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Original Article

Radiographic characteristics of odontomas in patients in the National Taiwan University Children's Hospital

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KEYWORDS

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Abstract *Background/purpose:* Odontoma is the most common odontogenic tumor. A literature review revealed limited data for odontomas in Taiwan. This study evaluated the radiographic characteristics of odontomas in 1280 patients in the National Taiwan University Children's Hospital (NTUCH).

Materials and methods: This retrospective study analyzed the odontomas based on examination of mainly panoramic radiographs and related radiographs of 1280 patients in the NTUCH. Chi-square test was used for trend analysis.

Results: Among 1280 patients (710 boys and 570 girls), a total of 16 patients with odontomas (10 boys and 6 girls) were identified. There were 14 compound and 2 complex odontomas.

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The mean age of the patients was 10.38 years with the majority of odontomas occurring in the first (37.5%) and second decade (62.5%) of life. Odontomas had a marked predilection for the mandible (56.25%) and for the anterior region of the jaws (75%), particularly for the anterior maxilla (43.75%). Ten odontomas (62.5%) were associated with the impacted corresponding permanent teeth. The sagittal position of odontomas and vertical relation of odontomas to the corresponding permanent teeth were significantly correlated with the eruption rate of corresponding permanent teeth ($P < 0.05$).

Conclusion: The odontomas occur most commonly in male patients with a male to female ratio of 1.67:1. The incidence of odontomas in our 1280 patients is 1.25%. The age range of patients with odontomas is 6–17 years. The most frequent location of odontomas is the anterior maxillary region. Odontoma is frequently associated with an impacted corresponding permanent tooth.

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Introduction

The odontoma is the most common type of odontogenic tumors. They belong to the benign calcified odontogenic tumors.¹ The term “odontome” was coined by Paul Broca in 1867. He defined “odontome” as an overgrowth or temporary formation of tumors from intact dental tissue.² Odontomas arise from the growth of fully differentiated epithelial and mesenchymal cells that give rise to ameloblasts and odontoblasts and subsequently form the enamel and dentin tissues, respectively. Enamel and dentin are often deposited in an abnormal pattern due to the failure of the organization of odontogenic cells to achieve a normal state of morphological differentiation.³ Therefore, odontomas are considered as dental developmental anomalies rather than true odontogenic tumors.¹

Odontomas are basically divided into two types: compound and complex odontomas. Odontomas account for approximately 22% of all odontogenic tumors of the jaws.⁴ About 10% of all odontogenic tumors of the jaws are compound odontomas.^{5,6} Odontomas are usually discovered when the patients are in the second and third decades of life.^{5,7,8} The compound odontoma is more common than the complex odontoma, which in turn is more common than ameloblastic odontoma. Most of the odontomas in the anterior jaws are the compound composite type (61%), while most of the odontomas in the posterior jaws are the complex composite type (34%).³ Compound odontomas mostly occur in the incisor and cuspid region of the maxilla, while complex odontomas mostly occur in the premolar and molar region of the mandible.^{9,10} Generally, odontomas are asymptomatic. Signs and symptoms related to their presence occasionally occur. The main management of odontomas depends on early diagnosis by radiographic and histopathological examinations, and resection of the odontomas.¹

Odontomas are usually discovered incidentally during radiographic examination such as panoramic radiography.³ Fortunately, the National Health Insurance (NHI) was implemented in Taiwan since 1995. At present, the penetration rate has reached 99.9% of the total population.^{11,12} In addition, the panoramic radiography is a regular payment

item for dental visits in the NHI system. A literature review revealed limited data for odontomas in Taiwanese children.¹³ However, we currently had an opportunity to review the dental records of panoramic radiographs from the National Taiwan University Children’s Hospital (NTUCH) and analyzed the radiographic characteristics of odontomas in a group of dental patients in the NTUCH. We hope that the results of this study will be helpful for the clinical diagnosis and treatment of odontomas as well as the future research of odontomas.

Materials and methods

This study adopted the retrospective analysis for all dental patients who had received a panoramic radiographic examination at the Dental Clinics of the NTUCH from January 2016 to September 2016. Among all patients, a manual search was performed to find odontomas from the digital panoramic radiograph database. The radiographs including any related periapical, occlusal, and cone-beam computed tomography (CBCT) radiographs were also reviewed to determine the position and status of odontomas.

Data collection from the radiographs and other patient medical records included age, gender, and the following characteristics of odontomas: (1) type (compound or complex); (2) location (maxilla or mandible); (3) region (anterior or posterior region of the maxilla or mandible); (4) eruption status of permanent teeth in the same region corresponding to the site of odontomas (erupted or impacted); (5) mixed or permanent dentition; (6) sagittal position (buccal/labial, within the dental arch or palatal/lingual); (7) vertical relation to the corresponding permanent teeth (at the level of incisal edge, crown, root or root apex); and (8) retention of corresponding deciduous teeth (with or without).

All data obtained from the interpretations of radiographs and other patient medical records were stored in excel files and used for analyzing the distributions and characteristics of odontomas by descriptive statistics. Besides, the correlations of odontoma characteristics were analyzed by chi-square test. The result was considered to be significant if the P -value was less than 0.05.

Results

The digital panoramic radiographs of 1280 patients were collected from the Dental Clinics of the NTUCH. The age of the 1280 patients ranged from 2 to 19 years with a mean age of 9.92 years. Among the 1280 patients, 16 (1.25%) patients were found to have odontomas. Besides, 14 patients (9 boys and 5 girls) had compound odontomas, and 2 patients (one boy and one girl) had complex odontomas (Table 1). The odontomas occurred more commonly in boys ($n = 10$, 1.41% of 710 boys) than in girls ($n = 6$, 1.05% of 570 girls) with a male to female ratio of 1.67: 1 (Table 1).

The age of the 16 patients with odontomas ranged from 6 to 17 years with a mean age of 10.38 years. The odontomas occurred more frequently in the 10-14-year age group (8/16, 50%) (Table 2).

Of the 16 odontomas analyzed, the most common location of the odontomas was the anterior maxillary region (7/16, 43.75%), followed in a descending order by the anterior mandibular region (5/16, 31.25%) and the posterior mandibular region (4/16, 25%) (Table 3). Various clinical characteristics of the odontomas are shown in Fig. 1.

Of the 16 odontomas, the most common type of odontomas was the compound odontoma (87.5%, 14/16), followed by the complex odontoma (12.5%, 2/16). The type of odontomas was not significantly correlated with the eruption rate of corresponding permanent teeth ($P = 0.051$) (Table 4). The eruption status of permanent teeth in the same region corresponding to an odontoma was the impacted status (62.5%, 10/16), followed by the erupted status (37.5%, 6/16). Of the 6 odontomas with erupted corresponding permanent teeth, 4 (28.57% of 14) were corresponding to the compound odontomas, and 2 (100% of 2) corresponding to the complex odontomas. Thus, the eruption rate of permanent teeth in the same region corresponding to the odontoma was higher in the complex odontoma than that in the compound odontoma (Table 4).

In terms of location, the most common location of odontomas was the mandible (56.25%, 9/16), followed by the maxilla (43.75%, 7/16). Of the 6 odontomas with erupted corresponding permanent teeth, 2 (28.57% of 7) were located in the maxilla, and 4 (44.44% of 9) in the mandible. Thus, the eruption rate of corresponding permanent teeth was higher in the mandible than that in the maxilla. However, the location of odontomas was not significantly correlated with the eruption rate of the corresponding permanent teeth ($P = 0.515$) (Table 4).

Table 1 Distribution of patients with odontomas at the Dental Clinics of the National Taiwan University Children's Hospital from January 2016 to September 2016.

	Boys	Girls	Total
Compound odontoma	9	5	14
Complex odontoma	1	1	2
Total	10	6	16
Number of all patients examined	710	570	1280
Proportion of patients with odontomas to all patients examined	1.41%	1.05%	1.25%

Table 2 The age distribution of 16 patients with odontomas.

Age (years)	Patients	
	Number	Proportion
0–4	0	0
5–9	6	37.5%
10–14	8	50%
15–19	2	12.5%
Total	16	100%

Table 3 Distribution of 16 odontomas by the region in the jaws.

Region	Odontomas	
	Number	Proportion
Maxilla	7	43.75%
Anterior region	7	43.75%
Incisor region	5	31.25%
Cuspid region	2	12.5%
Posterior region	0	0
Mandible	9	56.25%
Anterior region	5	31.25%
Incisor region	1	6.25%
Cuspid region	4	25%
Posterior region	4	25%
Premolar region	3 ^a	18.75%
Molar region	1 ^a	6.25%
Total	16	100%

^a One of each was complex odontoma.

In terms of the region, the most common region of odontomas was the anterior jaw (75%, 12/16), followed by the posterior jaw (25%, 4/16). Of the 6 odontomas with erupted corresponding permanent teeth, 3 (25% of 12) were located in the anterior jaw, and 3 (75% of 4) in the posterior jaw. Thus, the eruption rate of the corresponding permanent teeth was higher in the posterior jaw than that in the anterior jaw. However, the region of odontoma was not significantly correlated with the eruption rate of corresponding permanent teeth ($P = 0.074$) (Table 4).

In terms of the dentition stage, the most common dentition of patients with odontomas was the mixed dentition (56.25%, 9/16), followed by the permanent dentition (43.75%, 7/16). Of the 6 odontomas with the erupted corresponding permanent teeth, 2 (22.22% of 9) were discovered in the mixed dentition, and 4 (57.14% of 7) in the permanent dentition. Thus, the eruption rate of the corresponding permanent teeth was higher in the permanent dentition than that in the mixed dentition. However, the dentition stage was not significantly correlated with the eruption rate of the corresponding permanent teeth ($P = 0.152$) (Table 4).

In terms of sagittal position, the most common position of odontomas was the position within the dental arch (56.25%, 9/16), followed by the palatal/lingual position (31.25%, 5/16) and the buccal/labial position (12.5%, 2/16). Of the 6 odontomas with the erupted corresponding

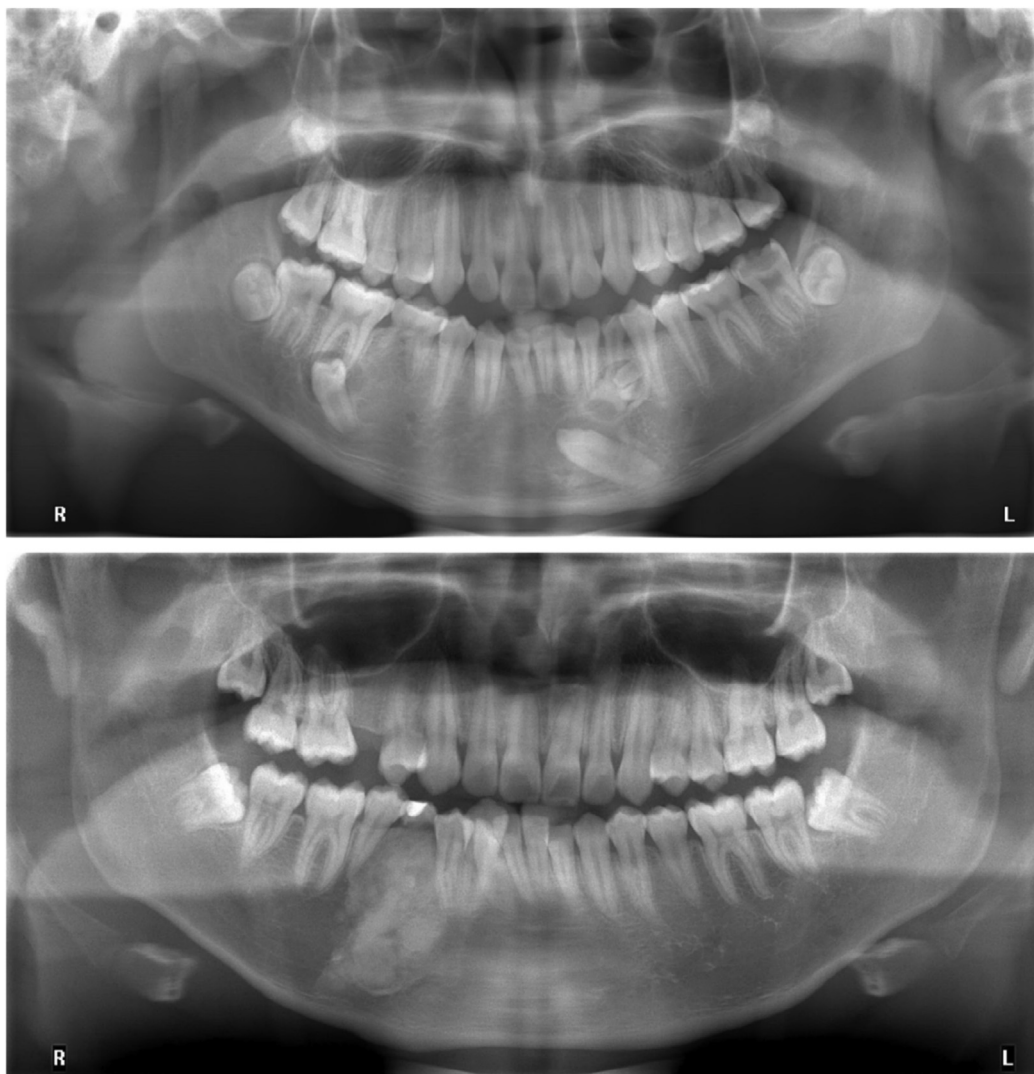


Figure 1 Panoramic radiographs of the odontomas in our patients. (Upper) A panoramic radiograph showing an unerupted compound odontoma in the left mandibular canine region of a 13-year-old boy. The compound odontoma was a radiopaque mass composed of multiple, small, calcified tooth-like structures surrounded by a narrow radiolucent zone. There was a deciduous canine reserved and a permanent canine impacted in the corresponding region. Whereas there was also a right mandibular deciduous molar reserved and a right mandibular second permanent premolar impacted in the non-corresponding region of the compound odontoma (the right mandibular region) (Lower) A panoramic radiograph showing an unerupted complex odontoma in the right mandibular premolar region of a 15-year-old boy. The complex odontoma was a radiopaque amorphous calcified mass, which showed no anatomical resemblance to a tooth and was surrounded by a narrow radiolucent rim. There was a deciduous tooth reserved in the corresponding region and congenital missing of a right maxillary permanent second premolar in the non-corresponding region of the complex odontoma (the right maxillary region).

permanent teeth, 5 (71.43% of 7) were located buccally/labially or palatally/lingually, and one (11.11% of 9) was within the dental arch. Thus, the eruption rate of the corresponding permanent teeth was higher in the buccal/labial and palatal/lingual positions than that in the position within the dental arch. The sagittal position of odontomas was significantly correlated with the eruption rate of corresponding permanent teeth ($P = 0.013$) (Table 4).

In terms of the vertical relation, the distribution of odontomas by the vertical relation to the corresponding permanent teeth showed that the most common vertical relation to corresponding permanent teeth was at the

level of incisal edge and crown (62.5%, 10/16), followed by at the level of root and root apex (37.5%, 6/16). Of the 6 odontomas with the erupted corresponding permanent teeth, one (10% of 10) was at the level of incisal edge, and 5 (83.33% of 6) at the level of root and root apex. Thus, the eruption rate of the corresponding permanent teeth was higher at the level of root and root apex than that at the level of incisal edge and crown. The vertical relation of odontomas to the corresponding permanent teeth was significantly correlated with the eruption rate of the corresponding permanent teeth ($P = 0.003$) (Table 4).

Table 4 Correlations between various parameters and eruption status of permanent teeth in the same region corresponding to odontomas.

Parameters	Number of teeth (%)			Chi-square test
	Erupted ^a	Impacted ^b	Total	P-value
Type				0.051
Compound odontoma	4 (25)	10 (62.5)	14 (87.5)	
Complex odontoma	2 (12.5)	0	2 (12.5)	
Location				0.515
Maxilla	2 (12.5)	5 (31.25)	7 (43.75)	
Mandible	4 (25)	5 (31.25)	9 (56.25)	
Region				0.074
Anterior jaw	3 (18.75)	9 (56.25)	12 (75)	
Posterior jaw	3 (18.75)	1 (6.25)	4 (25)	
Dentition stage				0.152
Mixed	2 (12.5)	7 (43.75)	9 (56.25)	
Permanent	4 (25)	3 (18.75)	7 (43.75)	
Sagittal position				0.013
Buccal/labial + Palatal/lingual	1 + 4 (31.25)	1 + 1 (12.5)	7 (43.75)	
Within the dental arch	1 (6.25)	8 (50)	9 (56.25)	
Vertical relation to corresponding permanent teeth				0.003
Incisal edge + crown	1 + 0 (6.25)	8 + 1 (56.25)	10 (62.5)	
Root + root apex	3 + 2 (31.25)	1 + 0 (6.25)	6 (37.5)	
Retention of corresponding deciduous teeth				0.182
With	1 (6.25)	5 (31.25)	6 (37.5)	
Without	5 (31.25)	5 (31.25)	10 (62.5)	
Total	6 (37.5)	10 (62.5)	16 (100)	

^a Odontomas did not hinder the eruption of permanent teeth in the corresponding region.

^b Odontomas hindered the eruption of permanent teeth in the corresponding region.

In terms of the retention of the corresponding deciduous teeth, the most common status of patients with odontomas was without retention of the corresponding deciduous teeth (62.5%, 10/16), followed by with retention of the corresponding deciduous teeth (37.5%, 6/16). Of the 6 odontomas with the erupted corresponding permanent teeth, one (16.67% of 6) was with retention of the corresponding deciduous teeth, and 5 (50% of 10) without retention of the corresponding deciduous teeth. Thus, the eruption rate of corresponding permanent teeth was higher in the status without retention of the corresponding deciduous teeth than that in the status with retention of the corresponding deciduous teeth. However, the retention of the corresponding deciduous teeth was not significantly correlated with the eruption rate of the corresponding permanent teeth ($P = 0.182$) (Table 4).

Furthermore, among 16 patients with odontomas, the most common type of concomitant dental developmental abnormalities was impacted permanent teeth (62.5%, 10/16) in the odontoma-corresponding region, followed by the retention of deciduous teeth (37.5%, 6/16) in the odontoma-corresponding region (Table 5). However, there were other dental developmental abnormalities (31.25%, 5/16) in the non-odontoma-corresponding regions of the jaws. These were congenital missing of permanent teeth (12.5%, 2/16), severe malposition (impaction) of the non-corresponding permanent teeth (6.25%, 1/16), supernumerary teeth (6.25%, 1/16), and fusion tooth abnormality of the non-corresponding permanent teeth (6.25%, 1/16). In overall, these patients with odontomas had a very high

proportion (81.25%, 13/16) of them showing another one or more dental developmental abnormalities other than the odontoma (Table 5).

Table 5 Dental developmental abnormalities among 16 patients with odontomas.

Category	Number	Proportion
Permanent or deciduous teeth in the odontoma-corresponding region	11	68.75%
No eruption (impaction) of permanent teeth in the corresponding region	10	62.5%
Retention of deciduous teeth in the corresponding region	6	37.5%
Permanent teeth in the non-odontoma-corresponding regions of the jaws	5	31.25%
Congenital missing of permanent teeth	2	12.5%
Severe malposition (impaction) of permanent teeth	1	6.25%
Supernumerary teeth	1	6.25%
Fusion tooth abnormality of permanent teeth	1	6.25%
An odontoma patient with another one or more dental developmental abnormalities other than odontoma	13	81.25%

Discussion

Among Taiwanese, the odontoma is not a very common odontogenic lesion. Japanese dental textbooks in the late 19th and early 20th centuries contained the descriptions of odontomas. According to the historical materials of the Taiwan Dental Association during the Japanese colonial period (1895–1945), in 1934 (Showa 9), the head of the Department of Dentistry of Taiwan Government Taipei Hospital (the predecessor of National Taiwan University Hospital [NTUH]) reported a case of odontoma containing 62 tooth-like structures in an academic lecture.¹⁴ After nearly thirty years, it was not until 1961 that the post-war Department of Dentistry of NTUH reported 3 cases of compound composite odontomas in another academic lecture.¹⁵ Then, after another forty years, a clinicopathologic study of 81 odontomas treated in the NTUH from 1998 to 2002 was reported.¹³ This finding indicates that during the 5-year period from 1998 to 2002, a mean of at least 1.35 cases of odontoma per month is detected in the NTUH (since untreated cases were not included in this study). Furthermore, our study collected 16 cases of odontoma in the NTUCH from January 2016 to September 2016. This finding indicates that an average of 1.78 cases of odontoma per month is found the NTUCH during the 9-month study period.

In fact, for more than 100 years, the ethnicity or genes of Taiwanese probably have not significant changes. In the NTUH system, the incidence of Taiwanese odontomas has changed a lot over time. In the early years, the odontoma is an extremely rare and novel case, but it is now a regular finding of at least 1–2 cases per month in the NTUH system. In Taiwan, the changes over the past 100 years include the improvement of people's economy, the advancement of medical technology, and the popularization of seeking the medical care by the people. More importantly, the NHI implemented since 1995 has greatly improved the convenience and accessibility of medical care for the public. In the early years, the people with a high social and economic status were more likely to seek medical or dental care in Taiwan Government Taipei Hospital.^{16,17} Today, however, all the people can easily go to NTUH or NTUCH for seeking medical or dental care.

In 2006, the dental benefit of NHI increased the initial consultation fee for the reading of a panoramic radiograph, making panoramic radiography a routine examination item that dental patients can obtain in any hospitals or dental clinics if needed. The dental use rate of NHI in Taiwan's population is as high as 46.98% in 2020. Furthermore, the children in the 5-9-year age group have the highest dental use rate (80.30%), followed in a descending order by the 10-14-year age group (57.19%) and the 15-19-year age group (46.98%).¹² This means that the majority of Taiwan's people may have the opportunity to receive the panoramic radiographic examination, especially school children and adolescents. Therefore, this makes us to have the opportunity to adopt panoramic radiographs as the study samples for dental epidemiological investigation of odontomas.

To the best of our knowledge, there were only few studies that reported the incidence of odontoma in the population. These previous studies reported the incidences

of odontoma in a sample of the population ranged from 0.1% to 0.4%.^{18–20} However, our study found that the incidence of odontoma in the dental patients of the NTUCH was as high as 1.25% (a total of 16 patients with odontomas among the 1280 patients using the panoramic radiographs as the study samples), which was much higher than the findings of other previous studies.^{13,18–20} This does not mean that the incidence of odontoma in Taiwanese people is so high, but it shows a fact that in Taiwan, due to the popularization of NHI and panoramic radiographic examinations, the dentists in hospitals or in the dental clinics in communities also have the ability to easily detect the patient's odontomas. For the treatment of patient's odontoma, most dentists in communities usually refer the patient to a large hospital for further examination and treatment. Since the Dental Clinic of the NTUCH is the place where receives the majority of referral patients, it is not surprising to find a high incidence of odontomas in dental patients in the Dental Clinic of the NTUCH.

The Taiwan's oral health policy conducts a comprehensive oral examination for every elementary or middle school student. The students with detected dental or oral diseases are advised and referred to see their dentists for further dental treatments.^{12,21} Thus, the patient's odontomas can be easily detected and treated in Taiwan's medical system. Furthermore, according to Taiwan's medical system, the patients can go directly to large hospitals for dental or medical treatment without going through a referral from a dentist or a medical doctor, respectively. Therefore, it was easy to understand that the incidence of odontoma in our study was much higher than those in other previous studies.^{13,18–20} Due to the NHI system and the public's medical habits, the incidence of odontoma in our study cannot be inferred to the total population of Taiwan. However, we can still perform a randomized study to examine the panoramic radiographs in the dental clinics of communities to infer the incidence of odontoma in the total population of Taiwan in the future. In fact, using panoramic radiography as a tool for epidemiological investigation of odontogenic or non-odontogenic diseases of the jawbones is indeed a good way to take the advantage of the universal acceptance of panoramic radiographic examinations in the dental clinics.

Among the 1280 children, the incidence of odontoma was higher in boys (10/710, 1.41%) than in girls (6/570, 1.05%) without a significant difference. The gender dimorphism is also reported by other authors showing no gender difference or different situation that the female patients are more commonly affected by the odontomas than the male patients.^{13,22} The samples of our study were obtained from a children's hospital, and the mean age of the patients with odontomas was 10.38 years, which also does not indicate the predisposing age of having odontomas is near 10.38 years. Furthermore, the children in the 10-14-year age group had the highest number of patients with odontomas (8/16, 50%), followed in a descending order by the 5-9-year age group (6/16, 37.5%) and the 15-19-year age group (2/16, 12.5%). However, our previous study analyzed 81 cases of odontoma from 1998 to 2002 in the NTUH. The mean age of the patients was 18 years with the majority of odontomas occurring in the first decade (32%) and second

decade (38%) of life.¹³ When compared to the current literature, the mean age of the patients with odontomas in this study seems relatively younger. The reason for the younger age of the patients with odontomas in this study may be that the impacted odontomas in the jawbones can be easily detected by the dentists in communities and then the dentists referred the patients to the hospital for further examination and treatment in the Taiwan's NHI system. Due to the characteristics of odontogenic diseases that once odontomas are formed within the patient's jawbones, the lesions always exist before they are excised by the oral and maxillofacial surgeons. Therefore, in this study, the mean age of the patients with odontomas referred to the mean age of the patients when the odontomas were found by the panoramic radiographic examinations, and could not be interpreted as the mean age of the patients when the odontomas occurred.

Most of the odontomas in children were found in their younger age, which means that the implementation of the NHI system in Taiwan, the convenience and accessibility of dental care resources, and the public's increased awareness of oral health all contribute to the early discovery and treatment of the odontomas in children in Taiwan. Therefore, the odontomas of Taiwanese children have a high chance of early diagnosis and treatment. Besides, our study showed a relatively low frequency (12.5%) of finding the odontomas in relatively older pediatric patients (the 15-19-year age group).

In our study, odontomas had a marked predilection for the mandible (56.25%) and for the anterior region of the jaws (75%), particularly for the anterior maxilla (43.75%). However, our previous study showed that odontomas had a marked predilection for the maxilla (70%) and for the anterior region of the jaws (83%), particularly for the anterior maxilla (62%).¹³ The regions where odontomas commonly occur are not so consistent across different studies. Therefore, we still need more studies to verify these inconsistent findings.

Complex odontomas are less common than compound odontomas. Radiologically, compound odontomas tend to occur in the anterior jaws and between the teeth, and tend to be composed of multiple small tooth-like structures, while complex odontomas tend to occur in the posterior jaws and present as a conglomerate mass.²³ Including the results of our study, these conclusions are more consistent across different studies.

In our previous study, 64 (79%) of the 81 odontomas were associated with 80 impacted teeth, including 71 permanent teeth, 2 deciduous teeth, and 7 supernumerary teeth.¹³ In fact, the most detrimental effect of an odontoma on the dental development is the result of dental abnormalities in its immediate vicinity. Odontomas mainly caused the impaction of permanent teeth and retention (delayed shedding) of deciduous teeth in the corresponding regions of odontomas.

The correlation between the eruption rate of corresponding permanent teeth and sagittal position of odontomas showed that the majority of the impacted permanent teeth occurred predominantly in the odontoma cases located within the dental arch. The majority (56.25%, 9/16)

of odontomas within the dental arch had a very high proportion (88.89%, 8/9) of impacted corresponding permanent teeth ($P = 0.013$). Moreover, the correlation between the eruption rate of corresponding permanent teeth and vertical relation of odontomas to the corresponding permanent teeth also showed that the impaction of permanent teeth occurred predominantly in the odontoma cases located at the level of incisal edge and crown of the corresponding permanent teeth. The majority (62.5%, 10/16) of odontomas at the level of incisal edge and crown of the corresponding permanent teeth had a very high proportion (90%, 9/10) of impacted corresponding permanent teeth ($P = 0.003$). Therefore, the sagittal position of odontomas and vertical relation of odontomas to the corresponding permanent teeth play a pivotal role in determining whether the corresponding permanent teeth may erupt or not, the final eruption or non-eruption of the corresponding permanent teeth mainly depends on whether there are obstacles (odontomas themselves) in the eruption pathway of the corresponding permanent teeth.

Our study investigated the radiographic characteristics of 16 odontomas in Taiwanese pediatric patients, and was helpful for us to understand the patients' medical visit patterns for management of their odontomas. According to our practice experience, if odontomas affect the eruption of the corresponding permanent teeth, they are usually considered to be removed as soon as possible. The surgery timing and children's age should be considered according to the degree of children's cooperation, and sometimes the excision of the odontomas needs to be performed under general anesthesia. If the eruption of the corresponding permanent teeth has been affected, surgical removal of odontomas and forced eruption of the impacted corresponding permanent teeth may be considered. If there is still a long period to the normal eruption time of the corresponding permanent teeth, the eruption status of the corresponding permanent teeth should be continuously monitored. Then, at an appropriate time, it will be considered whether we need to guide the corresponding permanent teeth to erupt with an orthodontic method. No recurrence was found after surgical excision of the odontomas with a follow-up period of 1–15 years.¹³ Based on the results of this study, we believe that analysis of the subsequent management of odontomas in pediatric patients is worthy of further studies.

In conclusion, the incidence of odontomas in 1280 Taiwanese patients is 1.25%. Odontomas occur most often in the first and second decade of life. In our study, the age range of the patients with odontomas is 6–17 years with a mean age of 10.38 years. The most frequent location for the odontomas is the anterior maxilla (43.75%). The odontoma is frequently associated with an impacted corresponding permanent tooth. Many factors such as type, location, sagittal position, and vertical relation to the corresponding permanent teeth, and other dental developmental abnormalities must be considered when evaluating the odontomas and other supernumerary teeth. The demographic profiles of the Taiwanese patients with odontomas in our study can provide useful epidemiological data in the literature.

Declaration of Competing Interest

The authors have no conflicts of interest relevant to this article.

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References

- Satish V, Prabhadevi MC, Sharma R. Odontome: a brief overview. *Int J Clin Pediatr Dent* 2011;4:177–85.
- Sprawson E. Odontomes. *Br Dent J* 1937;62:177–201.
- Shafer GW, Hine MK, Levy BM. In: Rajendran R, ed. *A textbook of oral pathology*, 4th ed. US, Philadelphia: WB Saunders, 1983:308–11.
- Bhaskar SN. Odontogenic tumors of jaws. In: *Synopsis of oral pathology*, 7th ed. US: Elsevier Mosby Year Book, 1986: 292–303.
- Bhaskar SN. *Synopsis of oral pathology*, 6th ed. St Louis: C. V. Mosby, 1977:241–84.
- Regezi JA, Kerr DA, Courtney RM. Odontogenic tumors: analysis of 706 cases. *J Oral Surg* 1978;36:771–8.
- Budnick SD. Compound and complex odontomas. *Oral Surg Oral Med Oral Pathol* 1976;42:501–6.
- Bimstein E. Root dilaceration and stunting in two unerupted primary incisors. *ASDC (Am Soc Dent Child) J Dent Child* 1978; 45:223–5.
- Kharbanda OP, Saimbi CS, Kharbanda R. Odontome: a case report. *J Indian Dent Assoc* 1986;58:269–71.
- Stajcic ZZ. Odontoma associated with primary tooth. *J Pedod* 1988;12:415–20.
- Cheng FC, Chiang CP. Analysis of emergency dental visits of pediatric patients in the National Health Insurance of Taiwan in 2020. *J Dent Sci* 2022;17:942–50.
- Cheng FC, Chiang CP. The dental use by pediatric patients in the National Health Insurance of Taiwan in 2020. *J Dent Sci* 2022;17:951–7.
- Chang JYF, Wang JT, Wang YP, Liu BY, Sun A, Chiang CP. Odontoma: a clinicopathologic study of 81 cases. *J Formos Med Assoc* 2003;102:876–82.
- Taiwan Dental Association. *Taiwan dental history*. Taipei, Taiwan: Taiwan Dental Association, 1943 [In Japanese].
- Hong YC, Yang HC. Compound composite odontoma - 3 cases report. *J Formos Med Assoc* 1961. Available from, <https://hyerm.ntl.edu.tw:3298/cgi-bin2/Libo.cgi?>. [Data Accessed 1 October 2022].
- Cheng FC, Wang LH, Ozawa N, Wang CY, Chang JYF, Chiang CP. Dental technology of Taiwan during the Japanese colonial period. *J Dent Sci* 2022;17:882–90.
- Cheng FC, Wang LH, Ozawa N, Wang CY, Chang JYF, Chiang CP. Dental manpower and treated dental diseases in department of dentistry, Taipei Hospital (the predecessor of National Taiwan University Hospital) in 1923. *J Dent Sci* 2022;17:170–5.
- Suluk Tekkesin M, Pehlivan S, Olgac V, Aksakalli N, Alatli C. Clinical and histopathological investigation of odontomas: review of the literature and presentation of 160 cases. *J Oral Maxillofac Surg* 2012;70:1358–61.
- Patil S, Doni B, Kaswan S, Rahman F. Prevalence of dental anomalies in Indian population. *J Clin Exp Dent* 2013;5: e183–6.
- Affify AR, Zawawi KH. The prevalence of dental anomalies in the Western region of Saudi Arabia. *ISRN Dent* 2012;2012: 837270.
- Lai WH, Ho SC, Weng TY, Huang ST. Profile of nonsurgical root canal treatment under the National Health Insurance in Taiwan in 2006. *J Dent Sci* 2009;4:187–90.
- De Oliveira BH, Campos V, Marcal S. Compound odontoma - diagnosis and treatment: Three case reports. *Pediatr Dent* 2001;23:151–7.
- Gedik1 R, Müftüoğlu S. Compound odontoma: differential diagnosis and review of the literature. *W Indian Med J* 2014;63: 793–5.