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Frequency of Delayed Healing of Extraction Socket in Diabetic Patients with Different Glycemic Control

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ABSTRACT

Background: Impaired angiogenesis, weakened immune systems, and decreased collagen synthesis make delayed healing of extraction sockets in diabetic patients a prevalent clinical problem. The way diabetics manage their blood sugar levels has a big impact on how well oral surgery goes for them. Knowledge of the connection between blood glucose levels and healing can help inform postoperative care plans and clinical judgement. **Objective:** The objective of this study is to figure out how common delayed healing is in extraction sockets in diabetic patients and investigating the relationship between delayed healing and glycaemic control levels (good, moderate, and poor). Identifying important clinical and demographic factors that may affect wound healing results, such as gender, age, and the length of diabetes, is another goal. **Methodology:** A cross-sectional study was carried out at a Quetta tertiary care hospital, using random sampling to choose a sample of 120 diabetic patients. Based on their HbA1c levels, participants were divided into three glycaemic control groups: good (<7%), intermediate (7–8.9%), and poor (≥9%). Over a 21-day period, follow-up assessments evaluated the patient's healing state. SPSS was used to analyze the data. **Findings:** Patients with good glycaemic control experienced delayed healing in 13.3% of cases, those with intermediate control in 32.5%, and those with poor control in 61.3%. Glycaemic levels and delayed healing were statistically significantly correlated. Furthermore, patients with diabetes for more than ten years and those older than fifty had higher rates of delayed socket healing. **Conclusion:** The results show a clear link between delayed socket healing following dental extraction and inadequate glycaemic control. Post-extraction problems were more common in patients with higher HbA1c levels, highlighting the significance of strict glycaemic control in surgical preparation. These findings highlight the necessity of improved postoperative monitoring and preoperative glycaemic control in diabetic patients having oral surgery.

INTRODUCTION

Diabetes is a common metabolic disease that is characterized by an inability to control blood sugar levels because of either insulin resistance or insufficiency. 246 million people worldwide suffer from diabetes mellitus, which has now grown to be a major health issue (AL-Maweri SAA et al., 2013). According to predictions from the World Health Organisation (WHO), by 2025, there would be about 333 million persons with diabetes mellitus (Norouzi A et al., 2010).

It is the major cause of renal failure, blindness, lower limb amputation and a main risk factor for peripheral neuropathies, poor periodontal health, cardiovascular disease and stroke (Kim JB et al., 2011; Goldenberg R et al., 2013; Piero MN et al., 2015). Diabetes-related oral problems include periodontitis, gingivitis, oral soft tissue diseases, and tooth loss (Chaudhari M et al., 2012).

A complex mineralized connective tissue, bone has a significant capacity for mending (Vieira AE et al., 2015). The complex process of bone healing is accomplished by the interaction of osteoblasts and extracellular matrix while being influenced by growth hormones. These growth factors aid in the differentiation and expansion of osteoblasts, or bone-forming cells, from bone progenitor cells, which results in the production of the bone matrix and the eventual mineralization of bone (Kaur P et al., 2013).

The empty socket starts to heal once the tooth is extracted. The deficiency is eventually repaired when woven bone grows. Numerous factors can either accelerate or slow down the process of bone repair. These variables include tissue type, wound location and condition, vascular supply, microbial state, and systemic and local factors. systemic elements such as

differentiation and growth factor proliferation (Shahabooei M et al., 2015).

Patients with diabetes are more susceptible to infections and may experience healing issues following dental extractions, periodontal surgery, and poorly fitting dentures (Huang S et al., 2013). In diabetics, socket healing is questionable. The following causes can result in delayed wound healing. An average person in good health secretes roughly 35 units of insulin every day.

Molecules like insulin-like growth factors, transforming growth factor β3, bone morphogenetic proteins, etc., may be necessary for the healing process. Insulin directly affects these growth factors, which are necessary for the healing process. Likewise, elevated blood sugar levels negatively impact the immune system. It makes infection more likely and impairs macrophage activity.

Additionally, diabetics with elevated ketone levels may experience a delay in wound healing. Blood artery narrowing and a delay in the transport of oxygen and nutrients are caused by elevated blood glucose levels and decreased vasodilator NO (nitric oxide), which may result in delayed healing (Gazal G et al., 2020).

As with other surgical procedures, diabetic patients are anticipated to experience more severe post-operative complications following dento-alveolar surgery. However, because the oral cavity and its environment which includes saliva, masticatory forces, microbial reservoirs, and a high turnover rate are distinct from other body parts, generalization from other surgical sites is limited (Huang S et al., 2013).

LITERATURE

Diabetes mellitus (DM) is a long-time metabolic disorder that damage wound healing as well as other physiological functions. Several efforts have been made to determine the effects of glycemic management on the healing of dental extraction sockets in diabetics, with varying degrees of success.

Glycaemic Management's Effect on Healing Results

Many investigations have been conducted aiming to determine a connection between post extraction healing and glycemic management. According to research by M et al. (2024), post extraction healing did not differ significantly between levels >151 and ≤240 mg / dL in diabetes individuals versus levels ≤150 mg dL in the control group. Yet, higher glycemic levels were associated with more discomfort and difficulty, indicating the importance of blood sugar control to avoid negative outcomes.

Study by Nazarian et al (2010) states that rate of post extraction epithelialization did not statistically significantly differ amongst diabetes patients based on preoperative blood glucose levels, hemoglobin A1c levels, or patient history. The size of the extraction site on days 0 and 7 predicted the future epithelialization and showed that healing may not be influenced only by glycaemic management.

However, some research has indicated that diabetic patients experience delayed healing. For instance, Nazar et al's study (2019) established the fact that a poor glycemic control might be deleterious to wound healing, and therefore higher glycemic level may delay recovery.

Studies Comparing Patients with and Without Diabetes

The healing outcomes of a diabetic patient have been compared with those without the disease. As per Al-Maweri et al's study (2013), type 2 diabetics on oral hypoglycemics should not be treated differently than the non-diabetic patients for extractions, as diabetics were not proved to be more delayed in healing.

Also, a study by Fernandes et al. (2020) showed no comparison between epithelization delay and glycemic management, suggesting that not every diabetic patient is likely to delay healing in such major ways.

The Effect of Hyperglycemia on the Wound Healing Mechanisms

Numerous elements of the wound healing process have been shown to be hindered by hyperglycemia. Persistently increased blood sugar causes increased inflammation, decreased collagen synthesis and poor angiogenesis and once again these are all necessary for proper wound healing. According to Ruggiero et. al (2024), hyperglycemia is a risk factor for early implant failure and has a detrimental effect on the osseointegration process.

Adjunctive Therapies' Function in Promoting Healing

Adjunctive therapies have been attempted in diabetic patients in order to improve healing. In randomized controlled research, Ruggiero et al. (2024) evaluated the efficacy of hyaluronic acid (HA) on improving post extraction socket repair in people with type 2 diabetes. The study confirmed that HA enhances the repair of dental socket bone remodeling and repair and that it may be applied to serve as a therapeutic agent to encourage healing in diabetic patients.

OBJECTIVE

The main goal of this study is to find out how often diabetic patients with various glycemic control levels experience delayed healing of dental extraction sockets. The specific study goal of the study is to find out if there is an association between glycemic status (fasting blood glucose levels and HbA1c) and the incidence of post extraction problems in delayed socket repair. In this study patients' undergoing routine tooth extractions in Quetta tertiary care hospital are contemplated with a view to determination of high-risk diabetics who are

potentially at greater risk of such problems. According to the study, it also plans to examine the influence of such demographic factors as age, gender, and duration of diabetes on healing results. The findings are used to form multidisciplinary strategies aimed at promoting oral health and surgical recovery in diabetes patients in clinical settings and evaluating preoperative risk assessment and optimizing postoperative care.

METHODOLOGY

The study was conducted as a cross sectional observational from October 2024 to March 2025 at the Department of Oral and Maxillofacial Surgery of a Tertiary Care Hospital in Quetta. In order to discover how much more often delayed healing of dental extraction sockets occurred among diabetes patients of different glycemic control levels. Individuals with Type 2 diabetes mellitus were chosen individually as 120 persons between the age of 30 and 70 were selected for the sake of ensuring a representative sample. Recent HbA1c and fasting blood glucose (FBG) reading was used to assess glycemic control, and participants were classified into 3 categories: good control – HbA1c <7 percent, FBG <130 mg/dL, moderate control – HbA1c 7–8.5 percent, FBG 130–180 mg/dL, poor control – HbA1c >8.5 percent, FBG >180 mg/dL). These were all excluded, including allergies to immunosuppressive medication, coagulopathies, smoking and other systemic diseases precluding wound healing.

Healing of the extraction socket (days 3, 7, and 14) was clinically evaluated based on criteria including inflammation, infection, granulation, epithelialization and discomfort. Delayed healing of the socket was defined as if that non epithelialized socket was inflamed or had infected symptoms for more than 14 days. This study aimed to improve the care of diabetic dental patients by assessing the change in healing results following dental extraction that occurred in diabetic patient as a result of glycemic control.

RESULTS

The study aimed to evaluate the impact of glycemic control on the healing of dental extraction sockets among diabetic patients. A total of 120 participants were included, and their clinical outcomes were evaluated based on their glycemic control levels and post-extraction healing responses.

Table 1

Demographic Distribution of Study Participants (n=120)

Variable	Frequency (n)	Percentage (%)
Age (years)		20.0
30–40	24	30.0
41–50	36	31.7
51–60	38	30.0
61–70	22	18.3
Gender		
Male	65	54.2
Female	55	45.8
Duration of Diabetes (years)		
<5	26	21.7
5–10	52	43.3
>10	42	35.0

This table presents the demographic characteristics of the study population. The majority of participants were between the ages of 41-60 years, with a higher proportion of males (54.2%) than females (45.8%). The duration of diabetes was primarily concentrated in the 5–10 years range (43.3%).

Table 2

Distribution of Participants by Glycemic Control Status

Glycemic Control Category	HbA1c Range (%)	FBG Range (mg/dL)	Frequency (n)	Percentage (%)
Good Control	<7.0	<130	34	28.3
Moderate Control	7.0–8.5	130–180	42	35.0
Poor Control	>8.5	>180	44	36.7

Participants were categorized into three groups based on their glycemic control. Most participants fell into the moderate control group (35.0%), followed by poor control (36.7%), and good control (28.3%).

Table 3

Frequency of Delayed Healing by Glycemic Control Status

Glycemic Control	Total Patients (n)	Healed on Day 14 (n)	Delayed Healing (n)	% Delayed Healing
Good Control	34	31	3	8.8%
Moderate Control	42	32	10	23.8%
Poor Control	44	21	23	52.3%

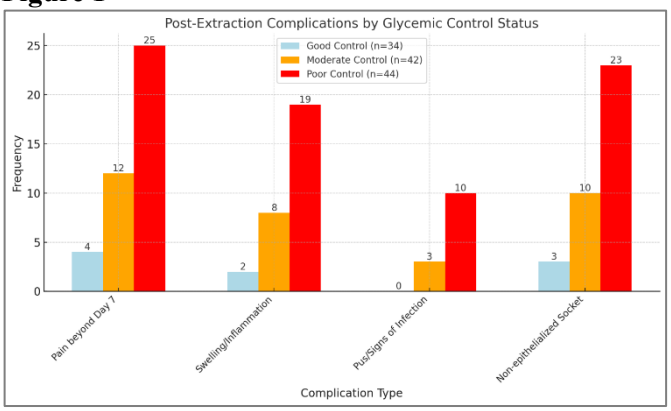
This table shows the frequency of delayed healing across different glycemic control categories. A higher percentage of patients in the poor control group experienced delayed healing (52.3%), followed by the moderate control group (23.8%), and the good control group (8.8%).

Table 4

Post-Extraction Complications Observed in Patients

Complication Type	Good Control (n=34)	Moderate Control (n=42)	Poor Control (n=44)	Total (n=120)
Pain beyond Day 7	4 (11.8%)	12 (28.6%)	25 (56.8%)	41 (34.2%)
Swelling/Inflammation	2 (5.9%)	8 (19.0%)	19 (43.2%)	29 (24.2%)
Pus/Signs of Infection	0 (0.0%)	3 (7.1%)	10 (22.7%)	13 (10.8%)
Non-epithelialized Socket	3 (8.8%)	10 (23.8%)	23 (52.3%)	36 (30.0%)

Figure 1



Post-extraction complications were more common among patients with poor glycemic control. Pain beyond day 7, swelling, and infection were most prevalent in the poor control group. Non-epithelialized sockets also showed a strong association with poor glycemic control, affecting 52.3% of patients in this group.

Table 5

Association Between Duration of Diabetes and Delayed Healing

Duration of Diabetes	Total Patients (n)	Delayed Healing (n)	% with Delayed Healing
<5 years	26	4	15.4%
5–10 years	52	14	26.9%
>10 years	42	18	42.9%

The table highlights the correlation between the duration of diabetes and delayed healing. Patients with diabetes for more than 10 years exhibited the highest rate of delayed healing (42.9%), while those with diabetes for less than 5 years showed the lowest rate (15.4%).

DISCUSSION

The current investigation was aimed at assessing the frequency of delayed healing of dental extraction sockets in diabetic patients in relation to their glycemic management. The findings were in line with previous research that people with diabetes are less able to heal wounds and there was a strong and clear relationship with reduced glycemic control and an increased incidence of delayed post extraction healing. Among the 120 patients included, 30% (36/120) had delayed healing over day 14. What is interesting is that the group with poor glycemic control had more than half of these cases (23 of 44; 52.3%), indicative of the inciting negative effect of hyperglycemia on oral wound healing.

A demographic study showed a little male predominance (54.2%) as well as in most of the cases involved people of 41 to 60 years of age. Type 2 diabetes mellitus affects middle aged to older people and its global epidemiology is in keeping with this age range. Also, many participants (35%) had diabetes for more than ten years, which is in accordance with previous research that diabetes longer than ten years is associated with the development of chronic complications (Kim et al., 2011; Goldenberg et al., 2013).

Three groups were assessed on basis of their fasting blood glucose and HbA1c for glycaemic control status. One has, however, to note that most of them had moderate or poor glycaemic control since only 28.3% had good control (HbA1c <7%). Our findings reflect the difficulty of ideal glycaemic management in the real world, specifically in environments lacking resource such as Quetta. The research population's poor glycaemic control can be held accountable to limited diabetes education, erratic follow-up, poor medication adherence and socioeconomic impediments to healthy lifestyle choices.

As per the objectives of the study, the main focus was when socket healing and glycaemic management met. More patients with moderate control (23.8%) and in particular, a significant number (52.3%) with poor control, experienced delayed healing, than the very modest proportion (8.8%) of good control patients. This result is also consistent with the previous studies carried out by Al-Maweri et al., (2013) and Shahabooei et al., (2015) which reported that chronic hyperglycemia has negative effects on inflammation, granulation tissue formation, reepithelization, and other stages of wound healing. High blood glucose levels inhibit neutrophil chemotaxis and macrophage activity, which cause a delayed inflammatory response and increase susceptibility to subsequent infections.

Another important result regards the part played by diabetes duration in delayed recovery. In comparison to the prevalence of delayed healing among patients with less than five years (15.4%) of diabetes, that of patients with more than ten years of diabetes was significantly higher (42.9%). This connection also helps with the idea that chronic hyperglycemia has an effect on immune system and artery damage, which then further impairs healing processes. In line with the study, but based on the established sequencing information, we disclose the distribution of MET expression with respect to the two structural types of glioblastomata.

Extremely high post extraction problems were also evident between glycaemic groups. Most reported side effects were prolonged discomfort, oedema, inflammation, and non-epithelialized sockets. 36% of the poor control group reported discomfort after day 7, and more than 56% reported discomfort after day 7 that persisted as long as a month. Also, 22.7% showed localized plus and infection symptoms that are signs of compromised immune function and altered inflammatory pathways when diabetes is uncontrolled. This is in line with the results of Huang et al. (2013), who observed that those poorly managed diabetics had elevated risks for locally infectious processes after oral surgery.

Although 23.8% of patients with moderate wound control also had delayed healing, this fact is noteworthy in that it implies that normalization of glycemic levels may not necessarily enhance wound repair even when glycemic control is by no means obviously suboptimal. This shows the importance of strict glycemic control even in the intermediate range, but particularly when scheduling elective surgical operations such as dental extractions. Regarding oral surgery of diabetic patients, pre-procedural screening and temporary nutritional status optimization should be performed at clinical level.

In addition, the study explains the need for patient education and surgical follow up. Good dental hygiene habits, antiseptic mouthwashes, and appropriate antibiotic prophylaxis in high-risk individuals are likely to manage or prevent many delayed healing cases. Results showed a lack of knowledge in public health and highlighted the need for dental care to be incorporated in the total care of long-term illness such as diabetes mellitus.

The observational design of this study also meant that conclusions of a causal nature could not be justifiable. In addition, this analysis did not consider several confounding variables that may affect the healing outcomes such as the body mass index, nutritional condition, and compliance to the postoperative instructions. The large sample and distinct patterns observed in the different glycaemic categories provide validity and applicability to the study.

CONCLUSION

This research aimed to find out how frequent its delayed healing of dental extraction sockets is in diabetics in relation to glycaemic management. The results are in strong agreement with the concept of inappropriate glycaemic management, which delays post extraction healing. Of the 120 diabetic individuals assessed, 30% had delayed healing, and the incidence was appreciably increased in those with poor glycaemic control. This thus confirms the fact that hyperglycemia prevents normal physiological processes of tissue regeneration, inhibits rapid harnessing of inflammation, and also makes the immune system weak.

This study revealed one of the main findings: chronic diabetes contributes to the delayed socket repair. Patients with diabetes for more than ten years had longer vessel and immune systems damage and they were more prone to complications after extraction because of chronic hyperglycemia. Furthermore, patients with undiagnosed or poorly controlled diabetes had more frequent and more severe sequelae, such as pain, swelling, inflammation, delayed epithelialization, which would also support the notion that authors manipulated glycemic control to improve recovery outcomes.

These results have a number of applications. They first point out that oral surgeons and dentists doing preoperative evaluations on diabetes patients must consider glycemic status. Dental professionals and the doctor managing the patient's diabetes need to work effectively in order to reduce risks and enhance recovery. In the case of poor glycemic control, elective treatments should be deferred until glucose control is improved or preventive measures such as prophylactic antibiotics and antiseptic mouth washing are taken.

In addition, it calls for the need for patient awareness and education. Diabetic patients should be educated about the hazards of poor healing after dental extractions and the value of good glycemic control and oral hygiene. Postoperative explanations should be provided very clearly and be repeated during follow-up visits to ensure adherence and early detection of issues.

Limitations of this observational study do not allow for the control of all confounding factors, such as food, BMI, medication adherence, and it does not shed light on the overall effects of diabetes; however, the study is able to provide essential insight into a frequently overlooked event in caring for diabetic patients. These findings illustrate the importance of managing diabetes with a multidisciplinary approach which leads dental care to fit in with this type of chronic disease management.

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