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Original Research

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Prevalence of edentulousness, prosthetic need and panoramic radiographic findings of totally and partially edentulous patients in a sample of Turkish population

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ABSTRACT

Objective: The aim of this study was to investigate the panoramic radiographic findings of totally and partially edentulous patients and to reveal the significant role of radiographic evaluations before prosthodontic treatment in a sample of Turkish population. **Materials and Methods:** A total of 845 patients referred to our hospital for removable dentures were selected. All the patients were totally or partially edentulous. The patients had clinical and radiographic examinations. All the radiographs were evaluated for significant radiographic findings as follows: Retained root fragments, embedded teeth, radio-lucencies, radio-opacities, maxillary sinus position and the location of the mental foramen. The obtained data were analyzed using descriptive statistics. **Results:** Positive radiographic findings were found in 40.47% of the patients who referred for removable prosthesis. Totally 84 retained roots were found in 74 patients; 64 (76.2%) of them have only one, and 10 (11.9%) have two retained roots. A total of 49 impacted teeth were found in 42 patients. According to our evaluation, 4.1% of patients ($n = 35$; female 17, male 18) have one; 0.8% of patients ($n = 7$; female 3, male 4) have two embedded teeth. Migrated sinus floor to the alveolar ridge was the most observed finding (37.5%), followed by resorption of the alveolar ridge (4.5% of the patients, $n = 38$) in the mental region. Moreover, 16 soft tissue calcifications, 12 osteosclerosis and 11 foreign bodies were found. **Conclusions:** Radiographic examination is crucial for pre-prosthetic evaluation on partially or totally edentulous patients that should consider as the first step to avoid the repetition of prosthetic rehabilitation, time waste, prestige loss and high treatment costs.

KEY WORDS: Dental health, dental hygiene, elderly, radiographic examination, prosthodontic rehabilitation

INTRODUCTION

Tooth loss and its replacement have been a major health problem as long as mankind has existed. Tooth loss is a condition that affects people's quality-of-life by creating various problems such as speech, chewing, nutrition, social and psychological [1-4]. Although aging is not mentioned as the definite cause of tooth loss, it is among predisposing factors by relating the increase of systemic diseases and functional disabilities. Improving life standards by restoring function and esthetics is the main goal of the rehabilitation of removable denture users, especially elderly patients [1,5,6]. To avoid the problems that appear in edentulousness and to obtain a function, foundation and esthetics, effective diagnosis and treatment methods should be chosen to meet the needs and expectations [7,8].

Several treatment methods have been utilized for thousands of years. Although the dental implant applications are the most accepted method for the clinicians, because of various disadvantages such as difficulty of application, lack of patient's tolerance and economic reasons, the use of removable dentures appears as the best alternative method that cannot be ignored [9]. Whatever, the chosen treatment method should provide maximum benefits. In addition, it should be noted that maximum benefits can only be achieved through denture's stability and retention [8,10]. Moreover, because of bone resorption, prosthetic applications may be difficult in edentulous patients; for instance, the mandibular removable denture base should cover the mandibular retromolar regions to provide proper basal seal and denture function [11].

Knowing the exact anatomic locations of the jaws can lead to a more positive and retentive border seal in designing removable dentures. Besides to avoid complications on prosthetic rehabilitation, anatomical features must be well-known and abnormalities in the jaws such as foreign bodies, embedded teeth, retained roots, radio-lucencies or radio-opacities should be well-evaluated [12]. For this instance, panoramic radiography is the most encountered radiographic modality for pre-prosthodontic purposes [12,13].

In the literature, previous studies reported the significance of radiographic examinations of total edentulous patients [8,10,14-16]. However, the information for partially edentulous patients before prosthetic treatment is limited. To the best of our knowledge, no studies have been reported in the literature on radiographic findings of partially edentulous patients. Hence, it was considered worthwhile to investigate the panoramic radiographic findings of totally and partially edentulous patients and to reveal the significant role of radiographic evaluations before prosthodontic treatment in a sample of Turkish population.

MATERIALS AND METHODS

Patients and Procedure

A total of 1358 patients referred to our hospital for prosthetic rehabilitation were selected for this retrospective and descriptive study. All the patients were examined and evaluated of their needs and expectations. The patients who are been treated by fixed dentures or the patients who had only one or two missing teeth were excluded. Totally 845 patients who have a lot of missing teeth and are not been treated by fixed dentures were included to the study and informed about their needs and the prosthetic treatment alternatives.

Although this study was based on retrospective evaluation of radiographs, ethical approval was obtained from the local Ethical Committee. Before taking any radiograph or intra/extra-oral examination, patients gave their informed consent prior to radiography and examinations according to the principles of the Helsinki declaration, including all amendments and revisions. Collected data were only accessible to the researchers. No preferences were made about gender regarding sample choice. Only high-quality images were included. Images with low quality, such as those with scattering or insufficient accuracy of bony borders or magnification, as well as artifacts, were excluded.

All the patients applied and agreed for a fabrication of a new or renew removable dentures due to lack of time, fear of application, contraindications of dental implant treatment or economic reasons. Panoramic radiographs were taken from all of the patients using Kodak 8000C digital panoramic system at 78 kV and 12 mA exposure settings. All the radiographs were evaluated by a dentomaxillofacial radiologist who has 10 years of experience in the basis of the radiographic findings such as retained root fragments, embedded teeth, radiolu-cencies, radio-opacities, maxillary sinus migration and location of the mental foramen.

Statistical Analysis

The agreement between age-related variations and normal distribution was tested with the Shapiro–Wilk test. The descriptive statistics of age-related variables, which is skewed were shown as median (interquartile range [IQR]). The Mann–Whitney test was used to compare the differences between sex and age groups. Relations between categorical variables such as sex, prosthetic needs (total or partial) were tested with Chi-square test by creating cross tabulations. Statistical analyses were performed using the SPSS software (version 15.0; SPSS Inc., Chicago, IL, USA) and MS Excel 2003. $P < 0.05$ was considered as statistically significant.

RESULTS

Eight-hundred and forty-five from 1358 patients (62.22%) ranging between 46 and 81 years of age who have referred for their prosthetic needs were included to the study. Out of the 845 patients, 408 (48.3%) were females and remaining 437 (51.7%) were males. Average age for female patients was 64 (IQR = 16), and for males 64 (IQR = 17). There was no statistical difference between male and female patients' age ($Z = 0.132$, $P = 0.895$).

Out of 408 females, 198 (48.52%) were already wearing dentures and 210 (51.48%) were referred first time for a denture. Out of 437 males, 193 (44.16%) already have a denture and 244 (55.84%) were newly totally or partially edentulous patients.

Table 1 shows the relation among gender, prosthetic needs and reasons for referring. The patients who needed a removable prosthesis as first time consisted of 46.3% females and 53.7% males. There was no statistical difference between sex and the reasons for referring ($\chi^2 = 1.617$, $P = 0.204$). The patients who needed mandibular total denture were 66.7% females and 33.3% males. The other prosthetic needs were nearly the same in both genders. However, there was no statistically difference between sex and prosthetic needs ($\chi^2 = 10.033$, $P = 0.187$).

Investigating the relations between reasons for referring and prosthetic needs, 11 out of 15 patients (73.3%) of the patients who needed mandibular total denture were referred for renew and 4 of them (26.7%) were referred for the first time. The other rates between prosthetic needs and reasons for referring were nearly the same ($\chi^2 = 7.307$, $P = 0.398$). Relatively lower amount of patients who needed only mandibular total prosthesis can be the reason for the significant differences.

According to routine panoramic examination, it should be noticed that several findings such as retained root fragments, embedded teeth, radio-lucencies, radio-opacities, location of mental foramen and migrated maxillary sinuses were observed. 771 (91.2%) of the patients showed no retained root, 64 (7.6%) of them have only one, and 10 (1.2%) have two retained roots. Distribution of sex and the location of retained root fragments are shown in Table 2. A higher incidence of retained root fragments was detected in mandibular and maxillary posterior region in both genders. Regarding location of retained root fragments according to gender, no statistically significant difference was found between men and women ($P > 0.05$).

Distribution of embedded teeth was shown in Table 3. Totally 49 impacted teeth were found in 42 patients. According to our evaluation, 4.1% of patients ($n = 35$; female = 17; male = 18) have one; 0.8% of patients ($n = 7$; female = 3; male = 4) have two embedded teeth. Out of 49 embedded teeth in 42 patients, 23 (5.6%) were females and 19 (4.3%) were males. As a result, incidence of impacted teeth was not found statistically significant in both sexes ($\chi^2 = 3.609$, $P = 0.057$). As a special note, maxillary canine impaction was the most seen tooth impaction ($n = 21$), followed by maxillary third molars ($n = 15$) and mandibular third molars ($n = 10$).

According to Table 4, which was constituted based on radio-lucencies, radio-opacities and the mental foramen position to the alveolar ridge, migrated sinus floor is the most seen problem on panoramic radiographs. It was detected that 317 (37.5%) of the patients have migrated maxillary sinus (female = 157, male = 160), followed by 38 (4.5%) of patients with the decreased distance of mental foramen to the alveolar ridge. 16 (1.9%) of the patients have soft tissue calcifications (female = 8, male = 8), 12 osteosclerosis (female = 1, male = 11), and 11 foreign bodies (female = 7, male = 4).

Distribution to the prosthetic needs was shown in Table 5. One hundred twenty-nine totally and 188 partially edentulous jaws with migrated maxillary sinus were found. The mental foramen was situated at the crest of residual alveolar ridge in 38 totally edentulous arches, whereas no mental foramen at the top of the alveolar bone in partially edentulous arches was detected.

Table 1: Distribution of the reasons for referring and prosthetic need according to gender

	n (%)		Female versus male	
	Female	Male	χ^2	*P*
Reasons for referring				
First time need	210 (46.3)	244 (53.7)	1.617	0.204
Renew	198 (50.6)	50.6 (50.6)		
Prosthetic need				
Totally edentulousness	73 (47.7)	80 (52.3)	10.033	0.187
Maxillary and mandibular partial denture	116 (54.2)	98 (45.8)		
Mandibular edentulousness, maxillary partial denture	11 (50)	11 (50)		
Mandibular partial denture, maxillary edentulousness	19 (34.5)	36 (65.5)		
Mandibular edentulousness	10 (66.7)	5 (33.3)		
Maxillary edentulousness	6 (50)	6 (50)		
Mandibular partial denture	106 (47.1)	119 (52.9)		
Maxillary partial denture	67 (45)	82 (55)		

Table 2: Distribution of root fragments to locations according to gender

Location	Retained root fragments (*n* (%))		
	Female	Male	Total
Maxillary anterior	6 (20)	6 (11.1)	12 (14.3)
Maxillary posterior	9 (30)	26 (48.1)	35 (41.7)
Mandibular anterior	1 (3.3)	0 (0)	1 (1.2)
Mandibular posterior	14 (46.7)	22 (40.7)	36 (42.9)
Total	30 (100)	54 (100)	84 (100)

Table 3: Distribution of embedded teeth according to gender

Teeth number	Embedded teeth (*n* (%))		
	Female	Male	Total
13	6 (20.7)	4 (20)	10 (20.4)
15	0 (0)	1 (5)	1 (2)
18	5 (17.2)	4 (20)	9 (18.4)
23	7 (24.1)	4 (20)	11 (22.4)
28	1 (3.4)	5 (25)	6 (12.2)
29	1 (3.4)	1 (5)	2 (4.1)
38	6 (20.7)	1 (5)	7 (14.3)
48	3 (10.3)	0 (0)	3 (6.1)
Total	29 (100)	20 (100)	(100)

Table 4: Frequency of radio-lucencies, radio-opacities and mental foramen position according to gender

Cases	Gender (*n* (%))		
	Female	Male	Total
Radio-lucencies			
None	248 (60.8)	277 (63.4)	525 (62.1)
Migrated sinus	157 (38.5)	160 (36.6)	317 (37.5)
Residual cyst	2 (0.5)	0 (0)	2 (0.2)
Residual infection	1 (0.2)	0 (0)	1 (0.1)
Radio-opacities			
None	342 (83.9)	359 (82.2)	701 (83)
Osteosclerosis	1 (0.2)	11 (2.5)	12 (1.4)
Soft tissue calcifications	8 (1.9)	8 (1.8)	16 (1.9)
Maxillary sinus polyp	0 (0)	1 (0.2)	1 (0.1)
Mucous retention cyst	2 (0.5)	0 (0)	2 (0.2)
Mucosal thickening	48 (11.8)	54 (12.4)	102 (12.1)
Foreign bodies	7 (1.7)	4 (0.9)	11 (1.3)
Mental foramen position			
Negative	392 (96.1)	415 (95)	807 (95.5)
Positive	16 (3.9)	22 (5)	38 (4.5)

Table 5: Distribution of prosthetic needs versus frequency of radio-lucencies, radio-opacities and mental foramen position

Cases	Prosthetic needs of the patients (*n* (%))							
	Totally E.	Mandibular and maxillary partial E.	Mandibular E., maxillary partial E.	Mandibular partial E., maxillary E.	Mandibular E.	Maxillary E.	Mandibular partial E.	Maxilary partial E.
Radio-lucencies								
None	62 (40.5)	105 (49.9)	14 (63.6)	23 (41.8)	15 (100)	5 (41.7)	225 (100)	76 (51)
Migrated sinus	90 (58.8)	107 (50)	8 (36.4)	32 (58.2)	0 (0)	7 (58.3)	0 (0)	73 (49)
Residual cyst	1 (0.7)	1 (0.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Residual Infection	0 (0)	1 (0.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Radio-opacities								
None	107 (69.9)	176 (82.3)	11 (50)	39 (71)	15 (100)	10 (83.3)	216 (96)	127 (85.2)
Osteosclerosis	6 (3.9)	1 (0.5)	0 (0)	3 (5.5)	0 (0)	0 (0)	2 (0.9)	0 (0)
Soft tissue calcifications	2 (1.3)	2 (0.9)	3 (13.6)	3 (5.5)	0 (0)	0 (0)	6 (2.7)	0 (0)
Maxillary sinüs polyp	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.7)
Mucous retention cyst	0 (0)	1 (0.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.7)
Mucosal thickening	38 (24.9	28 (13)	5 (22.8)	9 (16.2)	0 (0)	2 (16.7)	0 (0)	20 (13.4)
Foreign bodies	0 (0)	6 (2.8)	3 (13.6)	1 (1.8)	0 (0)	0 (0)	1 (0.4)	0 (0)
Mental foramen position*								
Negative	116 (75.8)	214 (100)	21 (95.5)	55 (100)	15 (100)	12 (100)	225 (100)	149 (100)
Positive	37 (24.2)	0 (0)	1 (4.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total	153 (100)	214 (100)	22 (100)	55 (100)	15 (100)	12 (100)	225 (100)	149 (100)

E.: Edentulousness, *Mental foramen position (positive/negative) term is used to describe whether the mental foramen is located at the tip of the alveolar ridge or not

DISCUSSION

The goal of modern dentistry is to obtain maximum benefits from dentures by using stability and retention. This can only be achieved by an effective clinic and radiographic examination. Before prosthetic rehabilitation supporting bone levels and vertical bone heights should be evaluated with radiographic techniques [8,17]. For this reason, panoramic radiography in which an image of both jaws can be produced on one film with relatively low dose of radiation is widely used in general dental practice. It is commonly used in routine examinations to reveal pathologies and vertical heights of bones, especially in prosthetic rehabilitation of totally or partially edentulous patients [13,18-21].

The panoramic radiographic examination of 845 totally or partially edentulous patients in the present study revealed positive radiographic findings with a rate of 40.47%. The results are a little different from the other studies in literature. A possible reason may be the inclusion of the migration of maxillary sinus as positive radiographic findings. In the literature from the 80's, 22.2-42.5% positive radiographic findings were found [22-24]. These studies contain not only totally, but also partially edentulousness. In more recent studies, which contain only totally edentulousness the rates were found between 20 and 47.6% [25,26]. This significant difference may be caused by different samples and methods.

Most of the retained root fragments are found in molar region in both jaws. 84 root pieces were found in 74 patients (8.7%). Out of total 84 root pieces, 71 (84.52%) are present in molar region of maxilla and mandible; 35 of them were in maxilla and 36 were in mandible. Hastar *et al.* [15] reported 31 retained roots in 106 patients; however, in their report the mostly retained roots seen area was the maxilla (64.5%), but they did not indicate anterior or posterior region. Another report, made by Mehdizade and Seydemir [16], indicated that 25.5% of 192 edentulous patients have retained roots. Edgerton and Clack [27] found 8% in 308, and Sumer *et al.* [26] reported 67 retained roots in 338 edentulous patients. Jindal *et al.* [8] reported retained roots in molar region (57%); they also reported that the majority of retained root pieces were present in maxillary molar region, and they emphasized on the need of careful extraction in the maxillary left quadrant. Similar results were presented by Ardakani and Azam [12], who detected 36 retained roots in the anterior parts of the jaws and 155 in the posterior parts; the prevalence of retained roots was 25.5%. Kaimenyi *et al.* [28] reported this prevalence to be 17.3%, Ritchie and Fletcher [29] as 45%, and Soikkonen [30] reported that the prevalence of retained roots ranges between 9 and 75% in different populations.

In addition to this subject, the retained root fragments are related to several factors The reason may be attributed to the wrong extraction technique, lack of clinician experience and not using any radiographic modalities before and after extraction procedure. However, we agreed with the other authors about the reasons, but we do not insist that clinicians should be more careful only in maxillary left quadrant. No matter left or right, we believe that the clinicians should be careful in whole quadrants.

Removal of retained root fragments is still controversial. The retained root stumps which are not associated with any pathological changes may not be removed to preserve the integrity of the edentulous ridges. In addition, if there is a close relationship between root fragments and some anatomic structures such as mandibular canal, maxillary sinus and mental foramen, fragments can be retained unless they were not associated with any pathologies [8]. In such a case, patients should be informed about their situation and recall follow-up radiographic examinations should be done. If any pathological changes were detected they should be extracted as soon as

possible with the aim of not to serve as a potential source of infection. The elimination of any potential source of infection is very important procedure for elderly people who have commonly encountered situations such as prior to transplantations, cardiovascular surgery, radiotherapy, chemotherapy, etc. [31,32].

The occlusal forces and atrophy are close related terms, which proceed like a chain reaction. Occlusal forces are transmitted directly to the mucosa and alveolar bone by dentures and can cause overloading, which might lead to bone resorption and atrophy [33]. The migration of maxillary sinus floor and the change of the mental foramen to the tip of the alveolar ridge can occur as a result of alveolar bone atrophy. Bone resorption and vertical heights of the bone play an important role to choose alternative approaches on prosthetic rehabilitation [17,18].

Misch [34] had reported that tooth loss was one of the reasons of bone resorption. Wical and Swoope [35] determinated residual alveolar ridge levels only in mandibular premolar region. Xie *et al.* [19] found significant differences between edentulous and dentate subjects and reported that vertical bone heights of the edentulous patients were less than in dentate individuals in both jaws. Saglam [21] revealed that the height of the mandible was significantly greater in dentate men than dentate women; on the other hand, he reported that the height of the maxilla and mandible was greater in men than in women among edentulous patients. As a result of bone atrophy, migration of the sinus can be seen and mental foramen can be located at the tip of the residual ridge. The relationship between mental foramen and residual alveolar ridge plays an important role in prosthetic rehabilitation. In the cases in which the mental foramen was located at the top of the alveolar bone, pain or numbness could be seen in the area due to compression caused by denture.

In our study, the mental foramen was near the tip of the residual ridge in 24% of totally edentulous patients (34 of 154 patients who needed total prosthesis). This is nearly similar to the prevalence reported by Jones *et al.* [36] which was 22%. However there are relatively higher prevalence rates in literature [10,24]. But in contrast, Jones *et al.* [36] and Soikkonen *et al.* [37] mentioned that mandibular bone resorption is more than in maxilla. In our study, we obtained similar results with Ardakani and Azam [12] in the basis of common resorption region but with different percentages. Moreover, the same researchers found maxillary alveolar resorption as 68.2%, and 49% in mandible [12]. In another report by Soikkonen *et al.* [38], the prevalence of mental foramen at the tip of the alveolar ridge was found to be 42%. Hastar *et al.* [15] found 51 cases that have mental foramen near to the alveolar ridge in 106 edentulous patients.

Previously mentioned reports were mostly from totally edentulous patients [8,10,14-16]. But in this study we wanted to reveal radiographic findings from all patients who referred for their prosthetic needs, not only for totally edentulous patients, as result, in partially edentulous patients no mental foramen was found located at the tip of the alveolar ridge. This result supports the differences between bone levels of dentate and edentulous jaws in line with the literature [19,34].

In addition to mandibular bone resorption, maxillary sinus migration should be considered as a result of maxillary bone resorption. Scarce reports exist in literature about maxillary sinus migration: Hastar *et al.* [15] found 38 migrated sinus cases in 106 edentulous patients; Ardakani and Azam [12] reported that the prevalence of maxillary sinus migrated to the tip of the residual ridge was 68.2%; Sumer *et al.* [26] reported 29 among 338 patients (8.5%) with migrated sinus. In this study, we found 37.5% of maxillary sinus migration in 845 patients and maxillary sinus migration was the most common situation in partially edentulous patients group; 188 migrated maxillary sinus were found in patients who needed partially removable prosthesis (22.24% overall), 129 (58.6%) maxillary sinus migrations were detected in 220 edentulous maxillary arches.

The presence of embedded teeth is another important radiological finding that should be considered prior of prosthetic rehabilitation. Jindal *et al.* [8] reported to have found 34 embedded teeth in 25 patients. Ansari [14] reported only three molar teeth were found in 572 edentulous arches, and Aydin *et al.* [39] reported 3.58% canine impaction on 4500 panoramic radiographs. Ardakani and Azam [12] found 28 (6.3%) impacted teeth in 447 edentulous patients. Hastar *et al.* [15] found 7 impacted canines and third molars in 106 edentulous patients. Mehdizade and Seydemir [16] found 6.3% of 192 edentulous patients with impacted teeth. Edgerton and Clack [27] found 3% in 308, Sumer *et al.* [26] reported 21 impacted teeth in 338 edentulous patients. In the present study, we found 49 (5.7%) impacted teeth in 845 patients; totally 14 impacted teeth (8 canines, 6 third molars) were found in 373 edentulous arches. According to our results, frequency of impacted teeth in edentulous patients shows agreement with literature.

Sclerotic bone islands were one of positive findings in edentulous patients. According to literature, frequency rates of dens bone islands show variety between 0.3 and 63.5% [8,12,15,16]. Some authors defined dens bone islands as condensing osteitis [12,16], and some are defined as osteosclerosis [8,15]. Condensing osteitis is defined as pathologic growth of bones by mild clinical symptoms. The bone thickening reflects the impaired bone rearrangement in response to mild infection of dental pulp. It is caused by mild chronic irritation of the root canal [40-42]. Condensing osteitis should be differentiated from idiopathic osteosclerosis, which is mostly unrelated to pathologic lesions of dental pulp, and is neither an inflammatory nor a neoplastic process [43,44]. According to definitions previously mentioned, at least one tooth must be available to describe dens bone islands as "condensing osteitis" or "idiopathic osteosclerosis." With relation to our main topic, that is., edentulousness and concerned edentulous regions, we suggest that dens bone islands should be defined as "osteosclerosis" in present study. Mehdizade and Seydemir [16] reported 63.3% and Ardakani and Azam [12] reported 63.5% of condensing osteitis as positive radio-opaque findings. Jindal *et al.* [8] reported 31 (5.9%) osteosclerosis cases in 525 patients, Hastar *et al.* [15] reported only 4 (0.3%) osteosclerosis in 106 patients. In our study we found 12 (1.4%) osteosclerosis among 845 patients; 6 of them were detected in the 153 edentulous patients (3.9%). In addition to osteosclerosis, another radio-opaque finding was foreign

bodies, a relative rare condition. One report emphasized only in one case [8], and another reported two foreign bodies [15]. In our work, no foreign body in the basis totally edentulousness was found, but a total of 11 (1.3%) foreign bodies were detected in 845 cases.

The mucosal lining of maxillary sinus is composed of respiratory epithelium and has normally about 1 mm thickness similar to the other paranasal sinuses' structure. Normal sinus mucosa is not visualized on radiographs unless the mucosa becomes inflamed from an infectious or allergic process. As a result of this process mucosal thickness increases 10 or 15 times and it may be seen radiographically [13,45]. Only scarce work exist in literature emphasizing mucosal thickening varying with reports among 2.07-42.26%; mucosal thickening was found 2.07% by Hastar *et al.* [15] in 106 patients, 42.26% by Mathew *et al.* [45] in 105 patients, and 23.3% by Maestre-Ferrin *et al.* [46] in 30 patients. The differences between these reports may be caused by patient selection or applied methods. In the present work, we found 12.1% of mucosal thickening in 845 patients; if mucosal thickening is considered solely in totally edentulous patients as made by Hastar *et al.* [15] reported, the rate rises to 24.9%.

According to the American Dental Associations' guide to dental health report, the public was informed that "an X-ray examination is performed only when necessary, not as a routine procedure, and only when the dentist believes such an examination will benefit health." As adherence to the previously mentioned principles and together with developing imaging technology, more effective radiographic images can be obtained by relatively less radiation exposure [47,48]. In consequence, radiographic examination is crucial for pre-prosthetic evaluation on partially or totally edentulous patients that should considered as the first step to avoid the repetition of prosthetic rehabilitation, time waste, prestige loss and high treatment costs.

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