**Evaluation of Significant Radiographic Findings and Their Impact on the Oral Health–Related Quality of Life of Patients with Complete Dentures**

Fatih Cabbar, DDS/Muammer Çağrı Burdurlu, DDS/Gonca Duygu Çapar, DDS/Hakkıcan Tekin, DDS/Ceyda Özçakır Tomruk, DDS

**Purpose:** The aim of this study was to assess the frequency and location of positive radiographic findings in edentulous patients and to evaluate the oral health–related quality of life (OHRQoL) and complacency of patients with positive radiologic findings. **Materials and Methods:** A total of 1,349 asymptomatic edentulous patients were retrospectively evaluated using a digital panoramic system for the presence of retained root fragments, impacted teeth, foreign bodies, radiolucencies, radiopacities, mental foramen at or near the alveolar crest, and maxillary sinus pneumatization. The patients with positive findings were called for a follow-up to take a new panoramic radiograph. The functional status and symptoms of participants were measured with the Oral Health Impact Profile (OHIP-14). **Results:** At least one or more of the radiographic findings were observed in 35.21% of the evaluated radiographs. The most frequent finding was sinus pneumatization (20.9%). The mean total OHIP score was 9.74 ± 8.34. There was no statistically significant difference observed for gender, age, education levels, marital status, or having surgical interventions for total OHIP-14 scores \( (P > .05) \). **Conclusion:** The results of this study suggest that routine radiographic examination of edentulous patients may not be crucial before rehabilitation, and using a total percentage of positive radiographic findings may result in the exaggeration of the disease risk in edentulous patients. *Int J Prosthodont 2018;31:594–600. doi: 10.11607/ijp.5717*

Panoramic imaging is a technique for producing a single image of the facial structures that includes both the maxillary and mandibular dental arches and their supporting bones. Positive findings such as impacted teeth, foreign bodies, root fragments, neoplasms, and radiolucent lesions can be overlooked, especially when they exhibit no symptoms. Radiographic guidelines developed by the United States Food and Drug Administration (FDA) and endorsed by the American Dental Association (ADA) recommend a full-mouth intraoral radiographic examination or a panoramic examination for the new edentulous patient. This recommendation for pretreatment radiographic surveys differs from the guidelines for dentate patients, which recommend an individualized radiographic prescription on the basis of selection criteria derived from the clinical examination. The FDA expert panel justified this exception on the basis of cited literature reporting that 33% to 41% of edentulous patients exhibited radiographic evidence of pathologic conditions. In contrast to the conventional method of reporting total positive findings, few authors have included an assessment of the impact on the treatment of the findings reported. This approach led these authors to question the benefit of routine pretreatment radiography because most of the findings had no impact on treatment. In addition, the authors are unaware of the impact of these findings on the life quality of the patients.

The impact of oral health on quality of life is termed oral health–related quality of life (OHRQoL) and has great importance in research, clinical practice, and monitoring treatment progress. Locker and Allen defined OHRQoL as “the impact of oral disease and disorders on aspects of everyday life that a patient or person values, that are of sufficient magnitude, in terms of frequency, severity or duration to affect
their experience and perception of their life overall.\textsuperscript{10} Thus, oral health impact assessments have become central in oral health research, and subjective instruments have been developed to identify how specific problems related to oral health affect the daily lives of patients.\textsuperscript{11}

This study aimed to evaluate the pretreatment positive radiologic findings in patients with complete dentures and to evaluate the OHRQoL and complacency of patients with positive radiologic findings.

\textbf{Materials and Methods}

This study was approved by the Ethical Committee of the University in accordance with the principles of the Helsinki Declaration (no. 581). Panoramic radiographs from patients who were treated with at least one conventional complete denture in the University Dentistry Hospital from 2007 to 2016 were examined. The same panoramic x-ray unit was used for all exposures, and the films were developed with automatic processing (Morita X550 Ex-2). Three authors independently judged the radiographs and collected the data before a decision was made, and conflicts were resolved by common consent of all authors after re-evaluation of the conflicted radiograph. The inclusion criteria were: being edentulous in at least one arch; having a complete denture in the edentulous arch; and the archived patient’s panoramic radiograph being older than 18 years. The exclusion criteria were: inappropriate panoramic radiograph quality. The following radiographic findings were considered clinically significant and recorded: (1) location of the maxillary sinus close to the crest of the ridge; (2) location of the mental foramen on the crest; (3) retained root fragments; (4) impacted teeth; (5) radiolucencies associated with cysts; and (6) radiopacities.

Patients with positive radiologic findings were called for a follow-up. Figure 1 shows the process of exclusion and how the study sampling was achieved. Written consent forms were signed by the patients who attended the follow-up, and panoramic radiographs were taken. The same investigators evaluated the follow-up panoramic radiographs independently.

The demographic data, OHRQoL, total time of usage of the existing prosthesis, any surgical interventions during the usage, and any problems patients declared while using the existing prosthesis were also recorded. Age groups were divided into five categories: \(\leq 40\); 41 to 50; 51 to 60; 61 to 70; and \(\geq 71\) years. In case the patients refused to come for follow-up but still wanted to participate in the study, the data were collected over the phone. Considering the patients who would not participate, a sample size was calculated on the basis of a previous study,\textsuperscript{12} and 27 participants were required to detect differences with a power \(\beta = 0.8\) and \(\alpha = 0.05\).

\textbf{Oral Health Impact Assessment}

The functional status and symptoms of participants were measured with the Oral Health Impact Profile (OHIP-14), which was developed and validated by Slade\textsuperscript{11} and translated into Turkish by Mumcu et al.\textsuperscript{13} OHIP-14 items are grouped into seven dimensions of impact: (1) functional limitation; (2) physical pain; (3) psychological discomfort; (4) physical disability; (5) psychological disability; (6) social disability; and (7) handicap. The patient’s response to each question was coded on a 5-point scale ranging from 0 to 4 (with response options: never; hardly ever; occasionally; fairly often; and very often). The total OHIP-14 score (ranging from 0 to 56) was computed by summing responses to all 14 items, and the total subscale scores by computing all items for that subscale (ranging from 0 to 8). Higher scores indicate worse OHRQoL.\textsuperscript{11}

\textbf{Statistical Analyses}

Statistical analyses were performed using Number Cruncher Statistical System (NCSS) 2007 Statistical
Table 1  Distribution of Positive Radiographic Findings

<table>
<thead>
<tr>
<th>Finding</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinus pneumatization</td>
<td>271</td>
<td>20.09</td>
</tr>
<tr>
<td>Mental foramen on the crest</td>
<td>152</td>
<td>11.27</td>
</tr>
<tr>
<td>Root segments</td>
<td>63</td>
<td>4.67</td>
</tr>
<tr>
<td>Impacted teeth</td>
<td>25</td>
<td>1.85</td>
</tr>
<tr>
<td>Radiolucenties</td>
<td>8</td>
<td>0.59</td>
</tr>
<tr>
<td>Radiopacities</td>
<td>6</td>
<td>0.44</td>
</tr>
</tbody>
</table>

Table 2  Characteristics of OHIP-14 Instrument Participants (n = 58)

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>26</td>
<td>44.83</td>
</tr>
<tr>
<td>Female</td>
<td>32</td>
<td>55.17</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>16</td>
<td>27.59</td>
</tr>
<tr>
<td>Married</td>
<td>42</td>
<td>72.41</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>19</td>
<td>32.76</td>
</tr>
<tr>
<td>High school</td>
<td>26</td>
<td>44.83</td>
</tr>
<tr>
<td>University</td>
<td>13</td>
<td>22.41</td>
</tr>
</tbody>
</table>

A total of 1,349 patients were included, with a mean ± SD age of 66.40 ± 11.95 years (range 26 to 98). Of these patients, 582 (43.14%) were men and 767 (56.86%) were women. The distribution of men and women was similar (P = .55). A total of 525 positive radiographic findings were found in 475 (35.21%) patients. Of these findings, 203 (38.66%) belonged to men and 322 (61.33%) to women with at least one edentulous arch. The most common finding observed was sinus pneumatization (20.09%), and the least common were radiopacities (0.44%) (Table 1). Close proximity of the maxillary sinus to the crest of the ridge was found to be 22.68% in men and 18.12% in women; this difference was statistically significant (P = .039). Women had a statistically higher incidence of mental foramen located on the crest (15.78%) than men (5.33%) (P = .0001). Radiopacities associated with localized sclerotic bone formation were found significantly more often in men than in women (P = .032). When the retained root fragments, impacted teeth, and radiolucenties were investigated according to gender, no statistical difference was observed. Evaluation of the findings according to age group showed that aging was significantly related to pneumatization and proximity of the mental foramen to the alveolar crest (P < .05 for both).

Contact information belonging to 122 patients was accessible. Of these 122 patients, 58 were willing to give information on the phone for the study, and of these 58, 19 were willing to come for a follow-up radiographic examination. The mean ± SD age of the 58 patients was 68.86 ± 10.24 years. Of these, 26 (44.83%) were men and 32 (55.17%) were women. Characteristics of the patients who came to follow-up or provided follow-up information are shown in Table 2. There were no significant differences in terms of age, gender, or marital status (P > .05). Twenty-six patients declared problems while using a prosthesis (44.83%); however, 25 of them had problems related to the prosthesis, such as denture-induced mucositis, loss of retention, biting cheeks, bad retention, denture fracture, difficulty while using, difficulty during chewing, old and deformed dentures, mobility of the prosthesis, implant failure, etc. Only one patient had a history of infection related to an impacted root. Eleven patients, including the patient with an impacted root (who had infection-related impacted root extraction), had surgical interventions: three impacted root extraction, five implant surgery, and three extraction. However, 10 of those surgeries were not performed in the edentulous arch and not related to complete dentures. The mean time of edentulism and of using an existing prosthesis was 10.43 ± 6.02 and 6.21 ± 3.04 years, respectively. In the 58 patients who delivered follow-up information over the phone, there were 65 positive radiologic findings: 26 (44.83%) were sinus pneumatization, 19 (32.76%) were mental foramen on the crest, 12 (20.69%) were retained root fragments, 5 (8.82%) were impacted teeth, 1 (1.72%) was radiolucency, and 2 (3.45%) were radiopacities. When the panoramic radiographs of the 19 patients who came for follow-up were examined, there were 8 sinus pneumatizations, 5 mental foramina on the crest, 4 retained roots, 2 impacted teeth, and 2 radiopacities observed; however, all of these findings were symptomless.

Table 3 summarizes the distribution of answers to the OHIP-14 items of the 58 patients. The total OHIP score was 9.74 ± 8.34. There was no statistically significant difference observed for gender, age, education levels, marital status, or having surgical interventions for total OHIP-14 scores (P > .05).
However, women felt significantly more impact on social disability (women: 0.63 ± 0.71, men: 0.19 ± 0.49, $P = .007$) and handicap (women: 1.13 ± 1.43, men: 0.46 ± 0.95, $P = .037$). The OHIP-14 score of patients who reported problems with their existing prosthesis was significantly higher than patients who did not (13.88 ± 9.8 and 6.38 ± 4.94, respectively, $P = .001$). There was no significant relation with the duration of edentulism, the duration of using complete dentures, or age. The total OHIP-14 difference between married and single patients was not significant (10.38 ± 8.92 and 8.06 ± 6.52, respectively, $P = .541$).

Discussion

The present study evaluates radiographic findings in edentulous patients and the OHRQoL of the edentulous subpopulation who use conventional complete dentures. Many reports have concluded that radiographic screening of all edentulous patients is mandatory because of the high percentage of positive radiographic findings. In the present study, panoramic radiographic examination of 1,349 patients revealed that 475 (35.21%) showed one or more positive radiographic findings. This incidence of positive findings showed that significant findings can be easily detected with panoramic radiographs. Although there are similar results reported in the literature, such as by Bohay et al.,14 Jindal et al.,14 and Köse et al.,8 who reported 28.3%, 32%, and 34%, respectively, there are other studies in which higher incidences were also reported (47.6% in 338 patients3 and 51.7% in 271 edentulous patients5).

According to previous studies, retained roots are reported to be the most frequent radiographic findings in edentulous patients, followed by impacted teeth, which have an incidence of between 8% and 16.4%.3,14–16 However, in the present study, the most common finding was sinus pneumatization followed by mental foramen close to the ridge, with frequencies of 20.09% and 11.27%, respectively. In line with the present study, Awad et al reported sinus pneumatization to be 30.6% and mental foramen close to the ridge to be 14.0%.1 However, Sümer et al found that the incidence of sinus pneumatization was 8.6% and mental foramen on the crest was 4.4% in 338 patients. Köse et al reported a frequency of 10% for sinus pneumatization in 743 patients with a mean age of 59.42 years.8 Jindal et al found that 1.7% of the evaluated patients had mental foramen on the crest.14 Although Awad et al and Sümer et al did not mention the mean age in their study, the relatively elderly age of the patients in the present study might cause this difference, because both sinus pneumatization and mental foramen on the crest were found to be significantly related to age. In addition, bone resorption might increase with several factors such as old age, duration of edentulism, and duration of complete denture use.17,18

Impacted teeth incidence was found to be 1.85% in this study. A literature search revealed that this finding was within the incidence range of previous reports. Köse et al reported the incidence of teeth impaction to be 3.6%,8 Sümer et al reported it as 6.2%,3 and Jindal et al reported a similar incidence of 4.8%.14, however, Awad et al found the prevalence of impaction to be only 0.7%, which is relatively low.1 Impacted teeth could cause a variety of complaints, such as cysts and tumors, pain, infection, and carious lesions. Therefore, some authors suggest that they have critical importance in preoperative planning for a dental prosthesis.19 On the other hand, Stathopoulos et al showed that 2.77% of 7,782 impacted teeth were related to pathologic conditions.20

Radiopacities are reported as commonly seen findings in many patients, and they are usually considered normal. The prevalence of radiopacities was found to be only 0.44% in the present study, which is lower than those reported in previous studies.1,3,8,14 Previous studies reported radiolucent lesions to range between 0.9% and 9.9%.1,3,8,14 Our findings were slightly lower than those studies, with an incidence of 0.59%. Although this is a relatively low incidence, radiolucent lesions should be investigated carefully in terms of cysts or tumors.

Another interesting finding was that, while sinus pneumatization was significantly more common in men, mental foramen on crest and radiopacities were significantly more related to female gender. Although some authors have reported a tendency of gender difference on these findings, they did not report any statistical evaluation.1,3 Unfortunately, the design of this study did not allow the authors to draw definite conclusions, but it is known that older age and menopause have effects on the female bone mechanism, which might lead to some changes on resorption and apposition processes.21

### Table 3 Mean Scale Scores of Responses to OHIP-14 Dimensions and Total Scores

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>n</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional limitation</td>
<td>58</td>
<td>0</td>
<td>5</td>
<td>0.52</td>
<td>1.00</td>
</tr>
<tr>
<td>Physical pain</td>
<td>58</td>
<td>0</td>
<td>3</td>
<td>0.38</td>
<td>0.86</td>
</tr>
<tr>
<td>Psychologic discomfort</td>
<td>58</td>
<td>0</td>
<td>3</td>
<td>0.40</td>
<td>0.79</td>
</tr>
<tr>
<td>Physical disability</td>
<td>58</td>
<td>0</td>
<td>6</td>
<td>0.78</td>
<td>1.49</td>
</tr>
<tr>
<td>Psychologic disability</td>
<td>58</td>
<td>0</td>
<td>3</td>
<td>0.43</td>
<td>0.90</td>
</tr>
<tr>
<td>Social disability</td>
<td>58</td>
<td>0</td>
<td>2</td>
<td>0.43</td>
<td>0.65</td>
</tr>
<tr>
<td>Handicap</td>
<td>58</td>
<td>0</td>
<td>5</td>
<td>0.83</td>
<td>1.27</td>
</tr>
<tr>
<td>Total score</td>
<td>58</td>
<td>0</td>
<td>33</td>
<td>9.74</td>
<td>8.34</td>
</tr>
</tbody>
</table>

SD = standard deviation.
In the literature, the primary focus of attention is generally just to identify the radiologic findings. Nevertheless, the interpretation of positive radiographic findings should be made with caution, because the evaluation should attempt to distinguish between those findings that pose a health risk and those that do not. For example, in most of the studies, the radio-opacities were actually idiopathic osteosclerosis and amalgam scraps, which are mostly nonpathologic conditions and have no impact on patient treatment. For retained roots, Bohay et al reported only one pathologic change in one retained root in a patient who had been edentulous for 38 years and stated that pathologies may arise from retained roots and impacted teeth, but they should not be generalized as pathologic for all edentulous patients. For pneumatized sinuses, maxillary sinus augmentation procedures might be required before implant surgery; however, pneumatized sinuses have no impact on treatment for complete dentures. In addition, in most cases, an exposed or vulnerable mental foramen can be located directly under the gum and identified with a thorough clinical assessment.

Regarding the impact of positive radiographic findings on surgical treatment, Bohay et al reported that 8.3% of patients required several surgical interventions before removable dentures. In accordance with these findings, the requirement of surgery was reported as 3.8% by Masood et al and 6% by Köse et al. It was reported that patients were without signs and symptoms of the disease for many years, even decades in some cases. The present results are in line with these studies and suggest that only a small amount of these findings required surgical interventions. Of the 58 participants in the present study, there were 65 positive findings. Among these, only one root was infected and required surgery while using complete dentures; furthermore, all of the findings on follow-up radiographs were symptomless. Therefore, the value of pretreatment radiographs should be determined not only by percentages of total findings, but also by the proportion of such findings that have an impact on patient treatment. To better address this issue, the present study was designed to evaluate the OHRQoL of edentulous patients using complete dentures who had positive radiographic findings.

The OHIP generic scale has demonstrated better results than other questionnaires for measuring OHRQoL. Nevertheless, OHIP-14 does not include items related to chewing, which can be found in the OHIP-EDENT instrument, a shortened questionnaire for edentulous subjects. However, to the best of the authors’ knowledge, the OHIP-EDENT instrument has not been translated and validated in Turkish. In addition, OHIP-14 has been used to detect dissatisfaction and effectiveness of treatments for edentulism in cross-sectional studies and clinical trials. The Turkish validated version of the OHIP-14 was applied in the interview format at the clinic or on the phone. It was reported that no reporting differences were observed regarding the form of administration, whether it was performed by interview or not.

Perea et al reported the mean total OHIP-14 score as 19 ± 9.8 for 51 edentulous patients using complete dentures, with a mean time of edentulism of 15.5 ± 13.1 years; 76.5% of these patients were over 65 years old. Heydecke et al reported a mean total OHIP-14 score of 27.3 ± 12.7 for edentulous patients using complete dentures with a mean age of 66 years. On average, these patients had edentulism for 19.8 years and the age of their dentures was 3.2 years. The mean total OHIP-14 score of the present report was 9.74 ± 8.34 for 58 edentulous patients, with a mean age of 68.86 ± 10.24 years, a mean time for being edentulous of 10.43 years, and a mean denture age of 6.21 ± 3.04 years. The total OHIP-14 score of this study was lower compared to previous reports, which indicates better patient comfort and higher satisfaction. However, these results should be interpreted carefully, because the time of edentulism reveals a shorter period compared to previous reports. It was reported that being edentulous and using the complete denture for less than 5 years resulted in lower OHIP-14 scores, as it takes time to get used to complete dentures. Furthermore, there might be several factors affecting this difference, such as sociodemographic backgrounds. Although this report fails to prove a significant relation between OHRQoL and time of edentulism or mean time for using the present complete dentures, further studies should be conducted for this parameter.

It was reported that the higher the age, the more frequent the impact. However, this was attributed mostly to the accumulative kind of oral findings, such as periodontal pathologies or caries. The patients in the present study were older edentulous people who were not seeking any treatment, which may explain the absence of correlation between total OHIP-14 scores and age, as was previously reported.

With regard to the major prevalence of impact, it was found that handicap was the main dimension behind patients’ general concern in contrast to functional limitation and physical pain, which was reported by Perea et al. In their study, none of the patients felt handicapped because of their dentures. Physical disability was the second most affected dimension, followed by functional limitation, revealing marked and interrupted meal dissatisfaction and disturbed pronunciation. Alteration of taste and fear of losing the denture while eating or talking are consequences...
of the intrinsic limitations of the complete denture treatment in addition to low masticatory performance, compromised retention and stability, and coating of palatal minor salivary glands. De Oliveira and Frigerio reported that complete denture users could be even more susceptible to malnutrition when compared to implant-retained overdenture wearers.

Psychological disability and social disability were less prevalent—as can be expected—and were the fourth-most affected dimensions. It has been suggested that patients wearing their complete dentures scarcely complain about being irritable or feeling embarrassed; in line with this suggestion, the dimensions psychological discomfort and physical pain were less prevalent, with the latter being the least. Because the patients had been using their dentures for 6.21 years, they had probably adapted and were not experiencing nervousness and/or pain due to their complete dentures.

Although some authors have stated the irrelevance of gender on OHRQoL, others have reported the opposite. For edentulous patients, gender yielded no significant difference in previous studies. These findings are in conflict with the results of the present study because female patients reported significantly higher dissatisfaction for social disability and handicap and for mean mental subdivision. Gender differences in emotional exhaustion might serve as a function of stress difference among genders. Therefore, the effect of this factor should be carefully assessed. Perea et al showed that single people had lower overall satisfaction with complete dentures without any significant difference, which was in line with the results of the present study (that married patients had higher satisfaction). In addition, previous studies reported that people with higher education levels showed a higher impact on their OHRQoL with respect to those with lower education. This tendency was also found in the present study. It should be noted that although the results support the tendency for these variables, there was no statistical significance observed for either marital status or education; therefore, these factors should be further investigated, as many studies underestimate these variables.

One limitation of the present study was that despite the large sample size of radiographs evaluated, the OHRQoL investigations included a smaller sample size. However, the sample size of the present study was similar to that of a previous study on the influence of prosthetic rehabilitations in OHRQoL. In addition, power analyses showed that the current sample size was sufficient to show OHRQoL of patients using complete dentures who had positive radiologic findings. Nevertheless, further studies with a greater number of subjects are needed. In addition, the participants were recruited only from a university dental clinic; therefore, these results should not be regarded as countrywide because treatment modalities could show differences between clinics. It could also be argued that these participants were more likely to have worse OHRQoL status; thus, negative response bias might have an impact on the findings.

Another outcome of this study was the higher OHIP-14 scores in patients who reported problems using the existing dentures, as has been previously reported. Most of these problems were related to the complete denture itself rather than to radiographic findings. Although some authors suggested pre-treatment radiographic evaluation for all edentulous adults, the present findings challenge this recommendation. Although there was a remarkable number of positive findings observed in radiographic evaluations, the OHRQoL scores of these patients indicated high patient satisfaction and comfort. Furthermore, only one impacted root caused discomfort, and most of the positive findings were symptomless without any clinical significance for years. However, it is equally obvious that these findings should be interpreted with caution, as individual differences, such as the location of an impacted tooth, are not possible to standardize. Although some impacted teeth might appear on the radiograph but cause no clinical discomfort to the patient, those teeth or roots—which partially penetrate the mucosa and cause chronic trauma—might be influential in the overall satisfaction of a patient.

**Conclusions**

Within the limitations of this study, the radiographic evaluation, OHRQoL, and follow-up data suggest that using a total percentage of positive radiographic findings only without assessment of OHRQoL and clinical significance may result in the exaggeration of the disease risk in edentulous patients. The pretreatment radiographic analyses and necessity of surgical interventions for edentulous adults might be individualized according to the time of edentulism, age, and type of treatment, such as rehabilitation with implants or conventional complete dentures. Future studies can be planned that include set standards for positive findings.

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