mesiodens (maxillary anterior incisor region), para-premolars (Figure 1, A), paramolars (B), and disto-molars (C). Disto-molars are special cases of supernumerary teeth due to their location distal to the third molars.²¹⁻²⁴ Some authors do not adhere to this guideline strictly and consider a supernumerary molar that is occlusal to the third molar to be a disto-molar.^{11,25,26} The supernumerary tooth labeled C in panel C of Figure 1 appears to have been a disto-molar that has erupted to the occlusal of the adjacent third molar. Fourth disto-molars are relatively common,^{1,11,12,15,21,24,27-36} but fifth and sixth disto-molars are rare; nonetheless, several cases have been reported.^{1,26,27,37} The scientific literature is devoid of any reports of seventh disto-molars and beyond in the human dentition.

Dental health professionals are taught numbering of the normal permanent dentition in one of three systems: the Universal/National, the Palmer/Zsigmondy notation, and the Federation Dentaire Internationale (FDI) numbering systems. However, there is no consensus among these systems as to how to identify permanent supernumerary teeth. This may lead to confusion and delay when trying to communicate with fellow dental professionals regarding a patient's care. Not only is there is no consensus on the identification of supernumerary teeth, but many of the symbols or notations used with them are vague and not specific enough. Several basic principles should be kept in mind when identifying supernumerary teeth. They should be 1) easy to understand and teach, 2) easy to pronounce in conversation, 3) readily communicable in print, 4) easy to translate into computer input, and 5) easily adaptable to standard charts used in the dental practice.^{38,39} In the past, dental organizations such as the American Dental Association

(ADA) and the FDI have discussed and implemented proposed guidelines for the profession through the decisions made in the House of Delegates⁴⁰ and a special committee,⁴¹ respectively.

When a decision is made to implement a proposed guideline, such as the one proposed in this article, an efficient way to educate student dentists in identifying supernumerary teeth is to introduce the guideline while they are learning a tooth numbering system. In this article, we propose identifying supernumerary teeth of the permanent dentition in a clearer fashion, thereby facilitating better communication in interdisciplinary dental care and with third-party administrators.

Universal/National Tooth Numbering System

The Universal/National numbering system has been adopted by the ADA and is used by most dental professionals in the United States today.³⁸ The maxillary arch is numbered from #1 through #16 (from the patient's right to left and from third molar to third molar). The mandibular arch is numbered from #17 through #32 (from the patient's left to right and from third molar to third molar). Many dental professionals use the Universal/National Tooth Numbering System and add a letter (such as an "a," "A," or "S") to the parent tooth number to denote supernumerary status. While using letters to identify supernumerary teeth can be easy to understand, these may sometimes cause confusion in certain situations where "S" may be confused with the number "5," especially in written form.

To alleviate some of these issues, some third-party administrators⁴² choose to use a numbering sequence called the Universal Supernumerary Tooth Numbering System for permanent teeth from #51 through #82 to complement the Universal Tooth Numbering System. The numbering of supernumerary teeth from #51 to #82 (fifty-one through eighty-two) is arguably simple to understand but does not resolve the issue of multiple supernumerary teeth within the proximity of a single parent tooth. Furthermore, we suspect that most practitioners would rather not memorize an additional set of numbers.

We propose adding a letter or a digit to the Universal Tooth Numbering System (#1-32) to identify the supernumerary tooth (Table 1). For example, a maxillary left para-molar at the #15 position would

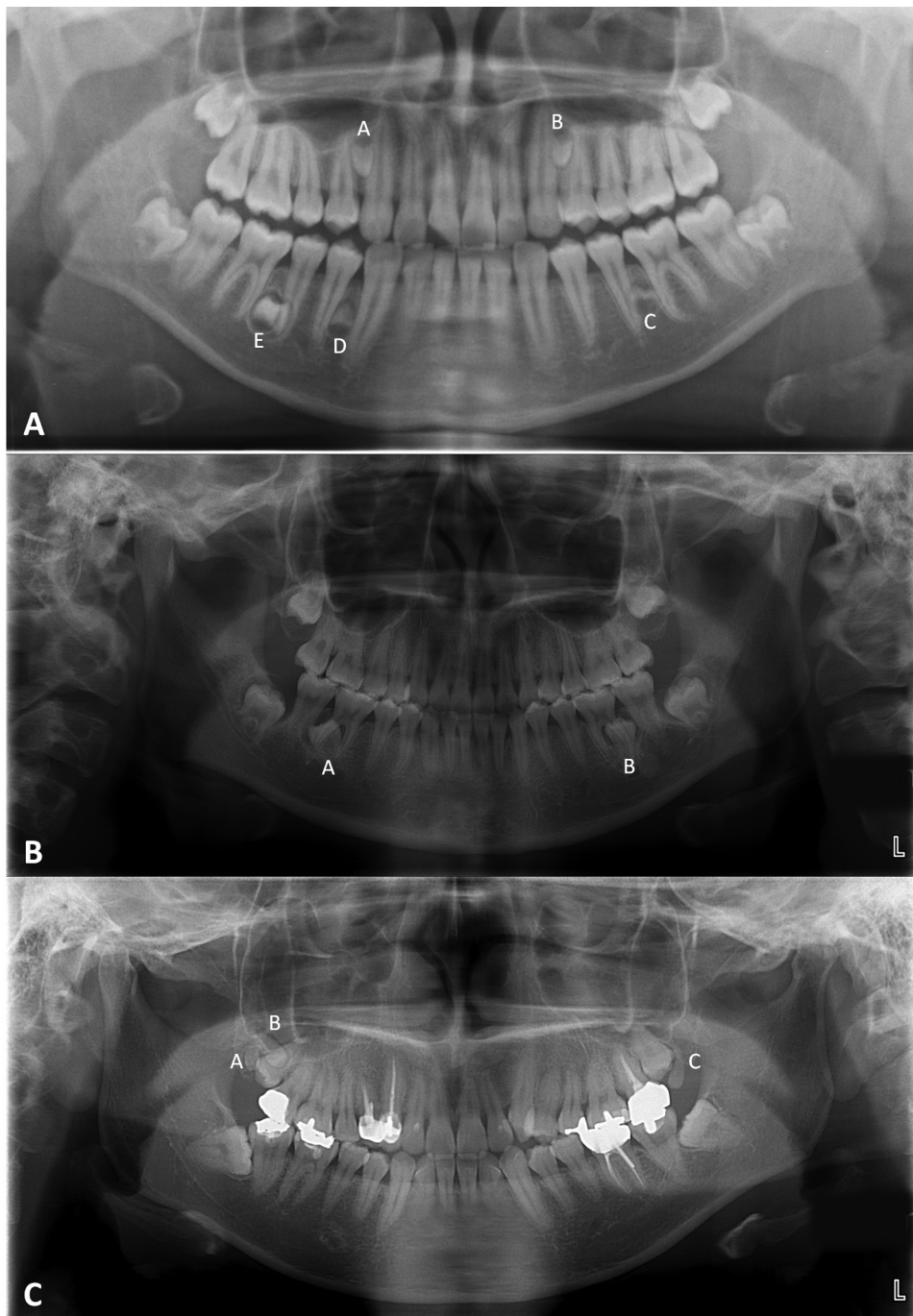


Figure 1. Para-premolars (A), para-molars (B), disto-molars (C): alphabets denote location of permanent supernumerary teeth, not the Universal Numbering System for primary teeth

Table 1. Proposed supernumerary tooth identification for the three systems

	Right								Left							
	1.A	2.A	3.A	4.A	5.A	6.A	7.A	8.A	9.A	10.A	11.A	12.A	13.A	14.A	15.A	16.A
A. Universal																
Supernumerary Maxillary	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Normal Maxillary																
Normal Mandibular	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
Supernumerary Mandibular	32.A	31.A	30.A	29.A	28.A	27.A	26.A	25.A	24.A	23.A	22.A	21.A	20.A	19.A	18.A	17.A
B. Palmer																
Supernumerary Maxillary	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
Normal Maxillary																
Normal Mandibular	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
Supernumerary Mandibular	8.A	7.A	6.A	5.A	4.A	3.A	2.A	1.A	1.A	2.A	3.A	4.A	5.A	6.A	7.A	8.A
C. FDI																
Supernumerary Maxillary	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Normal Maxillary																
Normal Mandibular	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
Supernumerary Mandibular	48.A	47.A	46.A	45.A	44.A	43.A	42.A	41.A	31.A	32.A	33.A	34.A	35.A	36.A	37.A	38.A

Note: For practical purposes, the periods may be dropped; multiple supernumerary teeth will be identified in sequential fashion: A, B, C or 1, 2, 3, etc.

be designated #15.A (read as “fifteen-A”) or, alternatively, #15.1 (read as “fifteen-one”). Also acceptable would be lower-case letters identifying supernumerary teeth (i.e., a, b, c, etc.). For multiple supernumerary teeth within the proximity of a single parent tooth, the extra letter or digit complementary to the Universal numbers will be designated in a sequential fashion (Figure 2). For example, if there are three extra teeth within the proximity of a mandibular right first premolar, then the supernumerary teeth would be called #28.A, #28.B, and #28.C (alternatively, #28.1, #28.2, and #28.3). Disto-molars would be identified as the supernumerary designation of the respective third molars. For example, mandibular left fourth, fifth, and sixth disto-molars would be identified as #17.A, #17.B, and #17.C, respectively (or, alternatively, #17.1, #17.2, and #17.3).

Palmer/Zsigmondy Tooth Notation System

Many orthodontists, pedodontists, and oral surgeons use the Palmer Notation Numbering System. The mouth is divided into four sections called quadrants. The numbers 1 through 8 and a unique symbol are used to identify the teeth in each quadrant. The numbering runs from the center of the mouth to the back.

Yusof⁴³ used a regional quadrant Palmer-style notation (A for anterior, PM for premolar, and M for molar) to approximate the location of the supernumerary tooth. Ferguson⁴⁴ suggested using special symbols for supernumerary teeth in the Palmer/Zsigmondy Notation System. Acton²⁷ used the numbers 9, 10, and 11 to denote fourth, fifth, and sixth disto-molars, respectively, but did not have a special designation for a supernumerary premolar, describing it instead as “supernumerary 5” in the Palmer/Zsigmondy Notation System. Similarly, Wood²⁶ and Fisher³⁷ used the Palmer/Zsigmondy Notation System to describe the fourth and fifth molars as 9 and 10, respectively.

For simplicity, we propose adding a letter or digit to the Palmer/Zsigmondy notation to identify the supernumerary tooth. For example, a mandibular right supernumerary at the second premolar position would be called lower right 5.A (read as “lower right five-A”) or lower right 5.1 (read as “lower right five-one”) (Table 1). Multiple supernumerary teeth within the proximity of a single parent tooth would be designated with sequential letters or digits (Figure

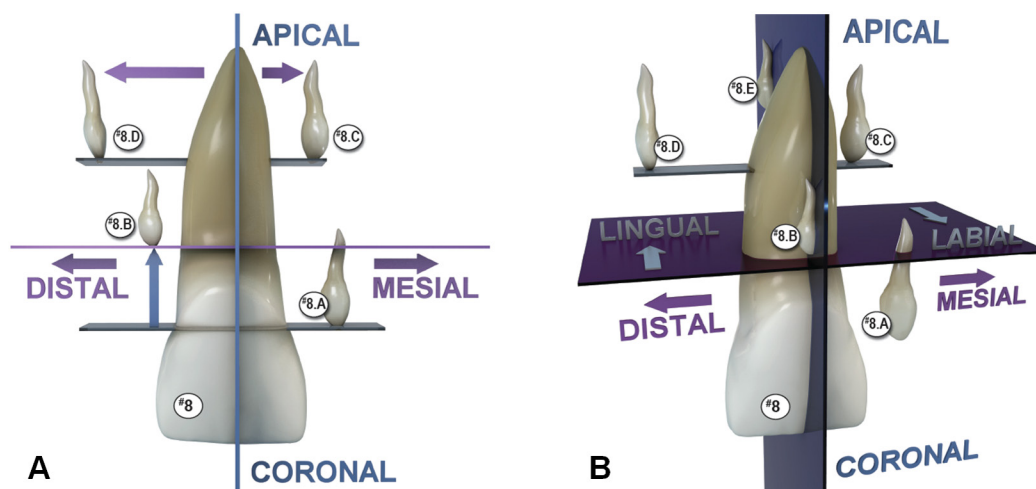


Figure 2. Proposed guideline for identifying multiple supernumerary teeth within the proximity of a parent tooth using the Universal system

A. 2D image: #8.A is more coronal to #8.B; #8.C is more proximal to the long axis of the parent tooth than #8.D.

B. 3D image: first, the supernumerary teeth are ranked according to their corono-apical positions, i.e., #8.A is most coronal and #8.E is most apical. Second, if there are supernumerary teeth on the same corono-apical level then the proximity of supernumerary teeth to the parent tooth's long axis in the horizontal plane (purple plane) is considered, i.e., #8.C is closer to the parent tooth than #8.D.

2). For example, if there are three supernumerary teeth proximal to the maxillary right second premolar, then they would be identified as upper right 5.A, 5.B, and 5.C or, alternatively, upper right 5.1, 5.2, and 5.3. The disto-molars would be identified as the supernumerary designation of the third molars. For example, maxillary left fourth, fifth, and sixth disto-molars would be designated upper left 8.A, 8.B, and 8.C, respectively (alternatively, upper left 8.1, 8.2, and 8.3).

FDI Tooth Numbering System

The FDI Tooth Numbering System utilizes a two-digit designation that has been adopted by most countries in the world.³⁸ Each quadrant in the permanent dentition is assigned a number in the first digit. For example, the maxillary right quadrant is assigned the number 1, the maxillary left quadrant is assigned the number 2, the mandibular left quadrant is assigned the number 3, and the mandibular right quadrant is assigned the number 4. The teeth within each quadrant are assigned a number in the second digit from 1 through 8, with 1 being the central incisor and 8 being the third molar. It should be noted that

the digits are pronounced separately, for example, tooth 18 (maxillary right third molar) is “one-eight,” not “eighteen.”

Anthonappa et al.⁴⁵ used “ST” (for supernumerary tooth) after the FDI parent tooth number to identify the locations of supernumerary teeth. Inchingolo et al.¹² continued the FDI numbering sequence and noted, for example, supernumerary fourth and fifth disto-molars in the maxillary left quadrant as “2.9” and “2.10,” respectively. Although unofficial, the FDI Working Group on Forensic Odonto-Stomatology (WG-FOS) has accepted the number 9 at the second digit designation as any supernumerary tooth in that quadrant.⁴⁶ The WG-FOS unofficial position on using the number 9 in the second digit for any supernumerary tooth in the quadrant is imprecise; furthermore, it does not address the issue of locating multiple supernumerary teeth.

We propose adding a third digit to the FDI notation to indicate supernumerary status. For example, a mesiodens close to tooth 11 (read as “one-one”) would be called 11.A or alternatively 11.1 (read as “one-one-one”) (Table 1). If there are multiple supernumerary teeth within the proximity of a single parent tooth, then the subsequent extra teeth would be numbered in sequence in the third digit. For example, if there are four supernumerary teeth within the range

of a maxillary left central incisor, they would be called 21.A, 21.B, 21.C, and 21.D or, alternatively, 21.1, 21.2, 21.3, and 21.4. Disto-molars would be identified as the supernumerary designation of the third molars. For example, fourth, fifth, and sixth molars on the mandibular right quadrant would be identified as 48.A, 48.B, and 48.C, respectively (or alternatively 48.1, 48.2, and 48.3).

Proposed Guidelines for Identifying Supernumerary Teeth

A dilemma arises about how to identify a supernumerary tooth when it appears midway mesial-distally between two normal teeth. Typically, the supernumerary tooth should be identified according to its proximity to the closest normal tooth. However, if it is located in the midline equidistant from adjacent normal teeth, then the dentist may arbitrarily pick either tooth as the parent designation (Figure 1).

Multiple supernumerary teeth within the range of a single parent tooth would require a method to assign designations based on proximity. Proximity to the parent tooth can be visualized in three dimensions (3D): corono-apically, mesio-distally, and labio (bucco)-lingually. The most coronal supernumerary tooth would have the first designation. If two

supernumerary teeth are on the same corono-apical level, then the closest one to the long axis of the parent tooth would take precedence (Figure 2). For many practitioners who still use two-dimensional (2D) radiography, the labio (bucco)-lingual plane would only be used to rank supernumerary units in rare cases where they are relatively far away from the parent tooth (e.g., palatally displaced). In this case, the palatally displaced supernumerary being the furthest from the parent tooth would get the last letter designation.

The advent of cone beam computed tomography (CBCT) has made 3D scans of the craniofacial region more practical and is the diagnostic medium of choice for an increasing number of practitioners. The ability to accurately locate supernumerary teeth and determine their relationship with adjacent teeth and other vital anatomical structures within the craniofacial region is important, especially when extractions of supernumerary teeth are indicated. Consequently, it is prudent to utilize CBCT to determine the best surgical approach to minimize harm to adjacent tooth roots and trauma to surrounding tissue.^{47,48} With a 3D view, the most coronal supernumerary tooth would get the first letter designation, while the most apical would get the last designation. Supernumerary teeth that are in the same corono-apical level would be ranked according to their proximity to the parent tooth's long axis in the horizontal plane (Figure 2). Figure 3 and Table 2 illustrate the proposed method

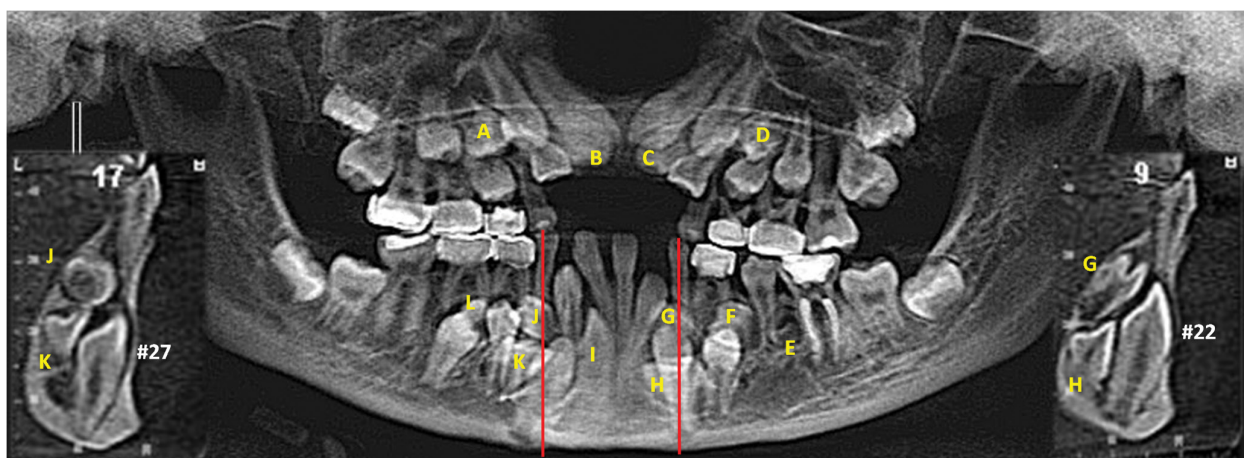


Figure 3. Panoramic radiograph with insets representing cross-sections (red lines) of multiple supernumerary teeth

Note: The alphabets denote location of permanent supernumerary teeth, not the Universal Numbering System for primary teeth. See Table 2 for identification of each supernumerary tooth using the three numbering systems. #22 and #27 are Universal numbers representing lower canines.

to identify and precisely locate supernumerary teeth, regardless of how complicated this may look at first glance. Notwithstanding the proposed identification system for supernumerary teeth described in this article, additional media such as photographs or radiographs with an indicator such as a circle or an arrow on the tooth or teeth of interest will further reduce treatment error.

Field testing and validation of the supernumerary teeth identification system described in this article may need to be performed prior to being implemented by dental professionals. Satisfaction and ease of use surveys of practicing and academic professionals may also shed some light on the acceptance of the proposed supernumerary teeth identification system.

Conclusions

According to our review of literature, there is apparently no consensus on identifying supernumerary teeth. This lack of consensus will oftentimes cause confusion and delay in dental treatment and may lead to wrong treatment, especially if there is miscommunication in interdisciplinary cases. We have proposed a guideline to identify supernumerary teeth according to their location within the dental arch using the Universal Numbering System, the Palmer notation, and the FDI systems. Introducing the proposed guideline to student dentists while they are learning a tooth numbering system may be an efficient way for them to learn how to locate and identify supernumerary teeth. Ultimately, the intention of the proposed guideline is to reduce miscommunication in interdisciplinary dental care, improve risk management, and gain effective communication with third-party administrators, ultimately enhancing the dental practice experience.

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Table 2. Identification of supernumerary teeth from Figure 3 using the three tooth numbering systems

Location on Image	Universal	Palmer	FDI
A	5.A	4.A	14.A
B	8.A	1.A	11.A
C	9.A	1.A	21.A
D	12.A	4.A	24.A
E	20.A	5.A	35.A
F	21.A	4.A	34.A
G	22.A	3.A	33.A
H	22.B	3.B	33.B
I	25.A	1.A	41.A
J	27.A	3.A	43.A
K	27.B	3.B	43.B
L	29.A	5.A	45.A

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