

Incidental Findings in Digital Panoramic Radiography of Patients Referred to Mashhad Dental School

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- Received: 1 March, 2020 Accepted: 11 November, 2020

ARTICLE INFO

Article type:
Original Article

Keywords:
Radiography
Panoramic
Incidental Findings
Jaw
Prevalence

Abstract

Background: Panoramic radiographs are among diagnostic tools used by dentists. Because of the relatively large area covered by panoramic radiographs, incidental findings are possible. This study aimed to evaluate the incidental findings in digital panoramic radiographs of patients referred to the Oral and Maxillofacial Radiology Department of Mashhad Dental School.

Methods: In this cross-sectional study, panoramic radiographs of 1987 patients over one year were evaluated, and any finding that was not related to the reason of panoramic radiography request was recorded as an incidental finding. These findings were grouped into five categories: intraosseous findings, dental abnormalities, soft tissue calcifications, maxillary sinus findings, and TMJ findings. The obtained data were analyzed using descriptive statistics and through SPSS18.0.

Results: A total of 3990 findings in 1987 patients, including 795 men and 1192 women aged 4 to 84 years old, were identified. The overall rate of incidental findings was 85%. The highest rate of incidental findings was related to intraosseous findings (53.8%), followed by dental anomalies (34.7%), soft tissue calcifications (21.2%), maxillary sinus (17.3%), and TMJ findings (3.2%). The most prevalent intraosseous incidental finding was rarefying osteitis. The most common dental abnormalities were impaction and missing. Half of the soft tissue calcifications were elongated calcified styloid ligament. The most common sinus and TMJ incidental findings were mucosal thickenings and articular eminence pneumatization, respectively.

Conclusions: Incidental findings in panoramic radiographs are common. Although most of the findings do not require treatment, early diagnosis of some of these findings is beneficial in preventing subsequent complications in patients.

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Citation: Imanimoghaddam M, Tohidi E, Ahmadian Yazdi A, Nikbakhsh E, Goudarzi F. Incidental Findings in Digital Panoramic Radiography of Patients Referred to Mashhad Dental School. *Journal of Kerman University of Medical Sciences*, 2021; 28 (1): 43-55.

Introduction

Panoramic radiography is one of the most common types of radiography in dentistry. Providing a single and complete image of both jaws, teeth, maxillary sinuses, nasal cavities, and temporomandibular joints are among the capabilities of this technique that allow the observation of pathologies and jaw lesions as well as dental anomalies in the maxillofacial region (1).

Precise evaluation of panoramic radiographs sometimes leads to incidental findings other than the primary reason of the patient referral to the dentist. Some of these findings need therapeutic interventions and can prevent future complications.

This study aimed to assess the incidental findings in digital panoramic radiographs of patients referred to the Faculty of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran, in 2014-15.

Materials and Methods

All Patients who referred to the Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Mashhad University of Medical Sciences, Iran in 2014-15 for digital panoramic radiographs were considered in this study. Digital panoramic radiographs were taken with Rayscan (Raymedical Co., Ltd., South Korea). The radiographs with low-quality panoramic radiography, and those with unclear reason of referral were excluded. Two maxillofacial radiologists, in cooperation with a dentistry student, recorded all patient information such as age, gender and incidental findings (those not related to the primary reason of the patient referral) and their corresponding frequencies.

Bone findings were categorized in three groups according to their radiographic patterns: lucent, mixed, and opaque lesions and their subgroups (2).

Dental findings were classified into two categories of developmental disorders (size, morphology, number and problems of eruption) and acquisitive disorder (3).

Maxillary sinus findings were classified into mucosal thickening, mucus retention pseudo-cyst, complete sinus opacity, sinus hypoplasia and oral-sinus fistula (4).

TMJ findings were classified into condyle hypoplasia, condyle hyperplasia, coronoid hyperplasia, bifid condyle, condylar or coronoid fracture, pathological lesions of the condyle, condylar head osteophyte, Ely's cyst and articular pneumatization of articular eminence (5). Findings of soft tissue were classified into the long calcified styloid ligament, tonsillitis, calcified vascular plaque, sialolith, calcified Lymph nodes, antrolith (6).

Two radiologists were calibrated to diagnose the lesions. The method of data collection in this study was referral sampling, and its tool was observation. Data were analyzed through SPSS18.0 and presented as tables and charts.

Results

In this cross-sectional study, panoramic radiographs of 1987 patients over one year were evaluated. Cases with inadequate quality of radiograph, and unclear cause of referral or main complaint of the patient were excluded from the study. A total of 1987 patients, including 795 males and 1192 females aged 4-84 years with the mean age of 34.35 ± 15.52 years, were considered in this study. The most common reason for patients' referrals was caries examination. The most frequent complaints were related to the third molar tooth, gingival and periodontal diseases, implantation, toothache, extraction, and orthodontic therapy. At least one incidental finding was observed in 85% of cases (1689 patients).

Incidental findings were bone lesions [53% (1069 patients)] followed by dental anomalies [34.7% (689 patients)], soft tissue calcification [21.2% (422 patients)], incidental findings in maxillary sinuses [17.3% (344 patients)], and TMJ findings [2.3% (63 patients)].

In the studied patients, 1799 cases of bone lesions, 1162 cases of the dental anomaly and 507 cases of soft tissue

calcification, 439 incidental findings in the maxillary sinus, and 83 TMJ findings were observed.

Bone incidental findings

In the group of radiopaque lesions "radiopacities not necessarily contacting teeth" with 186 cases was the most

common finding followed by "multifocal radiopacities with 163 cases. Among bone lesions, mixed lesions were the least common and 38 cases of condensing osteitis in periapical and 1 case of cemento osseous dysplasia were observed in this group (Table1).

Table1. Frequency distribution of bone lesions in subjects

lesions		Number of cases	
Radiolucent lesion	solitary periapical radiolucencies	granuloma or rarefying osteitis	372
		radicular cyst	15
		KOT	2
	multiple radiolucencies	multiple periapical granuloma	943
		multiple radicular cyst	19
		multiple KOT	3
		periapical cemento-osseous	3
	peri coronal radiolucencies	hyperplastic follicles	21
		follicular cyst	1
	interradicular radiolucencies	furcation Involvement	31
unilateral radicular cyst		2	
not necessarily contacting teeth radiolucencies	residual cyst	4	
	stafne bone cyst	3	
generalized rarefactions	physiological osteoporosis	10	
	thalassemia	1	
	chronic renal failure	1	
Mixed lesion	mixed periapical	rarefying and condensing osteitis	38
	mixed not necessarily contacting teeth	periapical cemento osseous dysplasia	1
Radiopaque lesion	solitary periapical radio opacity	idiopathic osteosclerosis	50
		condense osteitis	29
	radiopacities not necessarily contacting teeth	idiopathic osteosclerosis	149
		remaining root cases	32
		cemento osseous dysplasia	2
		odontoma	2
		dysplasia fibrosis	1
	multifocal radiopacities	multiple idiopathic sclerosis*	80
		condensing osteitis	32
		remaining root cases*	22
		idiopathy and idiopathic sclerosis	19
		focal cementoosseous dysplasia	8
	multiple odontomas	5	
diffuse radiopacities	FLCOD	3	

Dental incidental findings

For 16 dental disorders, the involved jaw and tooth number have been identified and a total of 1162 cases of dental malformations were identified in 689 patients.

As it is seen in table 2, the highest incidence of dental disorders was impaction (37.8%) followed by the absence of teeth (28%).

Moreover, 40 cases of supernumerary teeth were observed in 25 patients of whom, 65% were in the maxilla and 35% were in the mandible. The most common supernumerary tooth was the central maxillary tooth.

In the maxilla, the most common supernumerary teeth were the central tooth (mesiodens) and then the 8th tooth. In the mandible, the highest frequency was related to premolars.

Approximately 60% of the disorders of the number of teeth (including missing or supernumerary teeth) belonged to the maxilla.

Missing (excluding third molars) was reported in a total of 370 cases in 193 patients. In the case of missing teeth (except wisdom teeth), the most common teeth were maxillary premolars (26.8%), followed by lateral maxilla with a frequency of 26.2%, followed by mandibular premolars with 23.5%.

Regarding tooth size abnormalities, 3 cases of macrodontia were reported in 3 patients and 73 cases of microdontia in 47 patients.

In the case of microdontia, the highest frequency was present in both maxillary and mandibular teeth. In the mandible, after the third molar, the most common micro dent was the lateral peg shape.

Table 2. Frequency distribution of all types of dental disorders in the subjects

Dental anomaly	Problem type	variable	Male (%)	Female (%)	Total (%)
Developmental	Number	Supernumerary teeth	17 (68)	8 (32)	25 (3.7)
		missing teeth	63 (33)	130 (67)	193 (28)
	size	macrodontia	1 (34)	2 (66)	3 (0.4)
		microdontia	16 (34)	31 (66)	47 (6.8)
	eruption	Transposition	0 (0)	1 (100)	1(0.1)
		Transmigration	0 (0)	3 (100)	3 (0.4)
		Impaction	90 (35)	170 (65)	260 (37.8)
	Morphological	Germiation	1 (100)	0 (0)	1 (0.1)
		Taurodontism	3 (60)	2 (40)	5 (0.7)
		Dens invagination	6 (53)	4 (47)	10 (1.5)
Amelogenesis imperfect		0 (0)	4 (100)	4 (0.6)	
Dentin Dysplasia		1 (100)	0 (0)	1 (0.1)	
Talon cusp		6 (27)	16 (73)	22 (3.2)	
enamel pearl		24 (33)	48 (67)	72 (10.5)	
Acquisitive	Resorption	18 (51)	17 (49)	35 (5.1)	
	Root fracture	4 (57)	3 (43)	7 (1)	
Total			250	439	689 (100)

Among the soft tissue calcification findings, the most observed was long calcified styloid ligament (50%), followed by tonsillitis (28%) the most second incidental findings in soft

tissue calcifications (Table 3). The age range for soft tissue calcifications was between 18 and 83 years.

Table 3. Frequency distribution of soft tissue calcifications in the subjects

Variable	Male (%)	Female (%)	Total (%)
Long calcified styloid ligament	95 (45)	116 (55)	211 (50)
Tonsillitis	71 (60)	47 (40)	118 (28)
Calcified vascular plaque	30 (42)	42 (58)	72 (17)
Sialolith	5 (63)	3 (37)	8 (1.9)
Calcified Lymph nodes	2 (0)	4 (0)	6 (1.4)
antrolith	0 (0)	0 (0)	0 (0)
Other calculations	3 (43)	4 (57)	7 (1.7)
total	206	216	422 (100)

It is between 30 and 58 years for sialolith, between 35 and 83 years for vascular plaque, and between 18 and 83 years for long calcified styloid ligament, which has the most comprehensive range. The highest mean age was related to

calcified lymph nodes with 60 years and sialolith, with 42 years had the lowest mean age.

Furthermore, the most frequent finding in maxillary sinus was mucosal thickening (50.6%) followed by mucus retention pseudocyst (39%) (Table 4).

Table 4. Frequency distribution of different types of maxillary sinus pathologies in studied subjects

variable	Male (%)	Female (%)	Total (%)
Increases the thickness of the sinus mucosa	83 (48)	91 (52)	174 (50.7)
Mucus retention pseudocyst	63 (47)	71 (53)	134 (39)
Complete sinus opacity	18 (60)	12 (40)	30 (8.7)
Sinus hypoplasia	2 (50)	2 (50)	4 (1.1)
Oral-sinus fistula	1 (50)	1 (50)	2 (0.6)
Total	167	177	344 (100)

The pneumatization of articular eminence was the most found in the TMJ. In the case of TMJ, 63.5% of findings were related to the pneumatization of articular eminence, 15.8% to condylar osteophytes, 11.1% to condylar malformation, 4.8% to bicondylar, 3.2% to Ely's cyst, and 1.6% to condylar hyperplasia.

Condylar hypoplasia, coronoid hyperplasia, and condylar and coronoid fractures, and pathological intraosseous lesions of the condyle were not observed in the subjects.

The highest frequency of TMJ joint incidental findings in both men and women, as well as all subjects, was related to articular amniotic pneumatization. The second TMJ joint finding in men was related to condylar malformation and in women to condylar osteophyte.

Discussion

Panoramic radiography offers many advantages, since a wide range of maxillofacial area is examined. The patient receives low doses, preparation time is short, and a single facial structure image includes both the upper and lower arches and their supporting tissues. Therefore,

it can be used to diagnose diseases in their early stages (1). Accurate interpretation of panoramic radiography requires complete knowledge of anatomy, bone, and dental lesions and their variations.

In the present study, in 85% of the 1987 studied patients, at least one incidental finding was observed. Among incidental findings, intraosseous findings had the highest rate (53.8%) followed by dental and soft tissue calcifications, maxillary sinus, and TMJ findings, respectively. In the review study of Sandy Dief *et al.*(7) on CBCT images, the most incidental findings were mucus retention cyst and sinusitis, and it has been sinus pneumatization in the Hernández *et al.* (8) study on 783 patients, while bone findings had the most incidence in the present study.

The results of the studies by Khojastehpour on CBCT images and Pekiner on pediatric bone and dental findings are similar to our results in terms of the rate of such findings (9, 10).

Table 5 represents the frequency of incidental findings reported in some other studies compared to our results.

Table 5. The frequency of incidental findings in some recent studies

Study	Type of radiography	Number of patients	Age group of patients	Percentage of incidental Findings	Prevalence of bone findings	Prevalence of dental anomalies	Prevalence of soft tissue calcifications	Prevalence of sinus finding	Prevalence of TMJ findings
current study	OPG	1987	4-84	85% (3990 IFs in 1987 OPGs) 2IFs per OPG)	53.8%	34.7%	21.2%	17.3%	3.2%
Jadu (11) 2015	OPG	121	14-77	53.7% (65/121)	16.5%	4.1%	37.2%	10.7%	1.7%
Edwards(12) 2014	CBCT	427	5-46	83.4% (1.97 findings/scan)	4.52%	10.22%	4%	30.9%	6.4%
Khojastehpour 2014 (9)	CBCT	773	12-86	60% (475/773)	32.73%	6.2%	0.13%	26%	0
Rheem 2013 (13)	CBCT	147	8-80	40.1%	34.01	21.7%	12.92%	51.7%	26.53%
Allareddy 2012 (14)	CBCT	1000	11-87	94.3 (943/1000)	32.1%	8.1%	13.6%	25.45%	7.4%
Çağlayan, Tozoğlu 2014 (15)	CBCT	207	9-74	92.8% (192/207)	5.3% (endo lesions)	21.7% (impacted)	-	34.2%	11.1%
Price JB 2012 (16)	CBCT	300	9-80	90.7% (272/300) 881 IFs in 300 scans (2.9 IFs per scan)	28.9%	0.7% (dental developmental)	20%	35% (sinus & airway)	15.4%
Pette 2012 (17)	CBCT	318	16-91	93.4% (779 IFs in 318 scans (2.5 IFs per scan)	-	-	45%	41.9%	27%

In the present study, the most common finding of the intraosseous lesion was pulpo-preapical lesions, especially rarefying or condensing osteitis. Higher rate of incidental findings in the present study compared to other studies, can be due to the socio-economic problems in Iran (18).

In this study, among dental disorders and in term of size, microdontia was more common than macrodontia. In term of eruption problems, impaction was more common than others. Enamel Pearl in morphology problems was the most common. In the case of dental acquisitive problems, root resorption was observed more than root fracture.

This result is consistent with the results of Pekiner *et al.* (10) on incidental pediatric dental findings and the results of Shokri *et al.* (19) on the incidence of dental anomalies. According to Asaumi *et al.*, anomalies in the number of teeth account for approximately 90% of dental findings (20), while a lower incidence of dental anomalies is reported in Haghanifar *et al* (21).

The third most common incidental finding in the present study was soft tissue calcifications, half of which were related to the long calcified styloid ligament and tonsillitis and calcified vascular plaque. Various studies have reported different rates of soft tissue calcifications. Scaf *et al.* have stated that the results

of descriptive studies are not necessarily comparable to each other, since the statistical populations in terms of age, race, the number of samples, type of radiographs, and survey criteria are different (22) Sutter *et al.* and Missias *et al.* have reported a higher rate of incidental findings in CBCT images (23, 24), while Freire *et al.* have reported a lower rate (25).

The most common soft tissue calcification reported in some studies (11, 13, 16, 26, 27) is styloid ligament calcification which is consistent with the result of the present study, while Dief *et al.* have reported a higher incidence of the calcified styloid ligament (7). The second most common of these findings in panoramic radiography in previous studies (23, 28, 29) has been tonsillitis which is close to our result. However, Takahashi has reported a higher incidence in both panoramic and CT images (30). Dief *et al.* (7), as well as Kim *et al.* (31) have also reported a higher incidence of tonsillitis in CT images. The third most common of these findings in the present study was calcified vascular plaque (3.6%). Such an incidence has been different according to the age and gender of subjects in different studies. Some studies have reported incidences similar to our results (7, 23, 27-29), though Monteiro *et al.* (32) has reported a higher incidence of calcified vascular plaque.

Incidental findings in maxillary sinuses included increased thickness of sinus mucosa, followed by mucus retention cyst, complete sinus opacity, sinus hypoplasia, and oral-sinus fistula.

The results of this study are consistent with the results of Ortiz *et al.*(33) concerning the incidence of sinus findings and Abesi *et al.* (34) who have indicated an incidence rate of 7% for benign cysts of maxillary sinuses in panoramic radiography. Nevertheless, studies on 3D imaging such as CBCT have addressed a higher incidence of incidental findings in maxillary sinuses,

which is due to multiplanar (multidimensional) images of the sinuses that provide better view of maxillary sinus and Ostiomeatal complex and eliminate superimpositions of plain radiographs. For example, Niknami *et al.*(35) have reported similar panoramic radiography incidences compared to our results but a higher percentage of mucus retention cyst in CBCT. In Gracco *et al.* (36) study on CBCT images, the rate of incidental findings in maxillary sinuses has been 50% , whereas it has been 59.9% in Raghav *et al.* study (37). Therefore, it can be concluded that maxillary sinus anomalies are prevalent in asymptomatic patients.

In the present study, the least frequent incidental findings were in TMJ, and the most common finding in both sexes was pneumatized articular eminence. The frequency of articular eminence pneumatization was consistent with the result of Khojastehpour *et al.* study (۳۸). On the other hand, pneumatized articular eminence was multilocular in 40% of cases and unilocular in 60% of them, consistent with the results of Khojastehpour *et al.* (38) and Shokri *et al.* (39) studies ; even though, multilocular has been reported to be higher in CBCT by Miloglu *et al.*(40). It can be attributed to the fact that in CBCT, panoramic radiographic superimposition errors can be eliminated and the diagnostic accuracy is higher. In the present study, the pneumatization of articular eminence was unilateral in 70% of cases and bilateral in 30% of them which is consistent with the findings of studies that have been performed on panoramic radiographs (38, 39).

Several studies in panoramic radiography such as (19, 26, 34) have investigated the incidence of various

pathologies not necessarily intended to study incidental findings. The present study examined the total number of patients referred to the department of radiology for one year. However, other studies that have investigated incidental findings in panoramic radiographs have been conducted mostly on a specific population such as children (10, 20), patients before orthodontic treatment (8), or before to the wisdom teeth surgery (11). Therefore, there has been no diversity of participants in these studies. Another advantage of this study is its sample size compared to others. Moreover, the participants' age range was the widest compared with other studies and given such an age range and sample size, it was more likely to identify incidental findings. These were possibly the reasons for higher rates of incidental findings in this work.

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In the future studies of incidental findings in panoramic radiography and CBCT, it is recommended to classify conclusions according to the necessity for intervention and monitoring, and without the need for evaluation.

Conclusion

Since the high probability of incidental findings in panoramic radiography, dentists and maxillofacial radiologists are advised to consider radiographs carefully for incidental findings. Such incidental findings are beneficial in early diagnosis of some diseases.

Acknowledgements

This study was made possible by the generous support rendered by the Vice Chancellor for Research, Mashhad University of Medical Sciences in the form of grant No 930406.

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