Evaluation of dental panoramic radiographic findings in edentulous jaws: A retrospective study of 743 patients "Radiographic features in edentulous jaws"

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PURPOSE. The aim of this study was to determine the frequency of significant panoramic radiographic findings and eventual treatment requirements before conventional or implant supported prosthetic treatment in asymptomatic edentulous patients. **MATERIALS AND METHODS.** A total of 743 asymptomatic edentulous patients were retrospectively evaluated using a digital panoramic system. We analyzed the radiographic findings, including impacted teeth, retained root fragments, foreign bodies, severe atrophy of the posterior maxillary alveolar bone, mucous retention cysts, soft tissue calcifications and radiopaque–radiolucent conditions. **RESULTS.** Four-hundred-eighty-seven (65.6%) patients had no radiographic finding. A total of 331 radiographic findings were detected in 256 (34%) patients. In 52.9% (n=175) of these conditions, surgical treatment was required before application of implant-supported fixed prosthesis. However, before application of conventional removable prosthesis surgical treatment was required for 6% (n=20) of these conditions. **CONCLUSION.** The edentulous patients who will have implant placement for implant-supported fixed prosthesis can frequently require additional surgical procedures to eliminate pathological conditions. ***[J Adv Prosthodont 2015;7:380-5]***

KEY WORDS: Edentulous patient; Panoramic radiography; Treatment planning; Diagnosis

INTRODUCTION

Panoramic radiography is a cost-effective, low-dose method used in dental radiology for evaluating oral health status in routine dental practice.[1] This technique allows examination of the maxillary and mandibular arches and their supporting structures on a single image.[2,3] The advantages of panoramic radiography are time-saving, broad anatomic coverage, and high patient acceptability.[3,4] Abnormalities such as root fragments, impacted teeth, neoplasms, and foreign bodies are often overlooked when they do not cause symptoms or clinical signs.[5]

Panoramic radiography is often used in routine examinations of edentulous jaws to detect asymptomatic conditions such as root fragments, retained teeth, radiolucent lesions, and foreign bodies.[6,7] Thus it is a valuable diagnostic tool in prosthetic treatment planning. In addition, they provide the clinician with information about the sinus floor position in edentulous regions for implant placement.

Several studies have been carried out including the occurrence rate of these asymptomatic pathologies.[2,4,6,7] However, only a few studies have documented the rate of these radiographic findings requiring treatment.[4-7] Consequently, the aim of this study was to report the frequency of significant radiographic findings, to discuss utility of panoramic radiographs and to obtain the rate of the conditions which treatment is necessary before conventional or implant supported prosthetic rehabilitation in edentulous patients.

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MATERIALS AND METHODS

This retrospective study investigated 743 patients who applied to Istanbul University Department of Dentomaxillofacial Radiology between 2009 and 2011. All of the patients were edentulous in both jaws and considered for dentures. A retrospective analysis was carried out of using panoramic radiographs taken either due to patient complaints or prior to prosthetic denture treatment, using a panoramic machine (Kodak 8000 Digital Panoramic Machine, Carestream Health, Inc., Rochester, NY, USA) with 60 - 85 kVp and 10 mA, with total filtration of 2.5 mm aluminum.

Clinically, all of the patients were asymptomatic. The radiographs were evaluated by four oral radiology specialists and one oral surgery specialist for impacted teeth, retained root fragments, radiolucencies, radiopacities, foreign bodies, proximity of the maxillary sinus to the crest of the residual alveolar ridge, soft tissue calcifications, and mucous retention cysts.

The maxilla and mandible were divided into three areas-right and left posterior (includes bilateral premolar and molar teeth regions) and anterior (includes incisors and canines region)-for evaluation of root fragments and radiolucent–radiopaque areas. The maxilla was divided into two areas, left and right, for evaluation of mucous retention cysts and proximity of the maxillary sinus to the crest of the residual alveolar ridge. The patients whose subantral residual bone height is 1 - 2 mm on panoramic radiography (precise indication for lateral maxillary sinus lift procedures) were included in the study. Soft tissue calcifications (STC) were divided into three parts according to their location. The area number 1 (STC1) indicates possible tonsilloliths, parotid calcifications, possible tonsilloliths and parotid calcifications; the area number 2 (STC2) indicates possible submandibular calcifications and lymph node calcifications; and area number 3 (STC3) indicates possible carotid calcifications.

All of these pathologic entities were included. Then, two different options of prosthetic rehabilitation were planned for each subject including conventional removable prosthesis and implant supported fixed prosthesis. The patients who required surgical treatment for each treatment modality were determined based on radiographic findings. Exclusion criteria were poor quality radiographs and disagreement between evaluators.

RESULTS

Out of 743 patients, 428 (57.6%) were female and 315 (42.4%) were male. The mean age of the patients was 59.42; minimum age was 16 and maximum age was 88. A total of 331 significant radiographic findings were detected in 256 patients. Among these 256 patients, 125 (49%) were female and 131 (51%) were male. The frequency of radiographic findings and the findings which required treatment before conventional or implant supported prosthetic treatment are summarized in Table 1.

Seventy-four patients had proximity of the maxillary sinus to the crest of the residual alveolar ridge. Soft tissue calcifications were detected in 64 (6%) patients. The frequency of the subjects with posterior atrophic maxilla, soft tissue calcifications and mucus retention cysts are shown in Table 2.

Table 1. Frequency and percentage of radiographic findings among patients and number of these radiographic findings that require treatment for conventional removable prosthesis and implant supported prosthesis

Radiographic findings	Number of radiographic finding (n)	Frequency %	Treatment is required before implant placement (n)	%	Treatment is required before removable prosthesis (n)	%	Significant radiographic finding(s) number	Patient (n)	%
Impacted tooth	36	4.8	29	80.6	6	16.7	0	487	65.6
Retained root fragments	71	9.5	52	73.2	12	16.9	1	153	20.6
Radiolucencies	12	1.6	1	8.3	1	8.3	2	80	10.7
Radiopacities	11	1.5	1	9	1	9	3	19	2.6
Foreign bodies	16	2.2	3	18.8	0	0	4	4	0.6
Posterior atrophic maxilla	74	10	74	100	0	0	Total	743	100
Soft tissue calcifications	64	6	0	0	0	0	No radiographic finding	487	65.6
Mucous retention cysts	47	6.3	15	31.9	0	0	At least 1 radiographic finding	256	34.4
Total	331	-	175	52.9	20	6			

Table 2. Distribution of maxillary sinus findings

Radiographic findings	Right side (%)	Left side (%)	Both sides (%)	Total (%)
Posterior atrophic maxilla (Maxillary sinus proximity to crest)	25 (33.8)	17 (23.0)	32 (43.2)	74 (100)
STC1	16 (69.6)	5 (21.7)	2 (8.7)	23 (100)
STC2	18 (60.0)	6 (20.0)	6 (20.0)	30 (100)
STC3	8 (72.7)	3 (27.3)	-	11 (100)
Mucous retention cyst	13 (27.7)	19 (40.4)	15 (31.9)	47 (100)

STC: Soft Tissue Calcification; STC1: possible tonsilloliths, parotid calcifications; STC2: possible submandibular calcifications and lymph node calcifications; STC3: possible carotid calcifications.

Table 3. Distribution of retained root fragments, radiolucencies, radiopacities

Radiographic Findings	RMaxP (%)	AMax (%)	LMaxP (%)	LManP (%)	Aman (%)	RManP (%)	Total (%)
Retained root fragments	24 (33.8)	13 (18.3)	16 (22.5)	7 (9.9)	4 (5.6)	7 (9.9)	71 (100)
Radiolucencies	3 (25.0)	4 (33.4)	1 (8.3)	-	3 (25.0)	1 (8.3)	12 (100)
Radiopacities	2 (18.2)	2 (18.2)	3 (27.2)	4 (36.4)	-	-	11 (100)
Foreign body	3 (18.7)	2 (12.5)	-	5 (31.3)	-	6 (37.5)	16 (100)

RMaxP: Right maxillary posterior area, AMax: Anterior maxillary area, LMaxP: Left maxillary posterior area, LManP: Left mandibular posterior area, Aman: Anterior mandibular area, RManP: Right mandibular posterior area.

Seventy-one root fragments were detected in 60 (8%) of the 743 patients. Of the 60 patients who had root fragments, 50 (83%) had one root fragment, nine (15%) had two, and only one (2%) patient had three root fragments. A total of 12 radiolucencies were found in the study. One were (8%) residual cyst, 11 (92%) were idiopathic bone cavity. All of the radiolucent areas had well-defined borders. A total of 11 radiopacities were found in the study. Nine (82%) radiopacities had well-defined borders and two (18%) had diffuse borders. All of them were diagnosed as osteosclerosis. A total of 16 foreign bodies were found among all subjects. Three (19%) were extruded root canal materials, 13 (81%) were other foreign bodies including eleven (69%) retained amalgam fragments and two (12.5%) gunshot fragments. The distribution of the foreign bodies, root fragments and radiopaque–radiolucent conditions are shown in Table 3.

A total of 36 (5%) impacted teeth were found in 27 different patients. Nineteen patients (70%) had only one impacted tooth, seven (26%) had two impacted teeth, and one (4%) had three impacted teeth. The distribution of the impacted teeth among regions is shown in Table 4.

Table 4. Distribution of impacted teeth

Impacted teeth			
Right maxillary area		Left maxillary area	
C:	8	C:	10
SP:	1	SP:	9
TM:	4	TM:	-
T:	13	T:	19
Right mandibular area		Left mandibular area	
C:	-	C:	-
SP:	-	SP:	-
TM:	1	TM:	3
T:	1	T:	3

C: Canine, SP: Second Premolar, TM: Third Molar, T: Total number of impacted teeth

DISCUSSION

One of the most important goals of panoramic imaging is to detect any underlying pathology of both maxilla and mandible before prosthetic treatment.[8] Moreover, many reports have concluded that due to the high percentage of significant radiographic findings, radiographic screening should be required in all edentulous patients.[6,7] Similarly, our study showed that most of significant findings are easily detected on the panoramic radiographs of edentulous jaws.

The most important limitation of this study is that the treatment planning was performed by using radiographic findings. In fact, both clinical and radiological correlation is very important to assess effective treatment planning and 3-D evaluation by using Cone-beam Computed Tomography (CBCT) can be necessary for specific conditions. Thus, it is reported that almost all of the findings on panoramic radiographs coincide with clinical findings.[9] In the present study, our observations were in accordance with this hypothesis. Additionally, we did not achieve CBCT views due to comprehensive treatment planning for implant placement. Consequently, further studies can be designed by using 3D imaging methods. Moreover, several clinical conditions which require surgical treatment before application of conventional removable prosthesis in edentulous patients such as epulis fissuratum or alveolar ridge disruption were excluded.

Bohay *et al.*[10] reported 68.3% range of one or more significant radiographic findings in 375 edentulous patients. In addition, they determined 8.3% of these patients required treatment before treatment with removable dentures. Similarly, Masood *et al.*[4] suggested a few (3.8%) of the positive radiographic findings required treatment before denture fabrication. Our results revealed an important part of these findings did not require surgical intervention before conventional removable prosthodontic treatment. On the other hand, a significant amount of the radiographic findings in edentulous patients require treatment before implant supported prosthetic treatment.

Lyman and Boucher[11] reported only one impacted tooth which required extraction among 300 edentulous patients. By this conclusion, they have not suggested routine panoramic examination for every edentulous patient to avoid cumulative effects of radiation exposure. Similar suggestions have been produced by Ansari[12] in 1997. However, today's implant supported prosthetic rehabilitation becomes the most preferred treatment option for edentulous patients.[13] Hence, radiographic examination should be based on the concept that the edentulous patient is a candidate for implant placement.

Retained root fragments and impacted teeth are the most frequent significant radiographic findings in edentulous patients.[4,7,12] Previous research has shown that most root fragments are localized in the molar region of the maxilla.[4,7,14] In our study, retained root fragments represented the second most frequent pathology. The majority of these root fragments were localized in the premolar-molar region of the maxilla. The reasons for this finding could be morphology and number of roots, as they were located posteriorly, where it is difficult to perform an operation. In addition, extraction of these roots poses several risks of complications, such as nerve injury (inferior alveolar, lingual, and mental nerves) and displacement of the roots into the maxillary sinus.[15,16] In particular, dental surgery in older patients carries a high risk of these complications.

Impacted teeth are, of course, critically important in preoperative planning for dental prostheses and implants in edentulous jaws, and they affect patients' oral health and function.[17] As such, patients with impacted teeth have a variety of complaints, such as carious lesions, dentigerous cysts, tooth eruption abnormalities, pain, and infections. Stathopoulos *et al.*[18] retrospectively investigated 7782 impacted third molars in 6182 patients and reported that the pathologic conditions related to these teeth were lower than 2.77%. Sumer *et al.*[6] reported teeth impaction in 3.1% of 676 edentulous patients. In our study, we found 36 impacted teeth, representing a frequency of 3.6%. This result may be related to elective procedures recommended for impacted teeth in edentulous patients by specialists. Today, recent studies suggested an implant placement protocol encroaching upon residual roots and impacted teeth.[19,20] This unconventional method has been proposed to assess minimal invasive surgical procedures in implant dentistry. However, future research needs to be investigated for this procedure.

Panoramic radiographs have been used frequently for preoperative assessments of the maxillary sinus for implant placement. These assessments include the vertical dimension of the alveolar crest to the maxillary sinus.[21,22] In completely edentulous patients, the upper alveolar ridge should be related to the floor of the maxillary sinus because of bone resorption. In these circumstances, panoramic radiographs simply allow an evaluation of this relation by using a lower effective dose.[23] In this radiographic study, we determined that 22.4% of all radiographic findings were in relation of the floor of their maxillary sinuses with alveolar ridge. Therefore, open maxillary sinus augmentation was required before implant surgery for all subjects.

When maxillary sinuses are imaged, some maxillary sinus pathologies such as mucosal cysts can be detected with panoramic radiography. Sinus mucosal cysts were another frequent significant finding in our study, observed in 6.3% of all patients. As the prevalence of mucous cysts in radiographic studies has been reported as 2 - 13%, our finding was in accordance with the literature.[6,24]

It has been reported that a mucus retention cyst of the maxillary sinus is not a contraindication for sinus membrane elevation.[25] Feng *et al.*[26] retrospectively evaluated the survival rate of 21 endosseous implants placed into the elevated maxillary sinus area in the presence of mucus retention cysts. They reported that all of the implants were functionally stable during the 27-months follow up period. Nevertheless, other maxillary sinus pathologies (acute or chronic infections) accompany to positive radiological findings of maxillary sinuses should be evaluated carefully for implant surgery in posterior maxillary area.[27]

Carotid area calcifications can be detected in panoramic radiographies, and its prevalence has been reported as 3 - 5% in the general dental population. However, in a study conducted with a younger population (with a mean age of 32 - 35), the incidence was found to be very low, in a range of 0.4 - 0.8%.[28] In previous studies, the frequency of radiopaque findings which might be due to the inclusion of soft tissue calcifications was reported as 9.3 - 9.9%; thus,

our findings seem relatively low by comparison.[6,7] In our study, calcifications were detected in the area considered as tonsillolith in 23 patients (3.1%), in the submandibular area and radiopaque findings considered as lymph node calcification in 30 patients (4%), and in the carotid area in 11 patients (1.5%). These additional panoramic findings did not affect the treatment planning of implant placement or prosthetic rehabilitation. Nevertheless, it seems that panoramic radiographs may include critical important findings in the head and neck region.

CONCLUSION

In conclusion, to achieve successful results in prosthetic dentistry, preprosthetic-presurgical phase of treatment planning should be made carefully. It is our opinion that due to the high frequency of significant radiographic findings, panoramic radiography should be analyzed, even in the absence of clinical symptoms. Within the limitation of this study, patients candidates for implant placement can more frequently require additional surgical procedures to eliminate pathological conditions of edentulous jaws.

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