



Evaluation of panoramic radiographs of totally edentulous jaws: A retrospective study

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Abstract

Aim: This retrospective study aimed to determine the incidence of random findings in digital panoramic images acquired from edentulous patients presenting for conventional prosthetic rehabilitations or implant-supported dentures.

Materials and Methods: In this retrospective study, of the patients aged 16 years and older, 950 of 1,100 panoramic films were evaluated by two maxillofacial radiologists (MA and IBY) in ambient light on an LCD monitor. The final classification and radiographic status of each finding were recorded after inter-observer consensus. Radiographs with low image quality and artifacts that did not include the demographic information of the patients were not included in the study. In the present study; impacted teeth, root remnants, radiolucent (RL) lesions, radiopaque (RO) lesions (including idiopathic osteosclerosis), foreign bodies, crest atrophies, soft tissue calcifications, maxillary sinus opacities, and Stafne bone defects were examined. Lesions affecting the alveolar region were divided into three regions as anterior (incisors and canines region), premolars and molars region.

Results: Tonsillitis was observed in a total of 55 individuals, 26 men and 29 women. Sialolith was seen in a total of 3 patients, 2 male and 1 female, but phleboliths were not found in any of them. Styloid ligament ossification(SLO) was seen in a total of 125 patients, 69 of these cases were female and 56 were male, however calcified atherosclerotic plaque is the most common calcification with 156 individuals and a rate of 16.4% among calcifications. Laryngeal cartilage calcification, which is seen in 36 female and 23 male individuals.

Conclusion: The outcome of this study indicated that the ratio of advantageous findings fixed in digital panoramic images of totally edentulous patients was highly rated. There are indispensable for patients with total edentulism such as routine use and careful examination of panoramic images.

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Introduction

Dental panoramic radiography (DPR) is one of the most commonly used imaging methods to examine the maxillary and mandibular dental arches and the anatomical structures adjacent to the arches together and in a single image. DPR has become a popular and valuable diagnostic instrument since its introduction into general dental routine. DPR is routinely used in screening patients in various institutions and private clinics, as it allows easy examination of all teeth, temporomandibular joints, alveolar bone, and adjacent structures. Abnormalities such as neoplasms, foreign bodies, residual roots, and impacted

teeth are often unnoticed when they do not lead to clinical symptoms. Other advantages are that it can be applied in patients with limited mouth opening or who cannot tolerate intraoral techniques, it is a fast and useful technique, and it can be applied more easily than intraoral techniques. Despite many advantages, it also includes some handicaps. Panoramic radiographs have several disadvantages such as the inability to see the detail as in intraoral radiographs, superpositions, magnifications, and geometric distortions are especially seen in the premolar region. In most patients, in addition to panoramic radiography, additional imaging such as periapical or bitewing radiography is used to establish or confirm the diagnosis. The most important disadvantages are lower resolution images and unreliable measurements due to low details, distortions, and magnifications compared to the intraoral technique, making the

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patient accurate.

It can be counted as the critical importance of positioning and the difficulty of evaluating anatomical structures due to superpositions in the image. DPR is generally used in routine evaluation of edentulous jaws to determine asymptomatic conditions such as radiolucent-radiopaque lesions, impacted teeth, root remnants, bone changes, and foreign bodies. DPR is an important component in the examination of patients and plays a key role in diagnosis and treatment planning. In addition, the Food and Drug Administration (FDA) and the American Dental Association (ADA) recommend intraoral examination followed by evaluation with panoramic radiography. DPR provides a great advantage over other imaging methods because it is cost-effective, is obtained with short-term and low-dose radiation, and shows both jaws and adjacent anatomical structures. The central role of DPR, which has become the main imaging modality of many dental practices since the 1960s, has not yet been displaced, although cone-beam computed tomography (CBCT) is now ubiquitous for general dentistry. Apart from pathologies, the course of the mandibular canal, mental foramen, maxillary sinuses, and alveolar bone height can be evaluated by panoramic radiography in edentulous patients and ensures information to the clinician in the prosthetic and surgical treatment schedule. In addition, since the imaged area is large, dental and medically important soft tissue calcifications such as sialoliths, tonsilloliths, and carotid artery calcifications can be defined. Studies have been carried out to identify asymptomatic pathologies in edentulous patients on panoramic images, but the number of studies examining radiographic findings requiring treatment is limited in the literature [1]. The aim of this retrospective study is to evaluate the prevalence of incidental findings in digital panoramic radiographs of edentulous patients, who applied for total dentures or implant-supported complete dentures.

Materials and Methods

Ethics committee approval was obtained for this study from the Ethics Committee of the Faculty of Dentistry of Necmettin Erbakan University, with the decision numbered 2022/16-109.

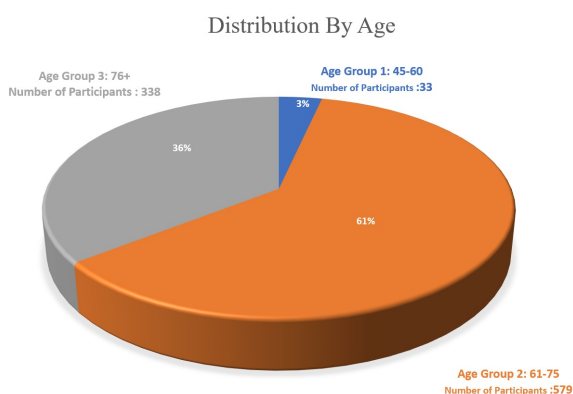


Figure 1. Distribution by age groups.

In this retrospective study, panoramic images of completely edentulous patients who applied to the Department of Oral and Maxillofacial Radiology at NEU Faculty of Dentistry between January 2020 and September 2021 were randomly selected. Panoramic radiographs were taken with Morita Veraviewepocs 2D panoramic unit (J Morita MFG Corp., Kyoto, Japan) at 60-70 kVp, 5-7 mA and 6-8 s exposure times according to the manufacturer's recommendations. All data were evaluated by two maxillofacial radiologists (MA and IBY) with ambient light on an LCD monitor. The final classification and radiographic status of each finding were recorded after inter-observer consensus. Radiographs with low image quality and artifacts that did not include the demographic information of the patients were not included in the study. In the study, diagnostically acceptable images of patients aged 16 years and older were used. Of the 1100 images, 950 panoramic radiographs of reasonable quality were scanned and included in the study. In our study; impacted teeth, root remnants, radiolucent (RL) lesions, radiopaque (RO) lesions (including idiopathic osteosclerosis), foreign bodies, crest atrophies, soft tissue calcifications, maxillary sinus opacities, and Stafne bone defects were examined.

Lesions affecting the alveolar region were divided into three regions as anterior (incisors and canines region), premolars and molars region. Other structures and lesions were classified as right, left, and bilateral.

Areas with a mandibular canal-crest distance and a maxillary sinus floor-crest distance of less than 2 mm were considered 'atrophic crest'. Mucosal thickening, mucus retention cyst, polypoid enlargement, antroliths, and antral exostoses were included in the maxillary sinus radiopacities group. Three groups were formed due to age distribution as 45-60, 61-75, and 76+ (Figure 1).

Statistical analysis

The data were evaluated with descriptive statistics according to gender and age groups. IBM SPSS Statistics 21.0 program was used for the analysis.

Results

In the present study, tonsillitis was observed in a total of 55 individuals, 26 men and 29 women (Table 1). According to the distribution of age groups, it was seen in group 2 (between 61-75 years) with 31 people the most. Sialolith

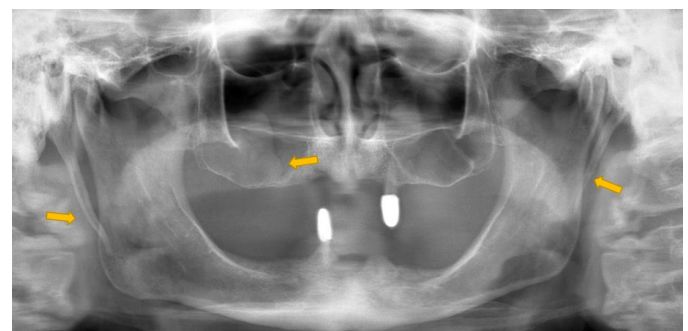


Figure 2. Bilateral styloid ligament ossification and radiopacity in the right maxillary sinus.

Table 1. Radiographic findings prevalence and distribution by gender-age groups.

Radiographic Findings	Gender		Age Group			Total
	Female	Male	Group 1 (45-60)	Group 2 (61-75)	Group 3 (76+)	
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Tonsillolith	26 (5.3)	29 (6.2)	4 (12)	31 (5.3)	20 (5.9)	55 (5.8)
Sialolith	2 (0.4)	1 (0.2)	0 (0)	2 (0.3)	1 (0.3)	3 (0.3)
Phlebolith	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lymph Node Calcification	22 (4.5)	38 (8.1)	2 (6.1)	40 (7)	18 (5.3)	60 (6.3)
Stylohyoid Ligament Ossification	69 (14.2)	56 (12)	0 (0)	50 (8.6)	75 (22.1)	125 (13.1)
Calcified Atherosclerotic Plaque	84 (17.3)	72 (15.4)	4 (12.1)	93 (16.1)	59 (17.4)	156 (16.4)
Arteriosclerosis	1 (0.2)	0 (0)	0 (0)	0 (0)	1 (0.3)	1 (0.1)
Laryngeal Cartilage Calcification	36 (7.4)	23 (4.9)	3 (9.1)	41 (7.1)	15 (4.4)	59 (6.2)

Table 2. Radiographic findings prevalence and distribution by gender-age groups.

Radiographic Findings	Gender		Age Group			Total
	Female	Male	Group 1 (45-60)	Group 2 (61-75)	Group 3 (76+)	
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Impacted Tooth	19 (3.9)	19 (4.1)	1 (3)	25 (4.3)	12 (3.5)	38 (4)
Impacted Residual Root	108 (22.2)	66 (14.2)	5 (15.1)	94 (16.2)	75 (22.1)	174 (18.3)
Mucosal Residual Root	20 (4.1)	26 (5.6)	4 (12.1)	26 (4.5)	16 (4.7)	46 (4.8)
Radiolucent Lesion	10 (2.1)	14 (3)	0 (0)	16 (2.7)	8 (2.3)	24 (2.5)
Radiopaque Lesion	58 (11.9)	40 (8.6)	3 (9.1)	53 (9.1)	42 (12.4)	98 (10.3)
Foreign Bodies	6 (1.2)	15 (3.2)	0 (0)	11 (1.9)	10 (2.9)	21 (2.2)
Posterior Atrophic Maxilla	167 (34.4)	201 (43.2)	11 (33.3)	226 (39)	131 (38.7)	368 (38.7)
Posterior Atrophic Mandible	204 (42.1)	147 (31.6)	6 (18.2)	211 (36.4)	134 (39.6)	351 (36.9)
Mucosal Retention Cyst	67 (13.8)	92 (19.8)	9 (27.2)	110 (18.9)	40 (11.8)	159 (16.7)

was seen in a total of 3 patients, 2 male and 1 female, and when examined according to age groups, 2 people in group 2 and 1 person in group 3 (at the age of 76 and older) were seen (Table 1) In our study, phleboliths were not found in any of the patients. On the other hand, 22 female and 38 male patients coincided with lymph node calcification (Table 1). Lymph node calcification was observed in 6.1% of group 1 (45-60 years old), 7% of group 2, and finally 18% of individuals in group 3 (Table 1). While styloid ligament ossification (SLO) was seen in a total of 125 patients, 69 of these cases were female and 56 were male (Figure 2). 75 of the cases are individuals in group 3 and 50 of them are in group 2 (Table 1). In group 1, this calcification was never seen. SLO is one of the most common calcification among the cases in Group 3, with 75 individuals and at a rate of 22.1% however calcified atherosclerotic plaque is the most common calcification with 156 individuals and a rate of 16.4% among calcifications (Table 1). The population with atherosclerotic plaque is included 84 are female and 72 are male people. 93 members of this population are part of group 2, 59 of them are group 3 and only 4 of them are part of group 1 (Table 1). Arteriosclerosis is another type of calcification that is rarely seen among people but in our study, it is represented by 1 person in group 3 (Table 1). Laryngeal cartilage calcification, which is seen in 36 female and 23 male individuals, is seen in group 2 with 41 individuals, and then in group 3 with 15 individuals. Finally, group 1 is stated as the least common group with

3 people (Table 1).

As well as the calcifications seen in edentulous patients, some radiolucent lesions (Figure 3b) and radiopacities (Figure 3a) may be encountered. For example, in 38 patients in total, impacted teeth were observed in equal numbers of males and females (Table 2). The distribution by age groups is as follows; group1 is with 1 person, group2 with 25 people, and group3 with 12 people too (Table 2). Infected residual roots are the most common radiopacity in edentulous patients with a total of 174 patients. This condition, distributed as 108 females and 66 males according to gender, was determined as 94 patients in group 2, 75 patients in group 3, and at least 5 patients in group 1 according to age groups (Table 2). Residual roots with mucosal retention (Figure 3d) are another common finding. In a recent study, it was seen in 20 female and 26 male patients. According to age groups, 4 patients found their place in group1, 26 patients in group 2, and 16 individuals in group3 (Table 2).

Residual roots with mucosal retention are another common finding. In this study, it was seen in 20 female and 26 male patients. According to age groups, 4 patients found their place in group 1, 26 patients in group 2, and 16 individuals in group 3 (Table 2).

Moreover, besides form all findings, foreign bodies can also be seen in edentulous jaws (Figure 3c). Foreign bodies were found in 21 patients in this study. 11 patients were

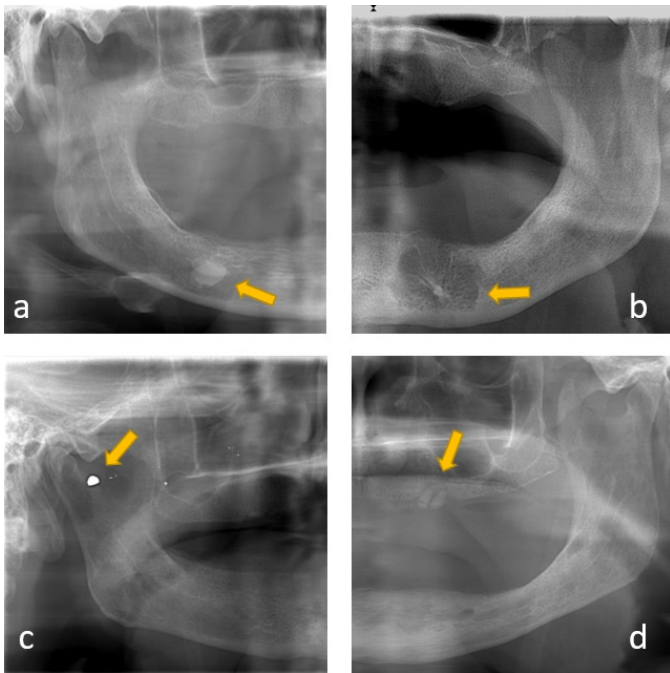


Figure 3. a: A radioopaque lesion at about mental foramina, b: A radiolucent lesion at corpus of mandible, c: A foreign body at mandibular notch, d: Two residual root at maxilla.

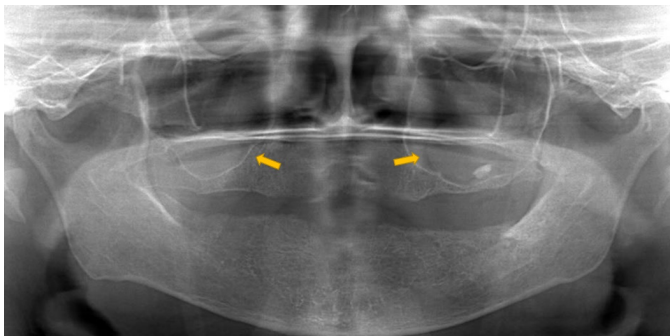


Figure 4. Bilateral mucus retention cyst.



Figure 5. Atrophy of both maxillary and mandibular crest.

found in group 2 and 10 patients in group 3. No foreign body was found in the patients in group 1 (Table 2). Mucosal retention cysts (Figure 4) were found in 67 female and 92 male patients. The distribution by age was also

examined, with 110 patients in group 2, 40 patients in group 3, and 9 patients in group 1 (Table 2).

Jaw atrophy is a common finding in edentulous patients (Figure 5). Atrophy in the posterior maxilla was observed in 368 patients, 167 of whom were female and 201 were male; Atrophy in the posterior mandible was observed in a total of 351 patients, 204 of whom were female and 147 male (Table 2).

Discussion

Calcifications occurring in the head and neck region are detected during the routine dental examination and panoramic radiographs [2]. Although soft tissue calcifications/ossifications are quite common, accurate diagnosis is important to distinguish these harmless lesions from pathologies. One of the most important purposes of DPR is to ensure that the alveolar crest and soft tissues are healthy before the planned prosthetic rehabilitation. It assists dentists to detect any infection in the jaws for pre prosthetic preparation, defects in the alveolar crest structure, and all pathologies that may bring about problems in the future when placed under the prosthesis [3-5].

It is pointed out by lots of studies that are in accordance with literature that DPR should be routinely taken before treatment due to the high prevalence of radiographic findings in patients before starting prosthetic rehabilitation. On the other hand, both clinical examination and radiological findings must be synchronized and this point plays a crucial role in evaluating effective treatment planning. During the examination, advanced imaging methods like CBCT may be needed in questionable prognoses to better diagnose with a 3D examination by using it. But there are some reasons for the limitation to routinely using CBCT such as including a high dose of radiation compared to DPR, the fact that it is still not widespread in clinics yet and its cost has increased the importance of DPR in the routine dental examination.

Soft tissue calcification/ossification rate in panoramic radiography 2.61-19% [3, 6, 7]. In the study of Mesude & Kaan Gündüz, it was found 27.64 times higher than the literature. The distribution of calcification types also varied considerably. Sutter et al. in their study, more than one calcification was observed at a rate of 1.9%, and it was seen in more than 3.7% in their study. In a recent study, the rate of any calcification was found to be 48%. In addition, the rate of co-occurrence of at least two calcifications is 6.53%.

Rizzatti-Barbosa et al. [8] reviewed 2252 panoramic radiographs of the partially edentulous adult population in Brazil and reported that most cases of SLO were bilateral and tended to occur more frequently in females aged 60-79 years [9]. In the present study, it was found that the incidence of SLO in edentulous patients increased with age; For example, while it was not encountered in group 1, it was observed in 50 patients in group 2 and 75 patients in group 3.

In addition, when evaluated in terms of gender, the incidence of SLO in the present study was in agreement with other studies in the literature, and it was found that it was more common in women than in men.

Soft tissue calcification/ossification rate in panoramic radiography 2.61-19% [6]. In the study of Mesude & Kaan Gündüz, it was found 27.64 times higher than the literature. The distribution of calcification types also varied considerably. Sutter et al. in their study, more than one calcification was observed at a rate of 1.9%, and it was seen in more than 3.7% in our study. In a recent study, the rate of any calcification was found to be 48%. In addition, the rate of co-occurrence of at least two calcifications is 6.53%.

Impacted teeth and retained root parts are the most common crucial findings which results from the evaluation of radiographs in edentulous patients. According to this previous research, the root fragments are usually located in the mandibular molar area. In our study, impacted teeth represented the second most common pathology. These root fragments were stated in the premolar-molar region of the mandibula in generally. It is difficult to carry out an operation because the reason why is about the number of roots and morphology, as they were located posteriorly. In addition to this situation, removal of these roots causes various risks of complications, such as displacement of the roots into the mandibular dangerous spaces and nerve injury (inferior alveolar nerve, mental nerves, and lingual) [10].

In the studies, it was confessed that the ratio of RL lesions in total edentulous patients varies between 1.2-9.9% [3, 11, 12]. In the present study, this ratio was appointed as 2.5% and it is coherent along with the literature.

The rates of radiopacity findings detected in the studies were between 1.5-12.9% [3, 11, 13], and the rate in the present study was found 10.3%, which is similar to compared these studies [4, 14].

The prevalence of foreign body findings distance between 2.2-8.8% in studies [7, 15, 16]. It is clearly stated that the findings related to the prevalence of foreign bodies in the present study are consistent with these studies by 2.2% ratio.

In the former studies [3, 7, 12, 17-19] the ratio of crest atrophy indications in the area of posterior maxillary bone distance between 8.5% and 30.6%, however it was slightly higher than others with 38.7% proportion in the present study having crest atrophy at the area of maxilla posterior. In these studies, data about the height of atrophic crest, completely edentulous times of the patients, and added that where the age groups were contained, were not presented in detail. The fact that the increase in age and edentulism period can be thinkable the increase in resorption may explain the high rate of atrophy but in our study group 2 patients are the most influenced by crest atrophy. Namely, according to the present study, the idea that crest atrophy may increase with age was refuted.

Some studies about this topic were defined that the rates of the crest atrophy in which the posterior regions of the mandible diverse between 1.7 and 4.4%. This distribution was found to be much higher (36.9%), in the present study [12, 17]. The studies which are in the past had a lower rate. This condition is seen less commonly because of arising from the evaluation of cases where mental foramen is located over the crest as an atrophy criteria for the mandible.

In the present investigation, the inadequate range between the alveolar crest, and both mandibular canal and mental foramen upper border was imagined as atrophy because this point is with regards to both overdenture prosthesis which is along with implants and conventional prosthetic rehabilitation [3].

This study has some restrictions such as it can be itemized by using only DPR images without clinical examination, this situation has a difficulty in separating from other similar lesions with panoramic radiograph image, and the incapacity to make certain recognition. When there is a need for a more exhaustive assessment, a CBCT examination may be called for [11]. Moreover, DPR is an imaging method which has two dimensional that restricts the detailed examination of certain anatomical situations or pathologic lesions. Nevertheless CBCT imaging does not use easily and commonly for everyone, DPR in which is used routinely and common and thus we use it for the present study frequently.

Conclusion

The outcome of this examination indicated that the ratio of advantageous points fixed in digitalised panoramic radiographs of totally edentulous patients was highly rated. It is clearly stated that all findings contribute to how the ways about our understanding of panoramic radiograph examination and provide a basis for the most effective medical examination. There are indispensable for patients with total edentulism such as use routinely and examination of panoramic images should be carefully.

Ethics approval

Ethics Committee of the Faculty of Dentistry of Necmettin Erbakan University, with the decision numbered 2022/16-109.

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