# The Association of Periodontal Disease and Metabolic Control of Type 1 Adult Patients with Diabetes at Tygerberg Hospital, Cape Town.


A thesis submitted in partial fulfillment of the requirement for master's degree in Periodontology, Department of Periodontology and Oral Medicine

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**The Association of Periodontal Disease and Metabolic Control of Type 1 Adult Patients with Diabetes at Tygerberg Hospital, Cape Town.**

**ABSTRACT**

Background: Periodontal disease is chronic inflammation of the periodontium. The inflammation can affect the gingival connective tissue or can progress, into the periodontal ligament and alveolar bone. Periodontal disease is a co-morbidity of diabetes and affects diabetics with poor control and suppressed immunity.

Aim: This study compared the periodontal status of adults with Type 1 diabetes mellitus (T1DM) with their diabetic metabolic control.

Method: This cross-sectional study was conducted in adult patients diagnosed with T1DM. PD was assessed using the AAP as well as EFP 2017 classification. Periodontal parameters (bleeding index, periodontal pocket depth and radiographical bone loss) were assessed and the periodontal health of the diabetic patient was compared to their glycemic control.

Results: There were 120 adult participants, of whom 61.67% (74), were female, and 38.33 % (46) were male. The majority were non-smokers and less than 44 years of age. There were 78 (65%) participants with uncontrolled blood glucose (BG) and 42 (35%) with good control, HBA1C>=7%. The median HbA1C level was 8.75 [6.1 to 12.2].
The majority of the participants, 94% had periodontitis, and 97% of them showed uncontrolled blood glucose. Only 7 participants had gingivitis and only 2 showed poor metabolic control.

Conclusion: There was a significant association between periodontal disease and adults with T1DM at Tygerberg Hospital.

**Keywords:** Type 1 DM**,** Adults, Glycemic control, periodontal disease

**Declaration:**

I, Ahmed Suliman, hereby declare that the work contained in this dissertation titled; "The Association of Periodontal Disease and Metabolic Control of Type 1 Adult Patients with Diabetes at Tygerberg Hospital, Cape Town" is my original work and has not been formerly in its totality or in any part submitted at any academic institution for degree or examination.

Dr. Ahmed Suliman 24 April 2022

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**ABBREVIATIONS**

AAP: American Academy of Periodontology

AIDS: Acquired Immunodeficiency Syndrome

ANOVA: Analysis of variance

BMREC: Biomedical Research Ethics committee

BG: Blood Glucose

CEJ: Cement-enamel-junction

Clinical AL: Clinical attachment level

DKA: Diabetes ketoacidosis

DM: Diabetes mellitus

EFP: European Federation of Periodontology

FBG: Fasting blood glucose

FBS: Fasting Blood Sugar

HbA1c: Glycated Haemoglobin

HIV: Human Immunodeficiency Virus

IDF: International Diabetes Federation

LOA: Loss of attachment

MM: Millimeters

N: Number

NA: Not applicable

P. gingivalis: Porphyromonas gingivalis

PD: Periodontal disease

PPD: Probing pocket depth

RANKL: Receptor activator of nuclear factor kappa-B ligand

SD: Standard deviation

STATA: Statistical software

SU HREC: Stellenbosch University Health Research Ethics committee

T1DM: Type 1 diabetes mellitus

T2DM: Type 2 diabetes mellitus

USA: United States of America

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**CHAPTER ONE**

**INTRODUCTION**

**CHAPTER ONE**

## Introduction

Periodontal disease (PD) is characterized as an inflammatory disorder of the supporting tissues around teeth. These disorders are initiated by bacteria within a biofilm.(Lobprise and Johnson, 2020). The prevalence of PD is reported to be approximately 90% worldwide (Dye, 2012). PD includes gingivitis, the inflammation of the gingiva, which is reversible and periodontitis, which signifies loss of clinical attachment of the supporting tissues around teeth and is irreversible. Periodontitis is always preceded by gingivitis but not all persons with gingivitis will progress to periodontitis, as there are many factors such as host susceptibility that determines this progression of disease. (Nazir *et al.*, 2020a)). An absolute or relative shortfall in insulin levels or activity resulting in hyperglycemia, defines the broad group of illnesses known as DM.(Glovaci, Fan and Wong, 2019) This metabolic condition with several etiologies can be identified by elevation of blood glucose level and changes in carbohydrate, lipid, and cellular metabolism. Symptoms include thirst, polyuria, polydipsia, obscured vision, weight misfortune and sometimes polyphagia. The foremost serious clinical manifestation is ketoacidosis or non-ketotic hyperosmolar state. (*The 2017 SEMDSA Guidelines for the Management of Type 2 Diabetes | Journal of Endocrinology, Metabolism and Diabetes of South Africa*, no date). (Njølstad *et al.*, 2003) Diabetes mellitus (DM) is a worldwide and highly prevalent non-communicable disease. Its current prevalence, worldwide, shows that 1 in 8 adults are living with diabetes (*IDF Diabetes Atlas | Tenth Edition*, no date).With the publication of standard criteria for the diagnosis of diabetes, the prevalence of this disease has been found to be high, especially in underdeveloped and less privileged countries. This prevalence has been documented to be increasing over the past decades with industrialization and urbanization of the communities. South Africa is a country of upper middle-income economy and holds one of the continent's major economy. It's part of Sub-saharan Africa (SSA), where only 25% of the population is unemployed. Its total population 51.770,560 million and >60.0% live in urban areas. The national prevalence, according to the 2015 consensus in South Africa was 7 %. That is to say that there are 2.3 million people with diabetes where 1.3968 million were undiagnosed and 57,319 died from the disease. This high burden

poses financial pressure on the economy of the country. DM can affect all age groups and is a life-long disease that affects the quality of life of the patient because if poorly controlled, can cause a number of acute and chronic complications. The major types of the disease, known as type 1, where there is complete insulin deficiency, and type 2 where there is insulin resistance. Other types are hyperglycemia during pregnancy called gestational diabetes or diabetes with pregnancy. Genetic defects can cause a group of syndromes known as monogenic diabetes. Infections, disorders of the pancreas, endocrinopathies and drugs are also causes and associations of diabetes (*The 2017 SEMDSA Guidelines for the Management of Type 2 Diabetes | Journal of Endocrinology, Metabolism and Diabetes of South Africa,* no date). Type 1 diabetes mellitus, although defined as (IDDM), affects childhood and teenagers and treated by insulin injections. Type 2 diabetes mellitus, although defined as (NIDDM), is the main type of DM that affects adults who's more than 20 years and managed with oral anti-diabetic agents (OAA) with or without insulin. In both types of DM lifestyle modification such as weight reduction, diet and exercise important key to treatment and prevention (Guyton & Hall, 2006)(González *et al.*, 2009). Periodontal disease, specifically periodontitis, has been reported with increased incidence and prevalence in patients with type 1 and 2 DM (Stöhr *et al.*, 2021). Some mechanisms for explanation of increased susceptibility to periodontal diseases are neutrophil dysfunction, changes in the subgingival microflora, structure and metabolism of collagen due to uncontrolled DM. (Matsha *et al.*, 2020). Therefore, in this study, we aimed to investigate the effect of the diabetic metabolic control on the periodontal health of adult patients, with specifically type 1 diabetes at Tygerberg dental hospital.

**CHAPTER TWO**

**LITERATURE REVIEW**

**CHAPTER TWO**

**Literature review**

**Periodontal Disease (PD)**

**Epidemiology of periodontal disease:**

The epidemiology of PD includes the study of its etiology and prevalence among the individuals. It also includes modalities of prevention and treatment (Lindhe *et al.*, 2015). PD is a prevalent oral disease of the periodontium. The WHO has designed a GOH data bank from CPI, different data from different societies has given an idea about the spread of PD (Wang, 2008). According to the Global burden of disease study, severe periodontal disease is ranked as the 11th most common disease in the globe(Nazir*etal.*,2020b). Between 20% and 50% of people worldwide are said to have periodontal disease. It is one of the main reasons f or tooth loss and can negatively impact mastication, appearance, selfconfidence, and quality of life. Periodontal disorders were responsible for 3.5 million YLD (years lived with disabilit y) worldwide in 2016. The prevalence of periodontal disease increased globally by 57.3% bet ween 1990 and 2010(Nazir et al., 2020b)

**Pathology of PD:**

The healthy gingiva appears as pale, pink in color, firm that shields both, bone and root surface (Mealey, *et al.*, 2007) (Matesanz-Prez, *et al.*, 2008). When the gingiva is inflamed the mouth reveals the sight of inflamed, sensitive gums, which normally bleed upon periodontal examination. The razor-sharp appearance of the gingival margin and the stippled gingival tissue found in healthy gingiva becomes more bulbous and erythematous (Rathee and Jain, 2022). Bleeding may occur (Sjdin, *et al.*, 2012; Socransky, 1977; Roy *et al.*, 2004; Kinane, *et al.*, 2001) and these inflammatory changes are

elicited by bacteria found within dental-biofilm in the gingival sulcus and on the tooth surface (Van Dyke *et al.*,2005) (Popławska-Kita, *et al.,* 2014) (Preshaw, *et al.,* 2013). In the absence of clinical attachment loss, this condition is known as gingivitis. When periodontal pockets develop in the presence of clinical attachment loss, gingivitis has progressed to periodontitis. (Kinane, *et al.,* 2001) (Gamonal, *et al.,* 1998). This inflammatory process that affects the gingiva, alveolar bone and periodontal ligament is caused by many dangers' element include bacterial microorganisms that produce enzymes like collagenase, hyaluronidase and endotoxins. These will trigger the inflammatory response that activates macrophages to produce prostaglandin E2, interferon and interleukin (IL1) (Wankhede *et al.,* 2017). Some researchers have shown that 38% to 82% of the community with periodontal disease was caused by biological factors (Michalowicz *et al.,* 2000), other researchers showed that IL1 genotype is associated with the severity of the disease (Wankhede *et al.,* 2017), suggesting a genetic relation. Environmental factors such as smoking, damages the gingiva by inhibiting the immune responses, and exacerbating the inflammatory response, which can harm and eventually destroy the alveolar bone (Zhang *et al.,* 2019). It reduces collagen synthesis and protein secretion that will break down the tissue that support the teeth, it also suppresses the RANKL/OPG ratio which are signaling regulators of osteoclast formation that will cause periodontitis (Ateeq *et al.,* 2021). Stress, can elevate glucocorticoid and increase insulin resistance resulting in high risk for PD (AlJehani, 2014). Maturity level, medications and systemic disease (Han, *et al.,* 2012) ((Sanz-Snchez *et al.,* 2008) (Denisse *et al.,* 2017) (Garofalo, 2008), such as DM, suppresses the immune system and increases plaque formation(Zhou *et al.,* 2015) (Mattson *et al.,* 2001).Different studies have shown that patients with DM have a reduced T cell and granulocytes causing infections in the oral cavity (Ochoa *et al.,* 2012) (Denisse *et al.,* 2017). DM influences the gingival health due to increased blood glucose levels. An elevation of advanced glycation product, reactive oxygen species and inflammatory mediator expression levels trigger osteoblast death and initiate osteoclastogenesis. It also raises the RANKL/OPG ratios. In the case of periodontal disease brought on by bacterial infections, this chain of events contributes to both increased bone resorption and decreased bone production, leading to higher alveolar bone loss(Wu, Xiao and Graves, 2015) . An alteration in subgingival bacteria was found in diabetic patients. These included Porphyromonas gingivalis and Treponema denticola. These gram negative bacteria are responsible of the progression of periodontal disease(Silva et al., 2022). Uncontrolled DM will cause an elevation in pro-inflammatory substances like interleukin1, TNF alpha and that will destroy the gingival tissue. Studies have found that DM can modify the immunologic

cell action leading to monocyte tumor necrosis factor secretion and damage the gingival health (Nazir and Amin, 2021)

**Diagnosis of periodontal disease:**

Periodontitis is classified by the ADA and EFP, into staging and grading system, staging was sub-classified into four stages which depends on the interproximal bone loss. Stage 1 shows less than two-millimeter bone loss, stage 2 shows loss at the coronal one third of the root, stage 3 at the mid-third and stage 4 at the apical third. Other variables such as clinical attachment loss, amount and percentage of bone loss, probing depth, presence and extent of angular bony defect and furcation involvement, tooth mobility, and tooth loss are associated with periodontal infection. Grading was done based on the percentages of bone destruction over patient age, to A < 0.25, B 0.25-1 and C > 1. Diabetes affects the classification grading as a modifying factor. DM patients with an HbA1c of less than 7% was classified as grade B and with an HbA1c of more than7% grade C. Smoking was also added as a modifying factor that affects the grading of the case. Patients who smoke less than 10 will be grade B and if more than 10 cigarettes a day its grade C. The classification also included the health of the periodontium and gingival disease and conditions. This was further subclassified to periodontal health and gingival health, dental biofilm induced gingivitis and non-biofilm induced gingivitis. There are other conditions that affect the periodontium, they were classified to systemic disease or condition that affect the periodontium, periodontal abscess, traumatic occlusal forces and mucogingival deformities and conditions. (Dietrich *et al.*, 2019), Intraoral radiographs are needed to provide an indication of residual alveolar bone heights as an aid to diagnosis (Heikkinen *et al.*, 2017)



**Diabetes Mellitus**

Diabetes is a metabolic diseases characterized by hyperglycemia (Clement *et al.*, 2004),(Moghissi *et al.*, 2009) which causes polyuria, excess thirst and hunger. Many problems might occur if DM not addressed or poorly controlled (Umpierrez & Korytkowski, 2016). The acute complications are non ketotic hyperosmolar coma, diabetic ketoacidosis and hypoglycemia or death (Bogun & Inzucchi, 2013). Chronic complications are in the form of ulceration of feet, small retinal blood vessels , stroke, heart disease and chronic kidney failure (Umpierrez & Korytkowski, 2016). Diabetes mellitus occurs either because of the inability of the pancreatic cells to make enough insulin because of the autoimmune breakdown of the pancreatic β cells. This is known as T1DM. T2DM, however, is the organ cells' failure to react to the insulin made due to insulin tension (Umpierrez *et al.*, 2015). A category of autosomal dominant single gene disorders known as maturity-onset diabetes of the young

(MODY) cause decreased insulin production and diabetes to develop in adolescence or early adulthood. In most cases, these patients show no or very minor symptoms, lack the characteristic profile of the obese metabolism seen in the T2DM individual, and got supportive early dementia in the families (mainly less than age of twenty-five) diabetes in previous generations. MODY is frequently misinterpreted as type1 or T2DM and is thought to account for 1-2% of diabetes occurrences. The necessity for genetic counseling, changes in treatment, and prognosis necessitate of doctors to be at a high level of concern of MODY in patients who presented with "T2DM" under 25 years old. A subtype of type 1 diabetes called latent autoimmune diabetes of adulthood (LADA) is frequently misunderstood as type 2DM. It is marked by a slower immunological death of beta cells than is characteristic of type 1 DM, and as a result, hyperglycemia develops more slowly and gradually, much like type 2DM. Patients with LADA have phenotypic characteristics that differ from those of normal type 1DM patients, such as being older (on average, over 35 years old) and less likely to be obese, as well as not having the strong familial history of diabetes that is so common in type 2 DM. These characteristics, however, are not constant. About 10% of those over 35 who are diagnosed with type 2DM may really have LADA. The condition known as gestational diabetes (GDM) was referred to as hyperglycemia also known as glucose intolerance—that began or first became apparent during pregnancy. The ADA defines GDM as pregnancy-related DM that was not definitely T1DM or T2DM when it was discovered during the 2nd or 3rd trimester (*The 2017 SEMDSA Guidelines for the Management of Type 2 Diabetes | Journal of Endocrinology, Metabolism and Diabetes of South Africa*, no date)Obesity and not exercising, are risk factors of this disease (Umpierrez & Korytkowski, 2016). The monogenic type that can be either, monogenic defect of beta cell function or monogenic defect of insulin acting which is rare than the other type as patient suffers clinically from hyperinsulinemia or polycystic ovarian condition and virilization.(Zhang *et al.*, 2021)

**Global report on diabetes mellitus**

Despite being present everywhere, this illness is particularly prevalent in wealthy nations (especially type 2). 80% of diabetic deaths occur in low- and middle-income nations, where there has been the greatest increase. By the year 2030, it is anticipated that the prevalence of diabetes people living there will significantly rise. The increase in rates in emerging nations is brought about by changes in lifestyle, such as decreased physical activity and increased consumption of high-energy-fat foods. (Carpenter *et al.*, 2015).

**Type 1**

Type1 DM is a severe, somewhat chronic disorder that affects children. It is brought on by autoimmune inflammation, which damages β cells in the pancreatic islets of Langerhans, which make insulin. According to Golden et al. (2009), the disease develops in genetically predisposed people (polygenic genetic predisposition) after the heredity and environment factor interacting . It is thought that both genetic and nongenetic factors contribute roughly equally to the pathogenesis of the disease. Enterovirus infections (coxsackievirus type B) are major environmental factors thought to be linked to an elevated incidence of autoimmune insulinitis (Oikarinen et al., 2014). Since the prevalence of T1DM has dramatically upraised in past eras, it is most likely due to environmental factors, or changes in how people are exposed to certain nongenetic factors, as an increase in the proportion of genotypes at risk for T1DM in the population is not likely. Since DM pathophysiology is still not fully understood, there are no reliable preventative interventions (Cinek, 2011).

**Type 2**

T2DM can be identified by increased insulin resistance and decreased insulin production (Keller, 2012). Insulin receptors play some role in the body cells' incapacity to react to insulin. There are three different forms of diabetes mellitus, although T2DM is the most common. The fundamental issue at the start of T2DM is decreased insulin sensitivity. At this point, hyperglycemia can be managed with a variety of techniques and drugs that increase insulin sensitivity or reduce the generation of liver sugars (Keller, 2012). T2DMis primarily brought on by lifestyle factors, including obesity, stress, poor food, urbanization, and insufficient physical activity, as well as heredity (Keller, 2012). Increased body adiposity is a factor in 20% of instances in Japanese and Chinese people, a hundred percent of cases in Pima Indians and Pacific Islanders, and a sixty to eighty percent of cases in people of European and African heritage. (2012) Keller. Dietary factors, such as eating drinks with a high sugar content, have an impact on the likelihood of developing non-insulin-dependent diabetes. However, eating saturated and trans fats may increase the risk, whilst eating monounsaturated and polyunsaturated fats may lower the risk. White rice and other starches increase the risk of diabetes (Inzucchi et al., 2012). 14% of instances were brought on by a lack of physical activity (Inzucchi et al., 2012).

**Epidemiological studies of periodontal disease in diabetic patients**

Research has shown that patients with DM frequently develop periodontal problems. Patients with poorly managed DM seems to be much susceptible to acquiring chronic periodontitis in the long run. (Mealey, et al., 2006) (Taylor and others, 1996) Diabetes patients with PD have greater HbA1C levels than diabetics with healthfully gingivae (Graziani, et al., 2018). Studies conducted in Pomerania revealed that among 2973 non-diabetics, those with the greatest percentage of sites with clinical attachment loss (CAL) more than or equivalent to 5mm experienced a.08% larger change in HbA1c than those with the lowest level of periodontal disease (Demmer et al., 2010).Evidence showed the relation between periodontal tissue and hyperglycemia is possible through cellular immunity, microangiopathy and formation of the advanced glycation ends products (Novotna *et al.*, 2015). Numerous studies found that the periodontal disease is the sixth complication of diabetes (Taylor and Borgnakke, 2008). In a study that consisted of 107 patients with type 1 diabetes mellitus and forty healthy controls of similar age and sex distribution, periodontitis was observed in 57.9% of patients with type 1 diabetes mellitus and 15.0% of healthy controls. The risk of periodontal disease is higher in diabetic patient compared to non-diabetic patients(Popławska-Kita *et al.*, 2014) Alma Pranckeviciene, in 2014 studied the severity of periodontal disease depending on the type of diabetes. 179 randomly chosen T1DM patients aged 18 to 62 and 87 T2DM patients aged 32 to 70 made up the study's participants. The levels of glycosylated hemoglobin were used to gauge the metabolic management of diabetes (HbA1c). The oral debris index (DI-S), probing pocket depth (PPD), gingival recession (GR), clinical attachment level (CAL), and bleeding on probing were used to assess the periodontal health of all patients (BOP). They discovered that patients with T2DM had considerably higher periodontal estimations across the board. Participants over 45 years old and those with DI-S greater than one had more advanced periodontal disease. Most periodontal indicators were negatively correlated with the disease duration of >12 years in T1 diabetic patients. In neither group was there a discernible relationship between periodontal estimations and HbA1c. T2DM (OR = 2.356), length of disease (OR = 1.827), high BOP (OR = 3.343), and DI-S (OR = 2.958) were all significant predictors of severe periodontal disease. Therefore, they came to the conclusion that the severity of periodontal disease is associated to the type of diabetes, being more prominent in T2DM patients than in T1DM patients. Dental plaque appears to be the main factor. Ankita Jindal et al, in 2015, conducted a study on the association between a patient's ability to control their diabetes and the severity of their periodontal disease in those with Type 1 diabetes. The study included 50 participants with Type 1 diabetes (n = 50). By assessing their HbA1c levels, they were categorized into three groups based on

their level of glycemic control: "Good" (HBA1c 7) Group A, "Fair" (HBA1c = 7-8) Group B, and "Poor" (HBA1c >8) Group C. All enrolled patients had thorough medical and dental examinations. By assessing tooth plaque (plaque index), gum inflammation (gingival index), probing pocket depth (PPD), and clinical attachment level, periodontal disease was evaluated. They discovered that individuals with Type 1 diabetes who had poor glycemic control had greater gingival inflammation (P 0.05), more dental plaque (P 0.05), increased PPDs (P 0.05), and attachment loss (P 0.05) in comparison to individuals who had fair and good glycemic control, respectively. It was found that in people with Type 1 DM, inadequate glycaemic management worsens periodontal disease severity. In 2018, Anastasios Plessas, Douglas P. Robertson, and Penny J. Hodge investigated radiographic bone loss in a type 1 diabetes mellitus population in Scotland who did not smoke. In comparison to non-diabetic people, T1DM individuals had greater radiographic alveolar bone loss overall (median: 1.27 mm versus 1.06 mm, P 0.001) and more than a two-fold increased chance of having sites with less than 2 mm of periodontal damage (OR = 2.297, 95%CI 1.058 to 4.986, P = 0.036). Even after accounting for numerous potential confounding variables, they came to the conclusion that type 1 diabetic individuals have a higher risk of developing periodontitis. This disparity can be detected on routine dental radiographs at an early stage. These findings support radiographic evidence linking type 1 diabetes and loss of periodontal bone. In 2018, Ana del Miguel-Infante et al. released a study on the prevalence and risk factors of periodontal disease in persons with diabetes. They examined the connection of PD & DM while controlling for sociodemographic traits, comorbidities, oral health status, and lifestyle variables, and they determined those factors are totally independent related to PD in people with DM. Data from the NEHIS, done in Spain in the period of 2003 to 2014, were used in this case-control investigation. They had 65 295 subjects under the age of 40. Self-reported diabetes status was present. Each diabetic patient had a matching non-diabetic control group survey year, age, and sex. The response "my teeth bleed spontaneously or while brushing" or/and "my teeth move" to the following query: "Do you suffer from any of these dental and oral diseases or disease?" was used to define the existence of periodontal disease. The status of oral health and comorbidities were independent variables, along with demographic, socioeconomic, and healthcare-related factors. Diabetes patients had a greater prevalence of periodontal disease than their non-diabetic controls (23.8% vs 19.5%: P 0.001). For participants with diabetes, the adjusted OR for periodontal disease was 1.22 (95% CI: 1.03-1.45). Diabetes patients had an increased risk of PD when they had missing tooth (OR 2.08, 95% CI; 1.70–2.53), osteoporosis (OR 1.41, 95% CI; 1.07–1.63), and depression (OR 1.39, 95% CI; 1.12-1.71). Lower rates of periodontitis were linked to older ages, private insurance

use, and higher levels of education. Periodontal disease is more likely in those with diabetes. Doctors and dentists should educate their diabetic patients more, especially those with lower levels of education, missing teeth, osteoporosis, and depression. Uncontrolled DM uplift the blood sugar and glucose levels in the saliva, which motivates the growth of bacterial resulting in PD. Conversely, unmanaged PD can increase levels of blood sugar and make managing of DM more challenging. Oral health is important for general health and is especially important for people with diabetes (including periodontal health). Diabetic patients must be informed since they need periodontal examinations just as much as those without diabetes do because of their elevated risk for periodontal disease.

**CHAPTER THREE**

**RESEARCH QUESTION**

**NULL HYPOTHESIS**

**OBJECTIVES**

**METHODOLOGY**

**CHAPTER THREE**

**Research question:**

Is there an association between the glycemic control of adult patients with type one diabetes and their periodontal status?



**Null Hypothesis:**

There's no association between the glycemic status and the presence of PD in adult participant diagnosed with T1DM.

**OBJECTIVES:**

**Aim (General objectives):**

The aim of the study was to assess the association of periodontal disease with the metabolic control of type 1 adult patients with diabetes at Tygerberg Hospital, Cape Town.

**Specific objectives:**

1- To determine the frequency of different types of PD in the group studied
2- To determine the diabetic control by HbA1c in the group studied
3- To compare HbA1c with periodontal status

## METHODOLOGY:

### Methodology:

Periodontal health was assessed according to the American Academy of Periodontology (AAP) and the European Federation of Periodontology (EFP) by bleeding on probing as a percentage score, probing pocket depth (PPD) and a radiographic assessment of alveolar bone loss.

### Study design:

This was cross sectional descriptive study

Statistical Analysis

Descriptive analysis was displayed with frequency and percentages. Differences between groups will be determined using an independent samples t-test. Summary statistics were displayed as mean and standard deviations. Associations were calculated using chi square tests, logistic and multinomial logistic regressions. All data was analysed using StataCorp. 2017. Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC.

### Sample size:

This study was conducted to evaluate periodontal health status of 120 type 1 DM in adult patients, who were referred from Tygerberg Medical Hospital, Department of Endocrinology to the University of the Western Cape, Faculty of Dentistry, and Department of Periodontology for dental consultation. Based on a 5% level of significance and a power of 80% and a guestimate odds ratio of 1.8 when assessing whether there was an association between periodontal diagnosis VS subjects with

healthy gingiva in participants with poor metabolic control. Patients were diagnosed according to HbA1c and have routine follow-up for the control of their blood glucose level in the Adult Endocrinology clinic.

**Inclusion criteria:**

1. Type 1 diabetic adults
2. Age:18 years and over
3. SEX: both male and female

**Exclusion criteria:**

1- Patients who did not match the determined age group
2- Adolescent patients with T1DM and adult patient with T2DM
3- Patient under another medication which affects the periodontium



**Data collection**

The data collection, interview of the patient, examination and treatment, during the covid-19 pandemic was done in Tygerberg hospital, dental faculty, in the oral medicine and periodontal department. Each patient had his own record file, saved in the hospital data base, which could be accessed by the researcher and the supervisor. Each patient went through covid-19 questionnaire and temperature monitoring according to the hospital regulations under the covid-19 circumstances when entering the health facility. The dentist used Personal Protective Equipment (PPE) to protect himself and the patient. This was in the form of gowns that cover skin and personal clothing likely to become soiled with blood, saliva, or infectious material, hand gloves, masks, protective eyewear, face shields, hair protector and shoe covering. The dentist changed the PPE between each patient and disposed of it in the safety boxes. Disinfection of the dental unit with alcohol spray was conducted after each patient.

**Diabetes-related parameters:**

Taking & obtaining a complete medical history and asking the doctor for details, assessing the control status of the patients based on the glycosylated hemoglobin value (HbA1c). According to the American Association of clinical endocrinology the controlled Hemoglobin A1c was determined as HbA1c of 6.5% and less, the uncontrolled was determined from 7% and more(Agiostratidou *et al.*, 2017)

**Oral examination:**

The periodontal examination was performed by the researcher using a periodontal probing (William's probe), and the diagnosis was made in accordance with the clinical and radiographic standards of the (AAP) and the (EFP). All adult patients were examined for periodontal disease if the pocket depth was greater than 3 mm, but if there was no indication of radiological bone loss or bleeding during probing, it was reasonable to record the patient's periodontal status as being within normal ranges.



**Ethical consideration:**

The patients were asked to provide informed consent to participate in this study. The informed consent was conducted in writing in a language that the patient understands. The patients could withdraw from the study at any time with no prejudice. Patients who were diagnosed incidentally with periodontal disease were referred for treatment at the Tygerberg Oral Health Centre. Ethical approval was sought from the University of The Western Cape as well as the University of Stellenbosch. Giving each patient a code helped preserve data anonymity, and the researcher was the only one with access to the patient identities, which were recorded on a separate page and stored on a password-protected computer.

# CHAPTER FOUR

# RESULTS

## RESULTS

There were 120 adult participants, of whom 61.67% (n=74), were female, and 38.33 % (n=46) were male. The majority were non-smokers and younger than 44 years of age. There were 78 (65%) participants with uncontrolled blood glucose (BG) and 42 (35%) with good control participants in this sample, based on HBA1C>=7% , according to the new periodontal disease classification diabetes is one of the rick factors that grades the disease depending on the HBA1c level of patient if not diabetic will be grade A if diabetic with HBA1c less than 7% grade B, more than 7% or equal is grade C(Li *et al.*, 2014). The median HbA1C level was 8.75 [6.1 to 12.2].

Table 1: Shows the demographics of the participants

| | TOTAL n (%) |
|---|---|
| SEX | |
| Female | 74 (61.7) |
| Male | 46 (38.33) |
| AGE | |
| <25 | 31 (25.8) |
| 25-34 | 38 (31.7) |
| 35-44 | 31 (25.8) |
| 45-54 | 12 (10.0) |
| >=55 | 8 (6.7) |
| SMOKING | |
| No | 79 (65.8) |
| Yes | 41 (34.2) |
| BLOOD GLUCOSE CONTROL | |
| Good control (<7%) | 42 (35%) |
| Poor control (>7%) | 78 (65%) |

Figure 1 Shows that the majority of the participants, 94% had periodontitis. This was statistically significant.

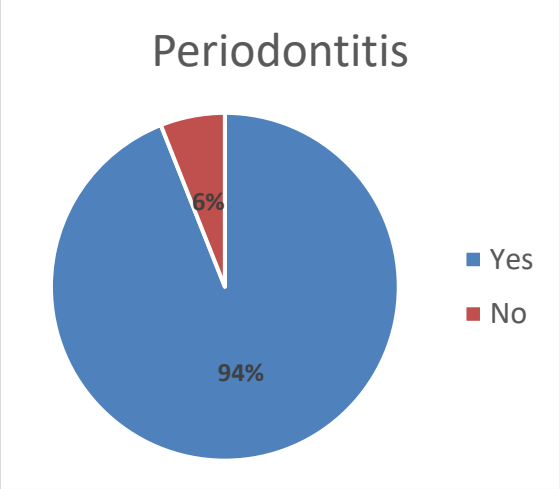



Fig.1: The frequency of periodontitis in the population studied.



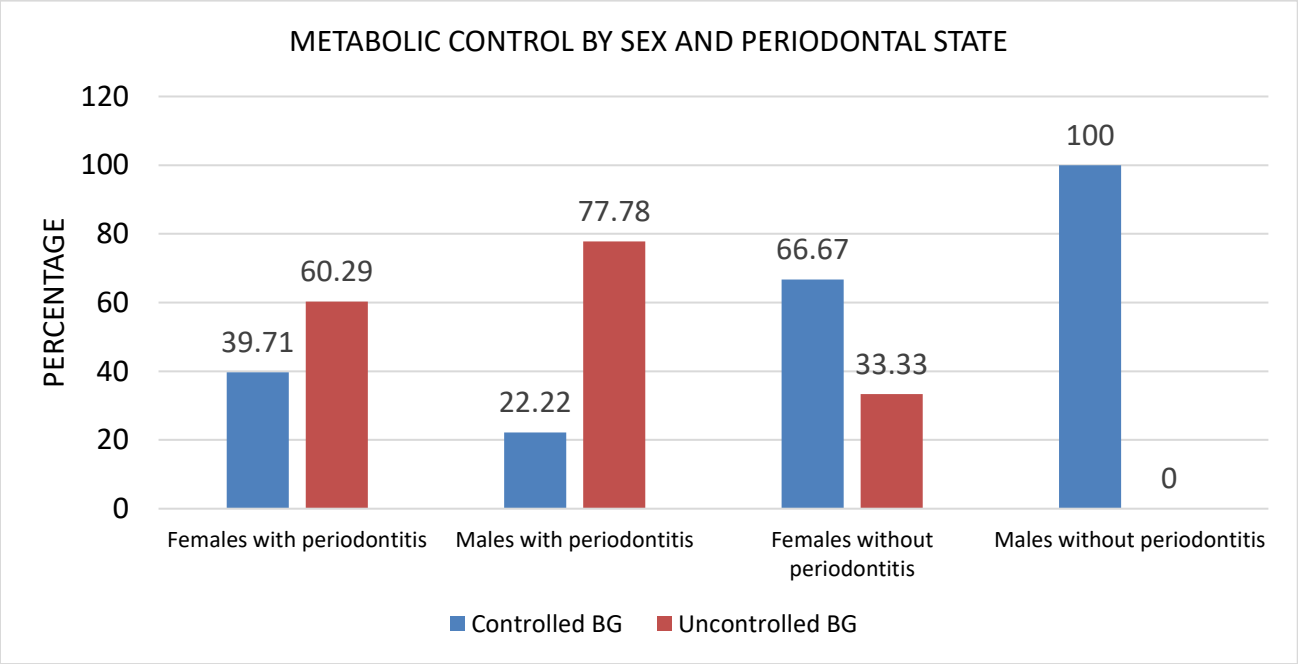
Table 2: Shows the relation between periodontitis and demographics with blood glucose control in the participants.

| | | HBA1C | | |
|---|---|---|---|---|
| | Total n (%) | Controlled n (%) | Uncontrolled n (%) | p-value |
| PERIODONTITIS | | | | |
| No | 7 (5.8) | 5 (11.9) | 2 (2.6) | |
| Yes | 113 (94.17) | 37 (88.1) | 76 (97.4) | 0.05[ζ] |
| SEX | | | | |
| Female | 74 (61.7) | 31 (73.8) | 43 (55.1) | |
| Male | 46 (38.33) | 11 (26.2) | 35 (44.9) | 0.248[ζ] |
| AGE | | | | |
| <25 | 31 (25.8) | 11 (26.2) | 20 (25.6) | |

| | | | | |
|---|---|---|---|---|
| 25-34 | 38 (31.7) | 13 (31) | 25 (32.1) | |
| 35-44 | 31 (25.8) | 10 (23.8) | 21 (26.9) | |
| 45-54 | 12 (10.0) | 6 (14.3) | 6 (7.7) | |
| >=55 | 8 (6.7) | 2 (4.8) | 6 (7.7) | 0.741[ζ] |
| SMOKING | | | | |
| No | 79 (65.8) | 33 (78.6) | 46 (59) | |
| Yes | 41 (34.2) | 9 (21.4) | 32 (41) | 0.094[ζ] |

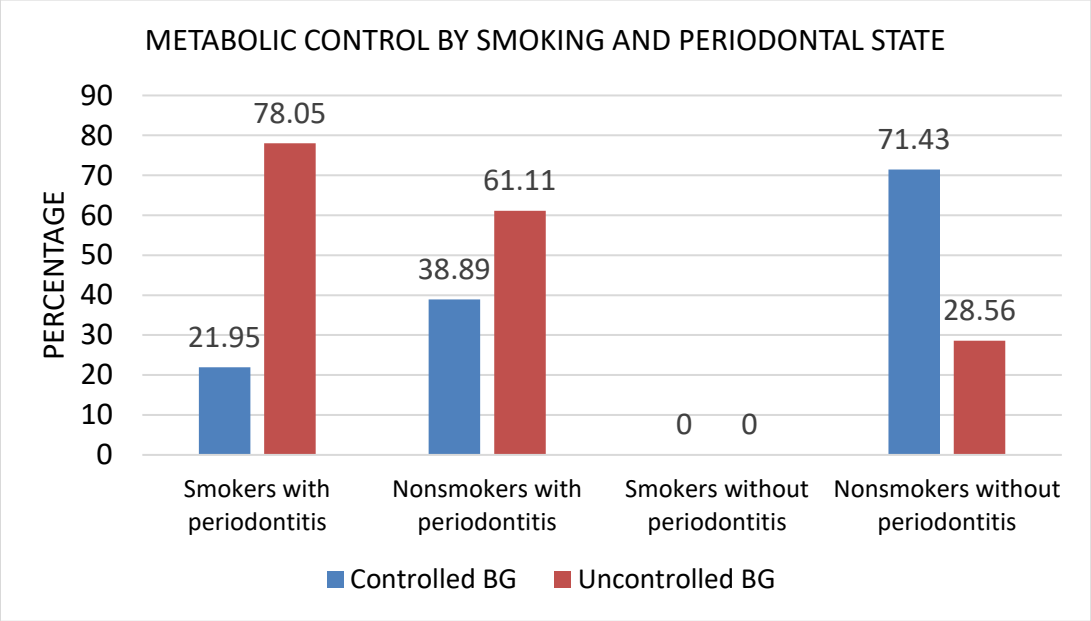
Table 2: depicts that 97% of the participants with periodontitis had uncontrolled blood glucose. As the BG is high the more prone is the patient to develop infections and the blood glucose forms a good media for micro-organisms to flourish. Females were a majority, and most of them had uncontrolled BG. The participants all had type 1 DM, which explains the younger age groups, which again showed higher BG levels and poor control. Smoking plays a remarkable complicating role in the development of periodontitis and 78% out of those who smoked had uncontrolled BG.

Figure 2: Shows the relation between blood glucose control, sex and periodontitis




(fig.2): More females with periodontitis had uncontrolled blood glucose than those with better metabolic control. This pattern was the same in males. The majority with periodontitis also had uncontrolled blood glucose. However, all males with good metabolic control did not have periodontitis. Again, females without periodontitis had adequate control.

Figure 3: Shows the relation between blood glucose control, smoking and periodontitis




A simple logistic regression shows in model 1, persons with Periodontitis 5.135 times odds of experiencing poor metabolic control compared to persons without periodontitis, 5.135(0.951 to 27.725). However, this finding was not statistically significant. Upon adjusting for age categories, subjects with periodontitis had 5.73 odds of experiencing poor metabolic control compared to persons without periodontitis, 5.73(1.034 to 31.758), p = 0.046.

Table 3: The frequency of gingivitis and its relation to metabolic control.

| Gingivitis | Freq n (%) | Controlled BG n (%) | Uncontrolled BG n (%) |
|---|---|---|---|
| Yes | 7 (5.83) | 5 (71.43) | 2 (28.57) |
| No | 113 (94.17) | 37 (32.74) | 76 (67.26) |

Table 3 shows that only 7 participants had gingivitis and only 2 showed poor metabolic control.

# CHAPTER FIVE

## Discussion

## DISCUSSION

This study included 120 participants, who were mainly females of ages between 18 to 35 years, with HbA1c > 7 %. Females who are not working or at school may have more time to go to the hospital to seek medical advice, however, school-aged patients may be compelled to go to the dentist as part of the routine health check that is compulsory in some schools. It is also noted that the population of type 1 DM are of a younger age-group. Alma Pranckeviciene, in 2014 studied the relationship between the type of DM and the intensity of periodontal disease in elderly patients who are diabetic. In contrast to our study, their patients were of age-group 18-62 years, and periodontal disease was found to be more severe in >45-year-aged participants. Whereas, in 2018 Anastasios Plessas studied T1DM in a Scottish population of non-smokers and radiological bone loss of a similar age-group to the study by Alma but found more males than females. Ankita Jindal et al, in 2015, conducted a study on the individuals having T1DM and the link involving periodontal disease severity and diabetes management unlike this study, the majority of the study group were males (64%).

It was found that the 94% of the participants, had periodontitis. This was statistically significant, indicating an association between DM and periodontitis in this study sample, probably due to the reduced immunity in diabetic patients and increased tendency to infections. A limitation of this study was that dental hygiene practices and access to dental care was not evaluated as a study objective and thus the role of this variable in this study sample remains unknown. As this study was done in a tertiary facility where more advanced and complicated cases are referred for care, could also explain the high prevalence of periodontitis in this group. This finding was comparable to a study done by Ankita Jindal in 2015 in the Department of Medicine at People's College of Medical Sciences and Research Centre which is also a tertiary center. Similarly, Alma Pranckeviciene in 2014, found an upsurge in periodontitis occurrence in diabetic individuals studied in Lithuania University of

Health Science. Anastasios Plessas and Douglas P. Robertson in 2018 also concluded that individuals with T1DM are more susceptible to developing periodontitis even when controlling for multiple possible confounding factors. Ana del Miguel-infante et al, 2018 concluded that the prevalence of periodontal disease was higher among those suffering from diabetes than their non-diabetes controls. Among diabetes sufferers, missing teeth status, osteoporosis and depression were positively associated with higher risk of periodontal disease. Older ages, using private insurance and university education level were associated with lower rates of periodontitis. In this study we also depicted that 97% of the participants with periodontitis had uncontrolled blood glucose. As the BG is not well controlled, the patient is more prone to develop infections and the blood glucose forms a good media for micro-organisms to flourish. Smoking is an important confounding factor in the pathogenesis of periodontitis, and 78% out of those who smoked had uncontrolled BG. Of note more females with periodontitis had uncontrolled blood glucose than those with better metabolic control. This pattern was the same in males. The majority with periodontitis also had uncontrolled blood glucose. However, all males with good metabolic control did not have periodontitis. Again, females without periodontitis had adequate control. Similarly, in 2015 a study by Ankita Jindal, Type 1 diabetics with poor glycaemic control had increased gingival inflammation, more dental plaque, increased PPDs and attachment loss as compared to those with fair and good glycaemic control, respectively. It was concluded that the severity of periodontal disease increases with poor glycaemic control in patients with Type 1 DM. However, in 2014 Alma Pranckeviciene studied the severity of periodontal disease in adult patients with diabetes mellitus in relation to the type of diabetes but did not find a significant correlation between the periodontal estimates and HbA1c in either group.

## CHAPTER SIX

## CONCLUSION

There is a significant connection that links PD and adults with uncontrolled T1DM at Tygerberg hospital. As the BG goes up, the more prone is the patient to develop infections because blood glucose forms a good media for micro-organisms to flourish. It is important that young adults with T1DM take care of oral hygiene and frequent the dental clinics. There is a need for continued education to patients with T1DM and there attending medical practitioners on the importance of periodontal care.

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# APPENDICES


**CONSENT FORM**

**Title of Research Project:**

The study has been described to me in language that I understand and I freely and voluntarily agree to participate. My questions about the study have been answered. I understand that my identity will not be disclosed and that I may withdraw from the study without giving a reason at any time and this will not negatively affect me in any way.

**Participant's name……..**

**Participant's signature……**

**Date……**

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## INFORMATION SHEET

**Project Title:**

**What is this study about?**

This is a research project being conducted by Dr, Ahmed A.A. Suliman at the University of the Western Cape in South Africa. We are inviting you to participate in this research project because you meet the set criterion for the population of interest and your participation will help other people. The purpose of this research project is to assess the association of periodontal disease and metabolic control of type 1 adult patients with diabetes at Tygerberg Hospital, Cape Town

**What will I be asked to do if I agree to participate?**

You will be asked to sign a consent form agreeing to take part in the study. You will also be examined. The periodontal examination will be performed by using periodontal probe (WHO) in diabetic adult patients and will be assessed to the American Academy of Periodontology (AAP) and the European Federation of Periodontology (EFP) criteria, both clinically and radiographically.

All adult patients will be evaluated for evidence of periodontal disease, if the pocket depth exceeds 3mm and if there is no bleeding on probing or evidence of radiographic bone loss, it is appropriate to document the patient periodontal status as being within normal limits.The study will be done in (*periodontal clinic , dental faculty at Tygerberg hospital*). The interview will last approximately *(30-45 min)*.

**Would my participation in this study be kept confidential?**

Your personal information will be kept confidential. To help protect your confidentiality, your real names will not be included in the data collection sheets and all information collected will be locked in cabinets and password protected computers. *All the data will be kept in password protected computer files known only to the researcher. Data collection sheets and audio tapes will be kept safely in a lockable filling cabinet accessed only by the researcher. All raw data including written documents and tapes will be destroyed after three months of the final dissertation being marked and graded. If we write a report or article about this research project, your identity will be protected.*

UNIVERSITY of the WESTERN CAPE

**What are the risks of this research?**

Risks from participating in this research study mainly (*explain risks involved*).

**What are the benefits of this research?**

This research is not designed to help you personally, but the results To assess the association of periodontal disease and metabolic control of type 1 adult patients with diabetes at Tygerberg Hospital, Cape Town

**Do I have to be in this research and may I stop participating at any time?**

Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify.

**Is any assistance available if I am negatively affected by participating in this study?**

If at any time of the study, you feel uncomfortable and need assistance, the researcher will refer you for counselling through social welfare office in your area.

**What if I have questions?**

This research is being conducted by:

Should you have any questions regarding this study and your rights as a research participant or if you wish to report any problems you have experienced related to the study, please contact:

**Head of Department, Researcher, Supervisor and REC Contact details**

Head of department: Dr. Anthea Jeftha

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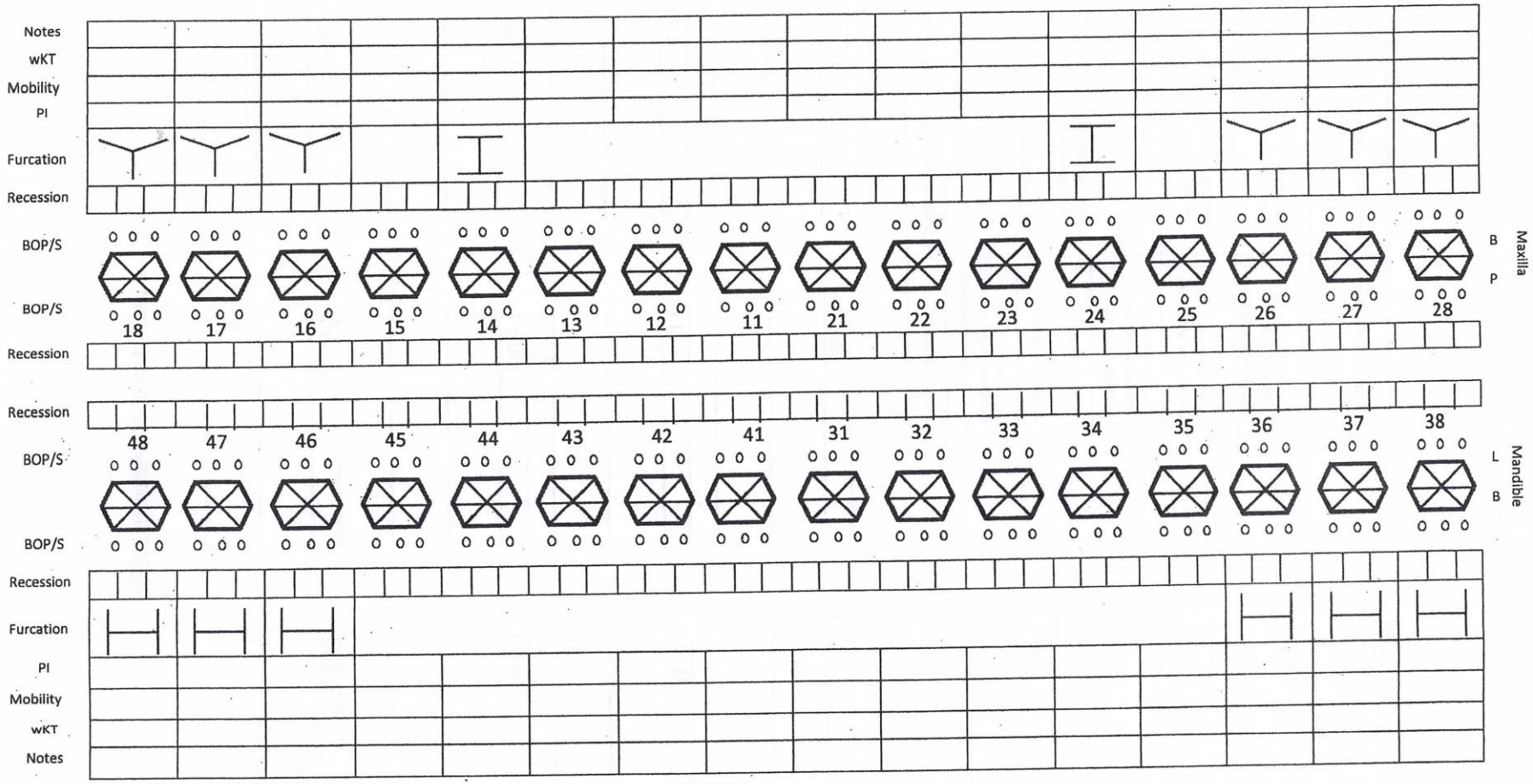
**Patient Details:** (Sticker) **Date:**




Stage= % Bone loss/Age = Grade= Risk factors:

**BOP % =** **Plaque score % =** **Current Periodontal status:**