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Radiographic Evaluation of Periodontal Bone Loss in Diabetic and Non-Diabetic Patients Using Orthopantomograms: A Retrospective Cross-Sectional Study at a Dental College in Melmaruvathur

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ABSTRACT

Background: Periodontitis is a chronic inflammatory condition that begins with the accumulation of dental biofilm plaque and advances through a chaotic immune reaction, ultimately causing irreversible damage to the alveolar bone and the supporting tissues adjacent to the tooth. Interdental bone loss, observable through periapical and orthopantomogram (OPG) images, indicates periodontitis, a significant issue in dental public health. This retrospective study aimed to investigate bone loss in the individuals with diabetes and those without the disease who visited Dental College in Melmaruvathur.

Methods: The study included both diabetic and non-diabetic participants between the ages of 18 and 50 who had full medical records from January 2024 to January 2025, including age, gender, and OPG imaging . Six teeth (numbers 16, 11, 26, 31, 36, and 46) had their mesial and distal bone loss quantified and each tooth was given a mean score. Collected data were entered into Microsoft Excel spreadsheet through the SPSS 22 software and subjected to statistical analysis in which descriptive statistics were done to analyse the demographic details in the study. The association between the study parameters and factors were analysed by using inferential statistics (Chi-Square test) which is statistically significant difference P- value kept as less than or equal to 0.05 as statistically difference.

Results: Of the 100 OPG imaging in this research, 39 (38.6%) had diabetes, and 62 (61.4%) did not. The average age of those without diabetes is 31.7581±9.3, whereas that of those with diabetes is 44.2821±6.1. Diabetics experienced bone loss that was comparable to that of non-diabetics. For example, the mean value of tooth number 16 is 3.8462 in diabetics and 2.7258 in non-diabetics.

Conclusion: According to radiography, diabetics have bone loss more frequently than healthy non-diabetics. Compared to incisors, first molars lose more bone. Keywords: diabetes mellitus, interproximal bone loss, periodontitis, orthopantogram X-ray, and retrospective study.

I. INTRODUCTION

Periodontitis is a chronic inflammatory condition that begins with the accumulation of dental biofilm plaque and advances through a chaotic immune reaction, ultimately causing irreversible damage to the alveolar bone and the supporting tissues adjacent to the tooth. Plaque, smoking, diabetes mellitus, and poor oral hygiene are some of the risk factors for this multimicrobial and multifactorial illness[(1)].Diabetes Mellitus (DM) is a metabolic disease marked by elevated blood glucose levels brought on by changes in the action or production of insulin, or both[(2)]. People with

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diabetes have a two to three times higher risk of developing periodontitis than people without the disease[3].

More prospective research is required to examine the relationship between diabetes mellitus and periodontitis, while a recent meta-analysis indicated that there could be a shared physiopathological component between the two conditions[4].Clinical and radiographic tests, including assessments of clinical attachment level and bone loss, are crucial in the assessment and diagnosis of periodontal issues[5].A radiograph offers crucial details on the extent of bone loss, the periodontal ligament space's continuity, and its integrity. Bone loss in periodontitis is assessed and diagnosed using intraoral periapical (IOPA), bitewing, and orthopantomogram (OPG) radiographs[6,7].

OPG is a radiography technique which creates a single picture of the maxilla, mandible, and supporting structures of the face. When evaluating periodontal diseases, it may be used in place of intraoral radiography since it uses intensifying screens, uses less radiation, and saves time[8]. Digital panoramic radiography is a recognised technique for quantifying the loss of alveolar bone[5]. Because of specific radiographic features, such as bone loss, enlargement of the periodontal ligament space, and a reduction in alveolar crest height, periodontal disorders can be evaluated using OPG imaging[9,10]. Periapical diseases such apical periodontitis, periapical cysts, granulomas, and other changes in the alveolar morphological pattern and furcation involvement can be identified early using OPG imaging .

Radiographs' lamina dura continuity is the first and most obvious indicator of periapical diseases. In both traditional and digital imaging, any loss or discontinuity of the same can be identified[6]. In addition to periodontitis, a thorough study of the OPG may reveal other incidental findings[11]. OPG is widely utilised because of its many benefits, such as being simple and affordable to perform and providing information on bone density and jaw shape[12,13]. This retrospective study aimed to compare and identify bone loss (periodontitis) in patients with and without diabetes using the Punjab Dental Hospital's OPG imaging records. Determining how the demographic traits of the two subgroups differed in relation to periodontitis was another goal.

II. METHODOLOGY

This study was submitted to the Adhiparasakthi Dental College and Hospital Melmaruvathur Institutional Review Board. The Adhiparasakthi Dental College and Hospital, a teaching hospital affiliated to Tamilnadu Dr MGR Medical University plays a significant role among public dental facilities serving the people of Melmaruvathur provided the OPG and patient retrospective data. The study includes both diabetic and non-diabetic participants between the ages of 18 and 50 who had complete medical records from January 2024 to January 2025, including age, gender, and OPG imaging .

Collected data were entered into Microsoft Excel spreadsheet through the SPSS 22 software and subjected to statistical analysis in which descriptive statistics were done to analyse the demographic details in the study. The association between the study parameters and factors were analysed by using inferential statistics (Chi-Square test) which is statistically significant difference P-value kept as less than or equal to 0.05 as statistically difference.

Patients under the age of 18 and those over 50 were not allowed to participate in the trial, nor were those with a history of autoimmune disorders, hypertension, ischaemic heart disease, or syndromic conditions. Age, gender, and diabetes information were extracted from the outpatient department's (OPD) indoor register, and the medical record number was recorded. After reviewing the OPG data of these patients who had been recommended to get an OPG, 101 patients' records were found to meet the requirements. The OPG of 62 patients without diabetes and 39 patients with diabetes were evaluated by the lead investigator.

Variables such as gender, place of residence, socioeconomic status, and whether a person has diabetes or not were analysed to determine their frequencies and percentages of bone loss.

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III. RESULTS:

TABLE 1 REPRESENTS THE DESCRIPTIVE DISTRIBUTION AMONG THE STUDY POPULATION

VARIABLE	SUBGROUPS	DIABETIC (56%)	NON-DIABETIC (44%)	TOTAL 100
AGE	18 to 40 years	24	28	52
	41 to 50 years	32	16	48
	MEAN	43.34	32.56	37.89
	STANDARD DEVIATION	6.081	9.833	10.56
GENDER	Female	20	20	40
	Male	36	24	60
	Total	56	44	100

The average age of those without diabetes is 31.7581±9.3, whereas that of those with diabetes is 44.2821±6.1. There are more women (69, or 68.31%) than men (32, or 31.69%). The majority of 64 (63.4%) had a household income of less than 20,000 Indian Rupees. Of them, 34 (61.4%) were non-diabetic, whereas 30 (38.6%) had diabetes. Of the 80 people with less than 10 years of schooling, 52 (65.0%) did not have diabetes, and 28 (35.0%) did.

TABLE 2 REPRESENTS THE DESCRIPTIVE STATISTICS OF BONE LOSS BY TOOTH NUMBER

TOOTH NUMBER	MEAN	STANDARD DEVIATION	< 2 mm (Bone loss	> 2 mm (Bone loss)
16	3.24	1.924	44%	55%
11	2.76	1.713	50%	50%
26	1.75	1.002	80%	19%
31	1.89	1.431	78%	20%
36	2.91	2.234	52%	38%
46	3.23	1.875	62%	48%

Table 2 shows the descriptive data for six teeth. The greatest bone loss in tooth 16 is 3.1584 out of 101, which indicates that 55.4% of the teeth have periodontitis. The other teeth are regarded as normal since the bone loss is less than 2 mm. In a similar vein, the mean bone loss and periodontitis for molars 46, 26, and 36 are 2.6386, 2.7228, and 2.7198, respectively. With only 18.8% and 20.8% periodontitis, respectively, and more than 2 mm of bone loss in 11 and 31, the mean value of bone loss in incisors is within the normal range.

TABLE 3 COMPARISON OF MEAN OF BONE LOSS BY TOOTH NUMBER AND DIABETIC STATUS

STUDY GROUPS		BONE LOSS IN TOOTH					
		16	11	26	31	36	46
DIABETIC	MEAN	3.92	2.07	3.82	2.86	3.901	3.61
	STANDARD DEVIATION	1.990	1.234	2.356	1.671	2.812	1.780
NON-DIABETIC	MEAN	2.32	1.012	2.03	1.456	2.78	2.22
	STANDARD DEVIATION	1.890	.708	1.021	1.101	1.343	1.671

Comparisons between the two groups are shown in Table 3. Bone loss is greater in the diabetic group in all six teeth. For instance, tooth 16's mean value is 3.8462 in comparison to the non-diabetic group; tooth 26's mean value is 3.8462 in comparison to the non-diabetic group 2.0161; tooth 36's mean value is 3.1282 in comparison to the non-diabetic group 2.4629; and tooth 46's mean

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value is 3.4103 in comparison to the non-diabetic group 2.1532. In contrast, both diabetic and non-diabetic patients experience incisor bone loss that is within the normal range.

TABLE 4 BONE LOSS >2MM AND < 2MM, BY TOOTH AND DIABETES STATUS

VARIABLES	BONE LOSS IN INDEXED TOOTHS			
	< 2mm	> 2mm	TOTAL	P VALUE
	16 TOOTH			
DIABETIC	8(16%)	27.5(55%)	35.5	0.00
NON-DIABETIC	42(84%)	22.5(45%)	64.5	
	11 TOOTH			
DIABETIC	17(34%)	29(58%)	46	0.05
NON-DIABETIC	33(66%)	21(42%)	54	
	26 TOOTH			
DIABETIC	12(24%)	32(64%)	44	0.00
NON-DIABETIC	38(76%)	18(36%)	56	
	31 TOOTH			
DIABETIC	17.5(35%)	26(52%)	43.5	0.01
NON-DIABETIC	32.5(65%)	24(48%)	56.5	
	36 TOOTH			
DIABETIC	15(30%)	24(48%)	39	0.00
NON-DIABETIC	35(70%)	26(52%)	61	
	46 TOOTH			
DIABETIC	17(34%)	27.5(55%)	44.5	0.00
NON-DIABETIC	33(66%)	22.5(45%)	55.5	

Table 4 shows how diabetes mellitus and tooth loss are related. Out of the 50 instances in tooth 46 with bone loss more than 2 mm, 31 (62%) had diabetes and 19 (38%) did not. Of the 38 instances of tooth 26 with bone loss greater than 2 mm, 24 (63.2%) and 14 (36.2%) are not diabetics. Out of the 48 instances with bone loss >2 mm in tooth 36, 23 (47.0%) had diabetes and 25 (52.1%) did not.

Out of the 56 instances with periodontitis in tooth 16, 30 (53.6%) had diabetes and 26 (46.4%) did not. There are 19 and 21 instances of periodontitis in Incisors in tooth 11 and tooth 31, respectively. All teeth, with the exception of tooth 31, showed a significant correlation.

Table 5 illustrates the correlation between age and bone loss. All teeth showed substantial bone loss beyond the age of 40, with the exception of tooth 31, where the p-value was greater than 0.05.

IV. DISCUSSION:

The aim of this study was to evaluate bone loss via OPG imaging in both diabetic and non-diabetic persons. Bone loss is a radiological characteristic of periodontitis. The normal interdental gap is a topic of debate in the literature. It is less than 1.5 mm, according to some, and less than 2 mm, according to others[15]. Using 2 mm as the standard spacing in this investigation, we found that teeth 16 (55.4%), 11 (18.8%), 26 (37.6%), 36 (47.5%), 31 (20.8%), and 46 (49.5%) had more than 2 mm of bone loss.

Upon comparing these findings across individuals with and without diabetes, it was shown that those with diabetes experienced more bone

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loss (> 2 mm) in all chosen teeth, with the exception of teeth 31 and 36. According to one study, individuals with diabetes have higher rates of periodontitis than both healthy subgroups and prediabetics[16]. On bitewing radiographs, diabetics and pre diabetics had greater rates of marginal bone loss (4.7 mm and 4.2 mm, respectively) than did healthy controls (2.2 mm). Additionally, if the mean is compared with the study of Alasqah et al. (2018), the diabetic group in the current study showed a maximum bone loss of 3.84 mm[17].

All six teeth show greater bone loss in the diabetes group. For instance, tooth 16's mean value is 3.8462 in comparison to the non-diabetic group; tooth 26's mean value is 3.8462 in comparison to the non-diabetic group 2.0161; tooth 36's mean value is 3.1282 in comparison to the non-diabetic group 2.4629; and tooth 46's mean value is 3.4103 in comparison to the non-diabetic group 2.1532. On the other hand, both the diabetes and non-diabetic groups exhibit incisor bone loss that falls within the normal range. In a different study, Akram et al. discovered that individuals with poorly controlled diabetes experienced a slightly greater rate of bone loss compared to a healthy control group and individuals without diabetes who had periodontitis.

Despite the fact that their study's mean age group was larger than ours, the three groups' mean bone loss was 5.2 mm, 4.1 mm, and 1.6 mm, respectively. People with poorly controlled diabetes and chronic periodontitis were 55.2 years old, those without diabetes who were 51.5 years old, and healthy people who were 50.7 years old[18]. Patients with well-managed diabetes mellitus are reported to have periodontal health on par with those in systemically healthy conditions[19]. Plessas et al. (2018) found that DM individuals were more likely than non-diabetic people to have locations with ≥2 mm periodontal damage and to have higher radiographic alveolar bone loss across all assessed teeth[20].

To make sure the framework integrates pertinent new information into an already functional framework, Tonetti et al. (2017) proposed the staging and grading of periodontitis. The suggested risk categorisation is based on well-established risk factors, such as smoking, uncontrolled diabetes, early illness diagnosis or clinical signs of progression, and the degree of bone loss in relation to patient age[21]. According to a review by Poudel et al., time constraints and a lack of oral health understanding are two more significant reasons why the majority of diabetes care providers do not address oral health care. Diabetes educators (DEs) can help raise awareness of oral health issues and send patients to a dentist for regular checkups.

Nevertheless, DEs lack access to suitable oral health education programs and evaluation instruments. Nurses and other non-dental professionals have effectively integrated oral healthcare in other contexts with the right training[22]. In a similar vein, oral health literacy among diabetics is a critical component as there are still gaps in health literacy that need to be filled in order for patients to comprehend the significance of identifying and controlling dysglycemia for the preservation of periodontal health, opening up potential for patient education[23]. A dentist should refer a patient to a physician (a diabetes care provider) for diabetes monitoring or evaluation if an x-ray shows bone loss. Therefore, the doctor and dentist should both diagnose and suggest patients[24].

Due to inadequate age matching between the two groups, bone loss was substantially more common among older adults and diabetics. In contrast to Suphanantachat et al. (2017), who found that 3 out of 14 cases (21.5%) were female and 11 out of 14 (78.5%) were male, the current study shows that females are more prevalent (69, 68.31%) than males (32, 31.69%)[26]. Akram et al. (2019) examined the relationship between diabetes mellitus and periodontitis. OPG imaging was used in the current investigation to detect bone loss, but bitewings and routine radiographs are periapical and bitewings can measure bone loss similarly[29].

Krois et al. (2019) has published a research paper employing deep convolutional neural networks (CNNs) to evaluate bone loss and detect periodontal bone loss (PBL) on panoramic dental radiographs. Additionally, they compared CNNS's results to those of the senior dentist, but they found that while CNNS's outcomes were equivalent, machine-based technology had the benefit of requiring less diagnostic work from the dentist[30]The study has several drawbacks. Only we were able to determine the presence or absence of diabetes in hindsight because there was no numerical data available to evaluate the individuals' glycaemic levels.

Secondly, while exact age matching cannot be achieved because of the limitations of historical data, we employ OPG imaging s instead of bitewing or more complex imaging techniques to identify bone loss. Conversely, the diabetic group indicates increased levels of bone loss in every chosen tooth. By aligning the ages of the case and control groups and assessing blood glucose or

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Hb1Ac levels, additional prospective studies in local settings could be undertaken.

V. CONCLUSION:

Individuals with diabetes and older adults are more prone than those without diabetes and younger individuals to suffer from interproximal bone loss, a characteristic indicator of periodontitis. In comparison to incisors, molars showed the greatest amount of bone loss. The average bone loss in molars was above 3 mm in diabetics compared to 2.1 mm in non-diabetics.

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