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ABNORMALITIES OF THE SINGLE-ROOTED ANTERIOR TEETH: AN INDEX FOR EARLY DETECTION OF DIABETES MELLITUS

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ABSTRACT

The major reasons behind the worsening cases of prognosis of diabetes mellitus (DM) world-wide and its associated death toll is late diagnosis and ignorance amongst populations. Of course, awareness and knowledge about the diseases and its complexity, lead to early diagnosis, treatment, and complications' prevention. The fact that some body organs can serve as indicators for derailing conditions like diabetes (the teeth being the most affected), formed the basis for this study designed to determine the extent to which the single-rooted anterior teeth are implicated in patients with diabetes mellitus. The study involved 1,350 randomly selected DM patients that visited the dental clinics of four (4) selected hospitals in Imo State, Nigeria. Their data were extracted from clinical notes and radiological reports and tabulated into two groups. Group A represents the incidence of dental abnormalities in pre-diagnosed diabetic conditions, while group B represented the incidence of dental abnormalities in established cases of DM. The statistical analysis showed that there exists a significant difference ($P \geq 0.05$) in the compared abnormalities of the single-rooted anterior teeth; indicating that the abnormalities of the single-rooted anterior teeth can serve as index for early detection of DM.

Keywords: Diabetes mellitus, Epidemic, Diagnosis, Teeth, Single-rooted anterior.

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INTRODUCTION

Diabetes mellitus is a metabolic disorder of multiple aetiology and it is characterized by chronic hyperglycemia as well as disturbances of carbohydrate, fat, and protein metabolism, resulting from defects in insulin secretion, insulin action or both (Alberti and Zimmet, 1998). There are different types of diabetes mellitus presenting with varying degrees of risks, and these include Insulin Dependent Diabetes Mellitus (IDDM; Type I or "Juvenile onset diabetes mellitus), Non Insulin Dependent Diabetes Mellitus (NIDDM; Type II or "Maturity" onset diabetes mellitus), Malnutrition-Related Diabetes Mellitus (MRDM) and Gestational Diabetes Mellitus (GDM) (Alberti and Zimmet, 1998; American Diabetes Association, 2009).

Jonathana (2003), documented that when diagnosis of diabetes is made, the clinician must feel confident that the diagnosis is fully established; since the consequences for the individual are considerable and life long. The requirements for definitive diagnosis for a person who presented with severe symptoms and gross hyperglycemia differ from asymptomatic persons with blood glucose values found to be just above the diagnostic range. In these circumstances, the clinician should take into consideration such additional factors like ethnicity, family history, age, adiposity, and concomitant disorders, before deciding on a diagnostic or therapeutic course of action amidst plasma/blood glucose test (Alberti and Zimmet, 1998; The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus, 2003; American Diabetes Association, 2009).

Anatomically, the teeth are hard organs that develop from the mucous membranes of the mouth and embedded in the jaw-bones (Romanes, 1981). It is used to bite, grind and to aid clarity of speech (Moore et al, 2010; Marcovitch, 2005). Each tooth is composed of an enamel, dentine, pulp (contains blood vessels and nerves), root, gingiva (gums), cementum, and a periodontal membrane, (Moore et al, 2010, Marcovitch, 2005). The human exhibits a heterodont dentition with specialized forms of teeth adapted for specialized functions (Romanes, 1981). Two sets of teeth exist: the teeth that appear in children and fall off with time (deciduous or milk teeth); and a set of permanent teeth that gradually replaces the deciduous teeth (Singh, 2009). Romanes (1981) also classified the teeth into single, double, and triple rooted sets. Specifically, the single-rooted teeth include all incisors, all canine and all mandibular pre-molars, while the double-rooted teeth include all maxillary premolars and the first and

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second mandibular molars. The triple-rooted teeth however, comprise the maxillary molars.

Of interest, is the fact that tooth loss and dental abnormalities are greatly implicated in patients with diabetes mellitus due to high glucose levels in plasma and saliva, diabetic neuropathy, vascular dysfunction, and low immunity (Stuart and Froum, 1985; Moore 1983; Agur and Dalley, 2009). Savage (1992), Tsai et al (2002), Taylor et al (1996), and Marcovitch (2005), working independently, reported the signs and symptoms accompanying dental abnormalities in patients with diabetes mellitus, and was seen to occur individually or in groups. They include 1) pain in mouth, face, or jaw, that does not go away; 2) gums that are tender and bleed easily when stimulated by brushing and/or flossing; 3) swollen, red, or tender gums; 4) a sore, or ulcer in the gum that does not heal with a burning sensation in the mouth; 5) gums in recession; 6) pain when chewing; 7) loose or broken teeth; 8) dark spots or holes in the teeth; 9) the presence of pus between the teeth or gums; 10) a changed bit or jaw alignment; 11) teeth that are sensitive to hot or cold; and 12) persistent bad breath.

Tooth abnormalities occurring as a result of diabetes include toothache, alveolar abscess, dental abscess or gumboil, cariers of the teeth, discoloration, gingivitis, periodontal disease, cavities, tooth mobility, decay, and tooth loss (Dorland, 1998; Tsai et al., 2002). However, dental abnormalities can be detected as early as six (6) years of age long before any sign and symptom of diabetes mellitus are observable (Kapp et al, 2007; Taylor et al 1996); and it is possible to have dental disease and not have the warning signs (Sznajder et al, 1978). It is also possible to have a case of asymptomatic diabetes in which case the adverse effect and complications are often gross and debilitating (Alberti and Zimmet, 1998).

This retrospective study therefore, is carried out to determine the extent to which the single-rooted anterior teeth are implicated in diabetic patients visiting the dental clinics of four (4) selected hospitals in Imo State, Nigeria.

MATERIALS AND METHODS

Study area and Study population: This study was conducted in Imo State, a State located in the heart of the south-eastern Nigeria and as such called "*the Heartland State*". Geographically, Imo State is located within latitudes 4^0 45^1N and 7^0 15^1 N and Longitude 6^0 50^1 E and 7^0 25^1 E and shares borders with Anambra on the North, Abia States on the east, River Niger and Delta State on the west, and Rivers State lies on the South. The State was created on February 3, 1976 and covers an area of about 5,530sq km (2,140sqmi) with a population of 3,934,899 (according to the 2006 population census). The state is divided into 27 Local Government Areas (L.G.A) and 3 senatorial Zones (Orlu, Okigwe, and Owerri).

Four hospitals in Imo State, Nigeria, namely; Federal Medical Centre, Owerri; Umuguma Specialist Hospital, Umuguma- Owerri; St. Mary's Joint Hospital, Amaigbo- Nwangele L.G.A; and the Imo State University Teaching Hospital, Umuna-Orlu, were selected for this study. From which 207,855 medical records of patients were examined between the months of January, 2008 to December, 2011. Overall, the relevant data of sixty one thousand, eight hundred and four (61,804) dental patients who had a medical history of diabetes alongside other diseases such as chest pain, blurred vision, high blood pressure, obesity, and arthritis (representing 29.7% of all the patients), were appropriately recorded.

Ethical Consideration: Ethical approval was obtained from the Ethics Committee of Imo State University Teaching Hospital, Umuna Orlu, Imo State, Nigeria.

Exclusion criteria: The normal shedding of deciduous teeth (Moore et al, 2010; Romanes 1981) were put into consideration and were not included in the study. Also, those abnormalities that occurred as a result of accidents and the congenital absence of teeth (anodontia) (Shaw, 1981) were excluded in this study.

Sampling/Data collection: 1,350 cases from patients that had a medical history of diabetes alone were chosen for this study using simple random sampling technique. This technique was chosen because it is the purest form of probability sampling (Nwana, 1981). All the relevant data were then extracted from their clinical notes and radiological reports, and tabulated as groups A and B; whereby group A represents patients with dental abnormalities in pre-diagnosed diabetics, while group B represented patients that had more than one tooth loss from the time they were diagnosed diabetic.

Statistical analysis: Statistically analysis was performed using the descriptive and inferential statistical tools (SPSS version 16).

RESULTS

Table 1 below shows tooth loss in pre-diagnosed diabetic patients. The number of tooth loss was

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grouped according to their names, and position in the row of each jaw without any differentiation to whether it is on the right or left half of the respective jaw, because they have the same anatomical similarity in keeping with some organ bilateral symmetry in man, such as the brain, eyes, nose, ears, upper limbs, lungs, breast, kidneys, ovaries, testes and the lower limbs. The first tooth lost by individual patients was selected from a whole lot of teeth loss as recorded in the patient's folder. These patients at this time have been clinically diagnosed to be diabetic, but those particular data in table1 of group A was obtained from the history of their previous tooth / teeth they lost before the time they were diagnosed to be diabetic (as indicated in their clinical notes). In the first column, the "NO history" recorded against 200 as a value represents the number of patients who had no history of previous tooth loss, except that they had, after they must have been diagnosed to be diabetic (See figure 1 and 2).

Table 2 shows the incidence of the single-rooted anterior teeth in group A and their p-values. It represents all teeth loss among single-rooted anterior sets of teeth, in keeping with the purpose of this study.

Table 3 however, shows the incidence of tooth loss in patients with established cases of diabetes mellitus. In this table, we recorded the teeth loss among those dental patients after they had been clinically diagnosed to be diabetic. Multiple teeth loss were noted in individual patients, but the most recent tooth loss (as indicated in their clinical notes) was selected and grouped together according to their names and position in the row of each Jaw without any differentiation to whether it is on the right or left of the respective jaw. The incidence of the single-rooted anterior teeth in group B and their p-values are shown in Table 4, and represents all teeth loss among the single-rooted anterior set of teeth, in keeping with the aims and objectives of this study.

Figure 3 is a bar chart representation, comparing data of the anterior teeth recorded when these dental patients were not yet diagnosed clinically to be diabetic and after they were diagnosed clinically to be diabetic.

Table 1: Showing tooth loss in pre-diagnosed diabetic patients

Teeth	**Occurrence**		**Ranking**
	Value (number)	*Percentage (%)*	
No history	200	14.81	-
Central mandibular incisor (CM^dI)	530	39.26	1st
Lateral mandibular incisor (LM^dI)	200	14.81	2nd
First mandibular premolar (FM^dP)	165	12.22	3rd
Central maxillary incisor (CM^xI)	100	7.41	4th
First mandibular molar (FM^dM)	85	6.30	5th
Maxillary canine (M^xC)	24	1.78	6th
First maxillary premolar (FM^xP)	13	0.96	7th
Second maxillary molar (SM^xM)	12	0.89	8th
Second mandibular premolar (SM^dP)	11	0.81	9th
Mandibular canine (M^dC)	10	0.74	10th
Total	**1,350**	**100**	

Table 2: Incidence of the single-rooted anterior teeth in group a above and their p-values

Teeth	**Occurrence**		**Ranking**	**P-value**
	Value (number)	*Percentage (%)*		P≥0.05
Central mandibular incisor (CM^dI)	530	50.96	1st	46.087
Lateral mandibular incisor (LM^dI)	200	19.23	2nd	17.391
First mandibular premolar (FM^dP)	165	15.87	3rd	14.348
Central maxillary incisor (CM^xI)	100	9.615	4th	8.696
Maxillary canine (M^xC)	24	2.308	5th	2.087
Second Mandibular Premolar (SM^dP)	11	1.058	6th	0.957
Mandibular canine (M^dC)	10	0.959	7th	0.870
Total	**1,040**	**100**		

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Table 3: Showing tooth loss in patients with established cases of diabetes mellitus

TEETH	Occurrence		Ranking
	Value (number)	*Percentage (%)*	
Third mandibular molar (TM^dM)	572	42.37	1st
First mandibular molar (FM^dM)	374	27.70	2nd
Lateral maxillary incisor (LM^xI)	70	5.19	3rd
First maxillary premolar (FM^xP)	60	4.44	4th
First maxillary molar (FM^xM)	50	3.70	5th
Lateral mandibular incisor (LM^dI)	45	3.33	6th
Third maxillary molar (TM^xM)	41	3.04	7th
Second maxillary premolar (SM^xP)	37	2.74	8th
Second mandibular premolar (SM^dP)	32	2.37	9th
Mandibular canine (M^dC)	28	2.07	10th
Maxillary canine (M^xC)	17	1.26	11th
Second maxillary molar (SM^xM)	14	1.04	12th
Central maxillary incisor (CM^xI)	10	0.75	13th
Total	**1350**	**100**	

Table 4: The incidence of the single-rooted anterior teeth in group b above and their p-values

Teeth	Occurrence		Ranking	P-value
	Value (number)	*Percentage (%)*		P≥0.05
Lateral maxillary incisor (LM^xI)	70	34.65	1st	5.185
Lateral mandibular incisor (LM^dI)	45	22.28	2nd	3.333
Second madibular premolar (SM^dP)	32	15.84	3rd	4.741
Mandibular canine (M^dC)	28	13.86	4th	2.074
Maxillary canine (M^xC)	17	8.42	5th	1.259
Central maxillary incisor (CM^xI)	10	4.95	6th	0.741
Total	**202**	**100**		

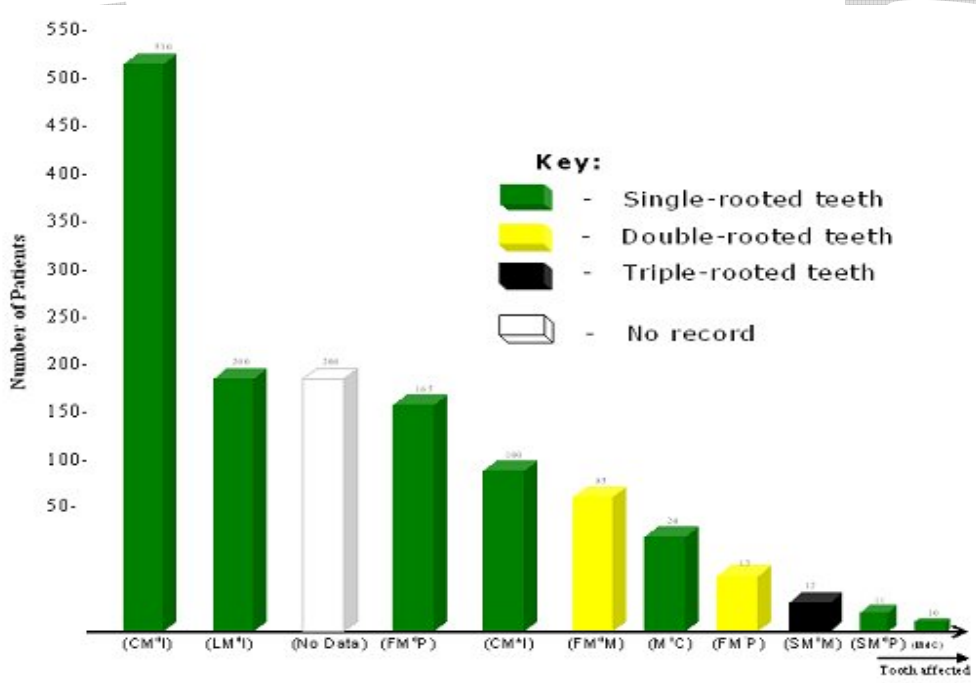

Figure 1: Dental abnormalities (tooth loss) in pre-diabetic patients (group a), showing the single, double, and triple-rooted teeth

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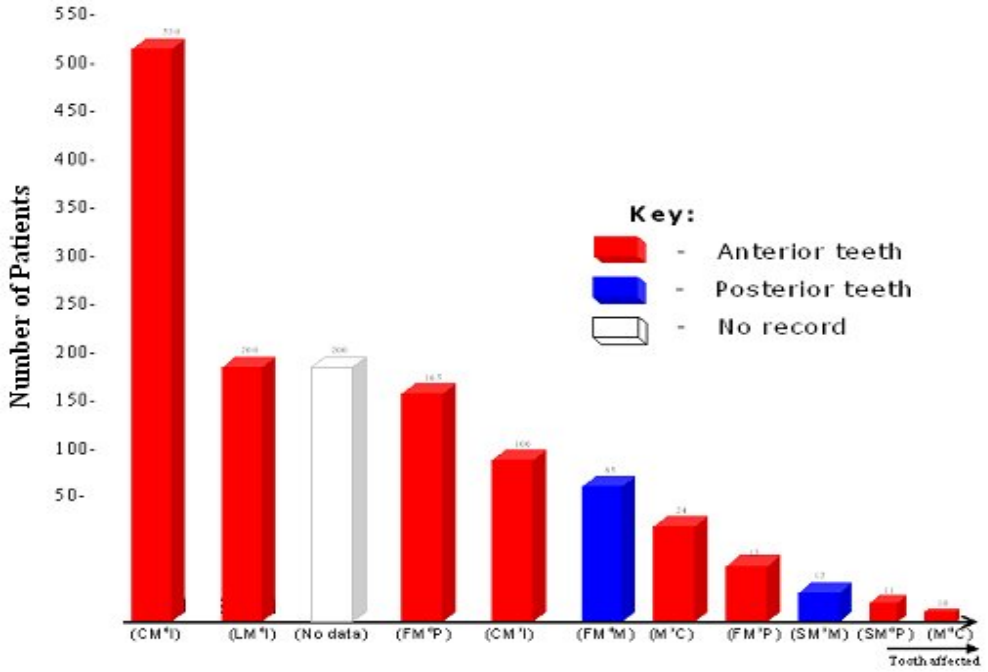

Figure II: Dental abnormalities (tooth loss) in pre-diabetic patients (group a), showing anterior and posterior teeth

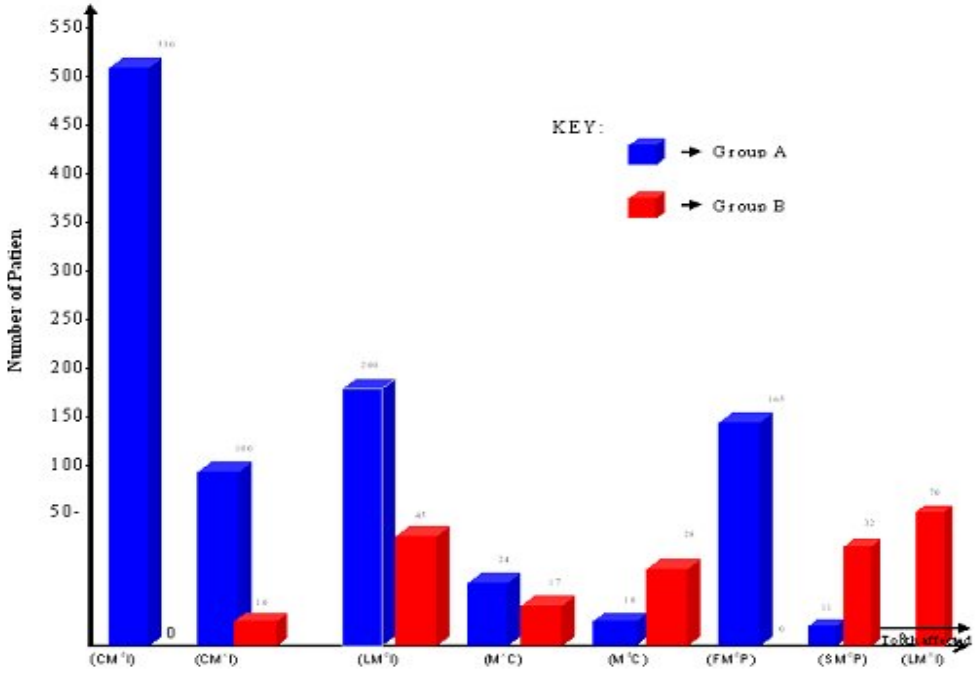

Figure III: Dental abnormalities (tooth loss) of the single-rooted anterior teeth in pre-diagnosed diabetics (group a) and in established cases of diabetes mellitus (group b)

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DISCUSSION

The observation that most of the diabetics in this study, lost at least a tooth or a set of teeth before and after being diagnosed diabetic, aligns with WHO's declaration (WHO, 1978) that common causes of teeth extraction include dental caries before the age of 34, and later because of periodontal diseases due to diabetics. Interestingly, these conditions share common triggers like high glucose levels in plasma and saliva (Stuart and Froum, 1985; Moore 1983; Agur and Dalley, 2009).

More so, tooth loss was obvious in patients with diabetes mellitus especially the third mandibular molar amongst patients with established cases of DM and the central mandibular incisor, amongst pre-diagnosed diabetic patients. This agrees with the assertion by Wass et al. (2002), Wilson (1999), and Emrich et al. (1991) that periodontal disease-induced tooth loss, is the most frequent disorder connected with diabetes.

Based on the statistical comparisons also, it is clear that a significant difference existed between the two groups under study. This was evident in the higher incidence of tooth loss amongst the single rooted anterior teeth (central mandibular incisor, lateral mandibular incisor, and the first mandibular premolar), thereby confirming the fact that diabetes remains a risk factor in periodontitis leading to tooth loss (Mealey, 1999; Oliver and Tervonen, 1994; 1993).

In addition, available literature does show that vascular changes, neutrophilic dysfunction, impaired collagen synthesis, and genetic predisposition has been outlined as the mechanisms associated with diabetes-periodontitis pathology. These changes have been postulated to impair oxygen expansion, leukocyte migration and immune factor activities, and thus, contributing to the progression periodontitis and tooth loss via disordered microcirculation in diabetics (Oliver and Tervonen, 1994).

Our results did show also that the time of occurrence of tooth loss among the single-rooted anterior teeth in pre-diagnosed diabetic patients had a significant effect on the parameter for early detection of diabetes mellitus. This finding can serve to fill in the gap of concomitant disorders witnessed among diabetics and is useful for the diagnosis and confirmation of diabetes mellitus, as well as forensic evaluations. It therefore, buttresses the relationship between diabetes and the dents, especially in the aspect of tooth loss following the debilitating effects of diabetes mellitus.

Nevertheless, dental abnormalities are not restricted to diabetes alone, but we recommend however, that all patients with any tooth abnormality or notice a recurrence of the signs and symptoms of such abnormalities should consult a dentist for appropriate follow-up.

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AUTHOR(S) CONTRIBUTION

All authors (Ofoego A.N., Obi A.U; Ihentuge C; Fawehinmi H.B.) contributed to this study as well as the manuscript preparation.