*Community Dental Health* (2008) **25,** 226–230
Received 1 March 2006; Accepted 19 September 2006

doi:10.1922/CDH_2208Dundar05

# The frequency of periodontal infrabony defects on panoramic radiographs of an adult population seeking dental care

N. Dundar[1], T. Ilgenli[2], B. Ilhan Kal[3] and H. Boyacioglu[4]

*[1]Assoc. Prof. Dr., Dept. of Oral Diagnosis and Oral Radiology; [2]Assoc. Prof. Dr., Dept. of Periodontology; [3]D.D.S., PhD, Dept. of Oral Diagnosis and Oral Radiology; [4]Lecturer, Faculty of Science Department of Statistics, Ege University, Izmir, Turkey*

By means of panoramic radiography (PR), the frequency and location of interproximal infrabony defects (IPIDs), their relationship with age, gender and remaining teeth were studied in 416 individuals seeking dental care. The presence/absence of IPIDs and the defect depths were evaluated on mesial and distal surfaces of a total of 8,964 teeth. One or more infrabony defects were recorded on 23% of the PRs (96 individuals, 152 IPIDs). The frequency of infrabony defects ≤ 3 mm, 3-5 mm and ≥5 mm was 12.5%, 9.6% and 3.6% respectively. The number of infrabony defects ≥ 5 mm was significantly lower than infrabony defects in ≤3 mm and 3-5 mm groups ($p<0.05$). The difference between the frequency of IPIDs among two genders was non-significant (20.6% for females, 26.8% for males). The IPIDs were most prevalent in the oldest group (>50 years), which also presented with significantly more missing teeth ($p<0.05$). The most frequent locations for IPIDs were maxillary and mandibulary molar teeth.

*Key words: dental radiology, interproximal infrabony defects, linear measurements, periodontology*

## Introduction

The essential characteristic of destructive periodontal disease is the loss of tooth-supporting alveolar bone. In general, horizontal bone loss is differentiated from vertical bone loss, which is termed as an infrabony defect since the bottom is apical to the alveolar crest. The presence of infrabony defects complicates marginal periodontitis and influences therapy and prognosis (Weinberg and Eskow, 2000). The treatment methods for infrabony defects have been evaluated in several studies; however the current information on their prevalence and location in human adult populations is limited (Camargo *et al*., 2002, Francetti *et al*., 2004).

Although early radiographic studies have indicated the presence of severe periodontal diseases in adult age groups (Marshall-Day *et al*., 1955), recent studies in industrialized countries have reported that advanced bone loss is uncommon under the age of 35 and infrabony pockets and furcation lesions are seldom found in subjects under 40 (Müller and Ulbrich, 2005). A number of studies have been carried out to determine the prevalence and distribution of periodontal conditions among different European and Asian populations (Baelum *et al*., 1997, Müller and Ulbrich, 2005, Müller *et al*., 2005). However, there have been no reported national or regional surveys of the prevalence of periodontal interproximal infrabony defects in an adult Turkish population.

Therefore, the purpose of this study was to determine the frequency and location of interproximal infrabony defects (IPIDs) recorded from panoramic radiographs (PRs) of adult patients sampled at the radiological archive of Ege University, School of Dentistry. The influence of age, gender and remaining teeth on the presence of IPIDs was also investigated.

## Methods

The panoramic radiographs (PRs) of patients 20 years and older were drawn at random from the records of the University of Ege, School of Dentistry, Department of Oral Diagnosis and Radiology between December 2004 and December 2005 (12 months). The selection of PRs was performed by drawing lots for each month using patient record numbers and aiming to pick 50 PRs per month. Radiographs with sufficient contrast/brightness and no significant distortions/projection errors were selected by one of the authors (BIK).

PRs were obtained using Ortopantomograph OP-100 Palomex (OY-Finland & Siemens Corp-West Germany) and the films were developed in an automatic film processor (Dürr-Dental, Bietigheim, Germany). After digitization with a flatbed scanner at 600 dpi (Hewlett Packard Scanjet XPA 7400c), images were saved as TIFF files and transferred into a software (UTHSCSA Image Tool Version 3.0, San Antonio, Texas). The viewing sessions were performed in a darkened room to minimize glare with the images displayed on a 17 inch monitor (Philips Electronics, Koninklijke, Netherlands).

The presence or absence of IPIDs and the depth of defects were evaluated on mesial and distal tooth surfaces (3rd molars excluded) on each image by two specialists in Oral Diagnosis and Radiology Department. (R1 and R2) The linear measurements of the IPIDs were performed between cemento-enamel junction (CEJ) and the most apical extension of the bony defect (BD). If the CEJ

Correspondence to: Professor Nesrin Dundar, Ege University Faculty of Dentistry, Dept. of Oral Diagnosis and Oral Radiology, 35100, Bornova, Izmir, Turkey. E-mail: nesrinergul@yahoo.com

was destroyed by a restoration, the margin of the restoration was taken as the landmark. BD was defined as the most coronal point where the periodontal ligament space showed a continuous width. If no periodontal ligament space could be identified, the point where the projection of the alveolar crest (AC) crossed the root surface was taken as the landmark. If both structures could be identified at one defect, the point defined by the periodontal ligament was defined as BD (Benn, 1992). The depths of infrabony defects were recorded at the site where they were most advanced. A mean value was calculated for each defect from the measurements of two observers

Kappa statistic was used to determine the overall level of agreement between examiners in recording the presence or absence of IPIDs. $X^2$ tests and descriptive statistical method including frequency distributions, means and standard deviations were used to describe the material. Statistical significance was declared if the $p$ value was equal to or less than 0.05.

## Results

The coefficient of agreement $K$ between R1 and R2 recordings of infrabony defects on 8964 available tooth surfaces (416 patients) was 0.554.

A total of 600 panoramic radiographs (PRs) were collected of which 17.5% (n=105) was defined to be of insufficient contrast and brightness or 13.2% (n=79) having significant projection errors and distortions. PRs from 416 individuals representing approximately 34% of all PRs taken during a 1-year period were analyzed. In order to facilitate the statistical analysis, the sample was classified into four age groups. Age and gender distribution of the study sample is presented in Table 1.

Radiographic images of 8,964 teeth were studied. A total of 152 IPIDs were recorded on 23% of the PRs (96 individuals). The number of IPIDs per individual ranged between 1 and 5 (Table 2). Infrabony defects were classified into three groups as ≤3 mm, 3-5 mm and ≥5 mm according to their depths. The distribution of 152 IPIDs with respect to their depth and patient gender is presented in Table 3. 52 of the female patients presented with a total of 84 infrabony defects, while 68 defects were detected in 44 of the male patients. According to this, although females presented more infrabony defects, the prevalence of IPIDs among females (20.6%) was lower than it was among males (26.8%) in the studied sample. However, the difference did not reach statistical significance ($p>0.05$). Table 4 presents the distribution of infrabony defects among different age groups. The number of IPIDs was significantly higher in the oldest group (>50 years) compared to younger age groups ($p<0.05$), indicating the increase in the frequency of infrabony defects with advanced age.

When the data from Table 3 or 4 is considered, it can be calculated that the frequency of infrabony defects was 12.5% for ≤3 mm (n=57, 52 individuals), 9.6% for 3-5 mm (n= 55, 40 individuals) and 3.6% for ≥5 mm (n=40, 15 individuals) in the studied sample. A statistically significant difference was observed with regard to the number of defects in each depth group. The number of infrabony defects ≥ 5 mm was significantly lower than infrabony defects in ≤3 mm and 3-5 mm groups ($p<0.05$). The frequency of infrabony defects deeper than 3 mm (3-5 mm + ≥ 5 mm groups) accounted for 13.2% in our sample.

The distribution of IPIDs with respect to localization is presented in Table 5. The comparison of anterior, premolar and molar regions of mandible and maxilla revealed no significant differences with respect to the distribution of infrabony defects ≤3 mm and 3-5 mm. The infrabony defects ≤3 mm were most prevalent around maxillary anterior teeth, while the most common localization for 3-5 mm group was maxillary molar teeth. A significant difference was observed with regard to the distribution of infrabony defects ≥5 mm, with a predominance of mandibular molar teeth ($p<0.05$). No IPIDs were recorded on mandibular incisor teeth. Mandibular teeth accounted for 44.07% of IPIDs compared with 55.9% in maxilla. The difference between maxilla and mandible regarding the distribution of IPIDs was non-significant ($p>0.05$).

The proportional distribution of maxillary and mandibulary missing teeth in the studied sample is presented in Table 6. The comparison of different age groups revealed a statistically significant difference regarding the mean number of missing teeth. The oldest group (>50) presented significantly more missing teeth than three other younger age groups ($p<0.05$). The difference between females and males regarding the number of missing teeth was non-significant ($p>0.05$).

Our results revealed a statistically significant relationship between the mean number of remaining teeth and presence of IPIDs ($p<0.05$). The number of IPIDs increased with decreasing number of remaining teeth, therefore, the oldest group in which the number of remaining teeth was lowest, presented with higher number of IPIDs (Table 7).

## Discussion

Direct measurements with millimeter graded rulers, digital imaging and computer software programs have been used for the assessment of radiographic alveolar bone height in periodontal research and practice (Müller and Ulbrich, 2005). The results of these studies indicate that, standardized intraoral radiographs are necessary for the assessment of bone and documentation of small bone-level changes after therapy. However, it has also been reported that panoramic radiographs provide a general overview on the extent and severity of periodontal disease and the distribution of osseous defects, while providing a reduction in radiation doses (Müller and Ulbrich, 2005).

Comparing periodontal measurements obtained from panoramic and intraoral radiographs, Persson *et al*. have reported that the measurements obtained from two radiographic methods were in high agreement and OPGs may substitute for intraoral periapical radiographs (Persson *et al*., 2003). In a study where marginal bone level measurements obtained from PRs were compared with clinical probing pocket depths, Akesson *et al*. (1992) reported that the underestimation of bone loss on PRs varies between 13-32%. It was also stated that although bone loss seems to be underestimated on PRs, the substantial mean enlargement of ~27% allows for infrabony defects deeper than 4 mm to be identified on PRs (Akesson *et al*., 1992). The underestimation of bone loss on PRs may

**Table 1.** Age and gender distribution of the study sample.

| *Age* | *Female* | *Male* | *Total (n)* |
|---|---|---|---|
| 20-30 | 40 | 32 | 72 |
| 31-40 | 40 | 52 | 92 |
| 41-50 | 56 | 44 | 100 |
| >50 | 116 | 36 | 152 |
| Total (n) | 252 | 164 | 416 |

**Table 2.** Distribution (%) of 96 individuals with infrabony defects with regard to number of defects per individual.

| *Number of defects* | *Male* | | *Female* | | *Both sexes* | |
|---|---|---|---|---|---|---|
| | *%* | *n* | *%* | *n* | *%* | *n* |
| 1 | 81.8 | 36 | 53.8 | 28 | 66.6 | 64 |
| 2 | 0 | 0 | 30.8 | 16 | 16.7 | 16 |
| 3 | 9.1 | 4 | 15.4 | 8 | 12.5 | 12 |
| 5 | 9.1 | 4 | 0 | 0 | 4.2 | 4 |
| Total | 100 | 44 | 100 | 52 | 100 | 96 |

**Table 3.** The distribution of IPIDs among two genders.

| *Defect depth/ Gender* | *Female (n=52)* | | *Male (n=44)* | |
|---|---|---|---|---|
| | *No. of defects* | *No. of individuals* | *No. of defects* | *No. of individuals* |
| ≤3 mm | 26 | 21 | 31 | 30 |
| 3-5 mm | 43 | 32 | 12 | 8 |
| ≥ 5 mm | 15 | 6 | 25 | 9 |

**Table 4.** The distribution of IPIDs among different age groups.

| *Defect depth/ Age group (years)* | *20-30* | | *31-40* | | *41-50* | | *>50** | |
|---|---|---|---|---|---|---|---|---|
| | *No. of defects* | *No. of individuals* | *No. of defects* | *No. of individuals* | *No. of defects* | *No. of individuals* | *No. of defects* | *No. of individuals* |
| ≤3 mm | 7 | 6 | 11 | 11 | 9 | 8 | 30 | 26 |
| 3-5 mm | 1 | 1 | 12 | 7 | 9 | 9 | 33 | 23 |
| ≥ 5 mm** | 1 | 1 | - | - | 9 | 3 | 30 | 11 |

*The oldest group presented significantly more IPIDs than younger individuals ($p<0.05$).
**The number of IPIDs ≥ 5 mm is significantly lower than ≤3 mm and 3-5 mm groups ($p<0.05$).

**Table 5.** The distribution of IPIDs with respect to localization.

| *Depth* | *Mandible* | | | | | | *Maxilla* | | | | | | *Total* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Molar* | | *Premolar* | | *Anterior* | | *Molar* | | *Premolar* | | *Anterior* | | | |
| | *%* | *n* | *%* | *n* | *%* | *n* | *%* | *n* | *%* | *n* | *%* | *n* | *%* | *n* |
| ≤ 3 mm | 10.7 | 6 | 10.7 | 6 | - | - | 33.9 | 19 | 5.3 | 3 | 40.3 | 23 | 37.5 | 57 |
| 3-5 mm | 27.2 | 15 | 18.1 | 10 | - | - | 29.09 | 16 | 1.8 | 1 | 23.6 | 13 | 36.1 | 55 |
| ≥ 5 mm* | 75 | 30 | - | - | - | - | 12.5 | 5 | - | - | 12.5 | 5 | 26.3 | 40 |

* The most common location for IPIDs ≥ 5 mm was mandibulary molar teeth ($p<0.05$).

**Table 6.** Distribution of mandibular and maxillary missing teeth with respect to age and gender.

| *Age* | *Mandible* | | | | | | *Maxilla* | | | | | | *Total* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Molar* | | *Premolar* | | *Anterior* | | *Molar* | | *Premolar* | | *Anterior* | | | |
| | *%* | *n* | *%* | *n* | *%* | *n* | *%* | *n* | *%* | *n* | *%* | *n* | *%* | *n* |
| 20-30 | 6.9 | 51 | 7.1 | 18 | 8.7 | 20 | 2.3 | 12 | 5.1 | 25 | 4.6 | 21 | 5.4 | 147 |
| Female | 4.48 | 33 | 3.95 | 10 | 3.93 | 9 | 1.14 | 6 | 3.66 | 18 | 1.54 | 7 | 3.09 | 83 |
| Male | 2.44 | 18 | 3.16 | 8 | 4.80 | 11 | 1.14 | 6 | 1.42 | 7 | 3.09 | 14 | 2.38 | 64 |
| 31-40 | 12.6 | 93 | 9.5 | 24 | 10.9 | 25 | 15.8 | 83 | 11.4 | 56 | 5.1 | 23 | 11.3 | 304 |
| Female | 5.85 | 43 | 5.92 | 15 | 5.67 | 13 | 6.67 | 35 | 4.48 | 22 | 2.65 | 12 | 5.21 | 140 |
| Male | 6.80 | 50 | 3.55 | 9 | 5.24 | 12 | 9.16 | 48 | 6.92 | 34 | 2.43 | 11 | 6.11 | 164 |
| 41-50 | 21.2 | 156 | 34.3 | 87 | 35.8 | 82 | 20.03 | 105 | 26.8 | 132 | 30.1 | 136 | 26 | 698 |
| Female | 10.47 | 77 | 17.78 | 45 | 22.70 | 52 | 12.02 | 63 | 15.07 | 74 | 18.14 | 82 | 14.64 | 393 |
| Male | 10.74 | 79 | 16.60 | 42 | 13.10 | 30 | 8.01 | 42 | 11.81 | 58 | 11.94 | 54 | 11.36 | 305 |
| >50* | 59.2 | 435 | 49.01 | 124 | 44.5 | 102 | 61.8 | 324 | 56.6 | 278 | 60.1 | 272 | 57.2 | 1535 |
| Female | 26.93 | 198 | 22.13 | 56 | 24.01 | 55 | 33.01 | 173 | 27.08 | 133 | 28.31 | 128 | 27.68 | 743 |
| Male | 32.24 | 237 | 26.87 | 68 | 20.52 | 47 | 28.81 | 151 | 29.53 | 145 | 31.85 | 144 | 29.50 | 792 |
| Total | 100 | 735 | 100 | 253 | 100 | 229 | 100 | 524 | 100 | 491 | 100 | 452 | 100 | 2684 |

*The oldest group (>50 years) presented significantly more missing teeth than younger age groups ($p<0.05$).

**Table 7.** The mean ± standard deviation of remaining teeth and distribution of IPIDs in different age groups. Note the increase in the number of IPIDs with decreasing number of remaining teeth in each age group.

| *Age* | *No. of individuals* | *Remaining teeth (Mean ± SD)* | *No. individuals with IPIDs* | *Number of IPIDs* |
|---|---|---|---|---|
| 20-30 | 72 | 26.5 ± 3.5 | 8 | 9 |
| 30-40 | 92 | 24.6 ± 4.8 | 18 | 23 |
| 41-50 | 100 | 20.7 ± 7.7 | 20 | 27 |
| >50* | 152 | 17.8 ± 9.01 | 60 | 93* |

* The relationship between the number of IPIDs and remaining teeth was significant ($p<0.05$).

account for the relatively higher frequency of infrabony defects less than 3 mm in the present study. However, the main objective was to gain information on the frequency and the distribution of infrabony defects and the PRs were selected randomly from the radiological archive for this purpose. Similar to previous studies where radiological archive records of particular departments were evaluated to asses the frequency of periodontal bone loss, we are also not able to interpret the relationship between clinical and radiographic findings (Persson *et al*., 1998b, Müller and Ulbrich, 2005). Nevertheless, our results are in accordance with large surveys which reported that most of the participants did not have excessive periodontal infrabony defects (Brown *et al*., 1996).

Our data shows that 23% of an adult population seeking dental care was affected by IPIDs to some degree, while infrabony defects deeper than 3 mm accounted for 13.2%. In a similar study one or more defects deeper than 3 mm were found in 15.8% of the participants (Müller and Ulbrich, 2005). The prevalence of infrabony defects of at least 2-3 mm depth was reported to be 32% in an adult Swedish population which is much higher than our frequency of 12.5% (Wouters *et al*., 1989). The reported prevalence of infrabony defects varies from 13% to 60.8% in the literature (Gilmore, 1970, Nielsen *et al*., 1980, Wouters *et al*., 1989, Persson *et al*., 1998a). The definition of critical size, sample selection and recording procedure also differed among these studies, which may have influenced their results. For instance; only posterior teeth were included in an early study by Gilmore, while the selected sample consisted predominantly of adults in the work by Persson *et al*. Therefore, comparisons between different studies should be made with caution.

The possible influence of advanced age on the destruction of periodontal tissues has been emphasized in earlier observations (Fox *et al*., 1994, Persson *et al*., 1998a, Müller and Ulbrich, 2005). An increase in the number of dentate elderly in Sweden during 1973-1983 led to a dramatic increase in the proportion of subjects having severe bone loss (Fox *et al*., 1994). In accordance with previous reports, the results of the present study confirm the observation that the frequency of infrabony defects increases with advanced age (Fox *et al*., 1994, Persson *et al*., 1998a, Müller and Ulbrich, 2005). The participants in the oldest age group, who also had significantly less remaining teeth, presented more infrabony defects than younger individuals in the studied sample. The true reasons for the loss of teeth are impossible to know but

it can be suggested that many extractions in the oldest group had been performed due to advanced bone loss. The pattern of remaining teeth being similar for males and females in the present study may also account for the non-significant gender differences regarding the frequency of IPIDs (Wouters *et al*., 1989).

A symmetrical localization pattern in relation to the sagittal plane was observed in the mandible for the localization for IPIDs in the present study. This is in agreement with Wouters *et al*. (1989) who suggested that the formation of periodontal infrabony defects is influenced not only by the location of subgingival plaque on the root surface but also by the morphology of the interproximal tooth surfaces and the width of interdental septa. The relationship between the width of interdental septa and the formation of a periodontal infrabony defect has also been reported in early studies (Schroeder, 1986). The absence of IPIDs on mandibular anterior teeth may be explained by the presence of narrow interdental septa in this region. According to our results, the most frequent location for IPIDs were mandibular and maxillary molar and maxillary anterior teeth, which were also among the most common missing teeth in our sample. Therefore it is reasonable to suggest that the common locations of infrabony defects in a dentate population concurrently reflect the pattern of most common missing teeth. Nevertheless, our results regarding the distribution of infrabony defects are in accordance with previous studies where it was stated that primarily maxillary molars and incisors are affected by vertical defects (Persson *et al*., 1998a).

A study has shown that no significant differences exist between the over-all subjective clarity of radiographic images obtained with professional and consumer grade scanners (Davidson *et al*., 2001). A consumer grade desktop scanner was used at 600 dpi for the digitization of radiographic images in the present study. The difference between intra-examiner agreements in recording the presence or absence was non-significant. This can be interpreted as the validity of the radiographic and digitization method used for recording IPIDs in the present study, which allowed substantial intra-examiner reproducibility and did not cause significant detail loss.

In conclusion, the present radiographic study demonstrated that 23% an adult sample seeking dental care in Turkey is affected by infrabony defects to some degree. A statistically significant relationship was observed between the frequency of infrabony defects and advancing age, and a possible influence of remaining teeth on the frequency of infrabony defects is shown.

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