International Journal Research in Medical, Dental and Pharmaceutical Sciences
Volume 1 Issue 2 ǁ August 2024
www.ijrmdps.com
ISSN: XXXX-XXXX

Tooth Extraction in Uncontrolled Diabetic Patients, Systematic Review

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ABSTRACT:

Background:

Patients with poorly controlled diabetes are at risk of developing oral complications because of their susceptibility to infection and sequelae, and likely will require supplemental antibiotic therapy. Anticipation of dentoalveolar surgery (involving mucosa and bone) with antibiotic coverage may help prevent impaired and delayed wound healing. Orofacial infections require close monitoring. Safe blood glucose level for tooth extraction in diabetic patients is controversial.

Purpose: *To systematically review evidence for the complications and acceptable level of blood glucose regarding tooth extraction in uncontrolled diabetic patients in the dental clinic.*

Data Sources: *Six databases were searched for both published papers to 31 March 2024. There were no restrictions on language or publication date. Furthermore, a cited reference search was conducted based on the included studies*

Study Selection*: Two investigators independently selected and assessed trials and observational studies for the evidence of acceptable level of blood glucose for safe tooth extraction in diabetic patients. The inclusion criteria included selection of observational, clinical trials, and systematic review studies that assessed the complications, acceptable level of blood glucose of diabetic patients for emergency tooth extraction, and the relationship between socket healing and diabetes of excellent and of excellent, good, and fair quality categories.*

Data Extraction: *Dual quality assessments and data abstraction.*

Data Synthesis: *From a total of 178 studies were retrieved using the search strategy, 8 studies were included.*

Study design*: Primary studies such as randomized controlled trial (RCT), cross sectional study, retrospective (case control), prospective observational studies (cohort studies), and Secondary studies like systematic reviews were selected.*

Limitations: *The analysis included only one RCT study due to the deficiency in such studies of same topic.*

Conclusion *In conclusion, determining the appropriate blood glucose level for tooth extraction in patients with uncontrolled diabetes is essential to reducing the risk of complications both during and after the procedure.*

Keywords: *Tooth extraction, diabetes, blood glucose level.*

I. INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both. The chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart and blood vessels [1]. DM results when one of the following conditions occurs: insulin released from the pancreas is impaired or insulin action at peripheral tissues is impaired [2]. A deficiency in insulin or a problem with its

metabolic activity can result in an increased blood glucose level (i.e. hyperglycemia). Hyperglycemia leads to an increase in the urinary volume of glucose and fluid loss, which then produces dehydration and electrolyte imbalance which may result in coma in severe conditions [3]. The stress of the disease also results in an increase in cortisol secretion. It is the inability of the diabetic patient to metabolize and use glucose, the subsequent metabolism of body fat, and the fluid loss and electrolyte imbalance that causes metabolic acidosis. It is the hyperglycemia and ketoacidosis coupled with vascular wall disease (microangiopathy and atherosclerosis) that alters the body's ability to manage infection and heal [3]. Based on the pathogenic processes, four types of diabetes are identified. Type 1 diabetes: 5% of diabetics, Type 2 diabetes: 90% of diabetics, Gestational diabetes, and other: caused by various metabolic disorders, drugs or surgery. The onset of symptoms is rapid in type 1 diabetes, and includes the classic triad of polyphagia, polydipsia and polyuria, as well as weight loss, irritability, drowsiness and fatigue [4]. Symptoms of type 2 diabetes develop more slowly, and frequently without the classic triad; rather, these patients may be obese and may have pruritus, peripheral neuropathy and blurred vision. Opportunistic infections, including oral and vaginal candidiasis, can be present. Adults with long-standing diabetes, especially those with poorly controlled hyperglycemia, may develop microvascular and macrovascular conditions that can produce irreversible damage to the eyes (retinopathy, cataracts), kidneys (nephropathy), nervous system (neuropathy and paresthesia), and heart (accelerated atherosclerosis), as well as recurrent infections and impaired wound healing.

Patients with poorly controlled diabetes are at risk of developing oral complications because of their susceptibility to infection and sequelae, and likely will require supplemental antibiotic therapy [5]. Antibiotic preparation prior to dentoalveolar surgery (involving mucosa and bone) may aid in the prevention of impaired and delayed wound healing. Orofacial infections necessitate close monitoring. Cultures should be performed for acute oral infections, antibiotic therapy initiated, and surgical therapies considered if appropriate (for example, incision and drainage, extraction, and pulpectomy). If the patient does not respond well to the first antibiotic administered, dentists can choose a more effective antibiotic based on the results of the sensitivity test. Wound infection is a major complication in diabetic patients [6].

Age, obesity, malnutrition, and macrovascular and microvascular diseases can all contribute to wound infection and delayed healing, particularly in type II diabetics. Furthermore, hyperglycemia caused by reduced insulin availability and increased insulin resistance can impair the cellular response to tissue injury. At the cellular level, there was an increase in the number of acute inflammatory cells, no cellular growth, and epidermal migration [7]. Diabetes patients have impaired leukocyte function, and the metabolic abnormalities lead to inadequate migration of neutrophils and macrophages to the wound, as well as reduced chemotaxis. Such alterations in the cells would put people at a higher risk of developing wound infections [8, 9].

AIM:

This study aimed to perform a systematic review regarding extraction of teeth in uncontrolled diabetic patients in the dental clinic to determine the acceptable level of blood glucose for tooth extraction.

II. METHODOLOGY

Study design: primary controlled studies, including randomized controlled trials (RCTs), observational studies such as case control and cohort studies, secondary studies, including systematic review; and analytical cross-sectional study were included.

- Exclusion criteria were descriptive studies, such as, (1) case reports and case series studies; (2) reports without eligible outcomes; (3) ongoing studies; and (4) nonclinical studies, such as in vitro studies and animal studies.

- Searching Methods:

The following six databases were searched for published papers to 31 May 2023: Google scholar, Medline, the Cochrane Library, Scopus, Web of Science, and PubMed. Additionally, the International Clinical Studies Registry Platform (ICTRP) were searched for registered clinical trials up to May 31, 2023.

Data Synthesis: A total of 178 studies were retrieved using the search strategy. After screening and checking for eligibility of 112 titles, abstracts and 21 full-text articles, **eight studies were included** as shown in figure 1.

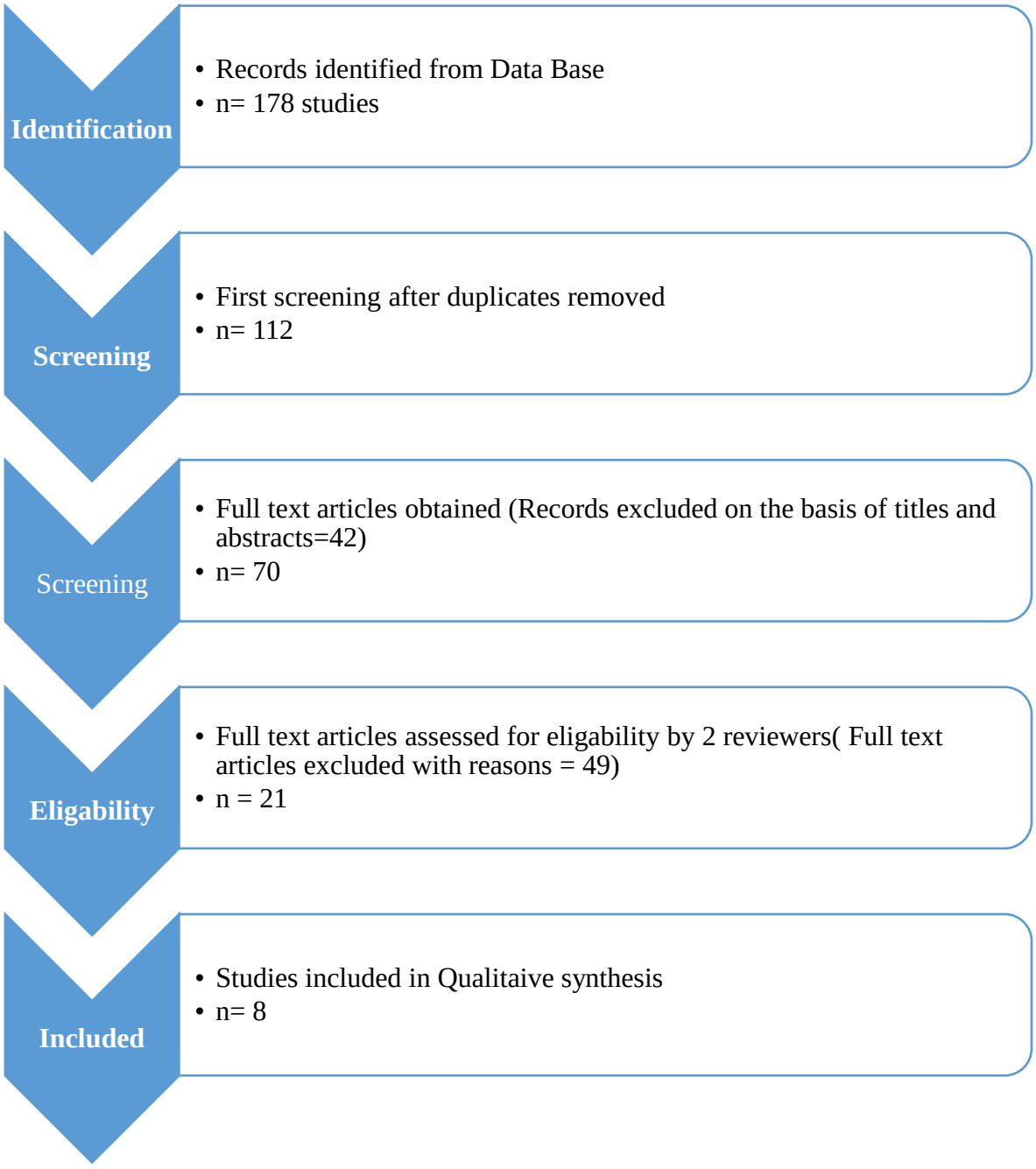

Figure 1: Flowchart of studies selection (n=8)

Study Selection

Every study's abstract was independently examined by two researchers in accordance with predetermined inclusion criteria. Studies evaluating complications, diabetic patients' tolerable blood glucose levels for emergency tooth extractions, and the connection between diabetes and socket healing were all included in the study. The papers that were chosen included a cross-sectional study, a randomized controlled trial, four prospective cohort studies, one retrospective case-control study, and a systematic review study.

Data Extraction and Quality Assessment

One investigator abstracted study design information, population characteristics, sample size, acceptable blood glucose level for emergency tooth extraction, complications during tooth extraction for diabetic patients

and harms, the data from all included studies are presented into table 1. A second investigator checked these data for accuracy.

Quality assessment

Two investigators independently assessed each study's quality as "excellent," "good," "fair," or "poor" by using check lists. RCT was checked by using CONSORT checklist, observational studies were assessed by STROBE check list, and systematic review was evaluated by using PRISMA check list. In general, an excellent quality complied with 85-100% of check list categories, a good-quality study met 70-85% of criteria, Faire one met 50-70%, and the poor one met <50%. Furthermore, the poor-quality study contained a fatal flaw or several significant limitations.

III. RESULTS

Among dental patients, diabetes mellitus is one of the most prevalent systemic diseases with oral symptoms. Uncontrolled diabetes can cause oral symptoms such as xerostomia, burning in the mouth, poor or delayed wound healing, increased risk and severity of infections, secondary candidiasis infection, enlargement of the parotid salivary gland, gingivitis, and/or periodontitis. [10].

One of the most popular oral surgery procedures is dental extraction. Severe dental caries and periodontal disease are the most common reasons for tooth extractions. Patients with Type II diabetes are more vulnerable to these conditions. According to a cross-sectional study by Almusawi et al., dental caries is a major risk factor for people with Type 2 diabetes and is closely linked to fasting blood glucose (FBG), hemoglobin A1c, and salivary glucose levels. Compared to control participants, individuals with type 2 diabetes have a higher load of cariogenic bacteria, specifically Streptococcus mutans and Lactobacilli. [11].

According to worldwide studies, people with uncontrolled diabetes are more likely to experience post-operative problems after tooth extraction. Deficits in microcirculation, in particular, have a significant influence on wound healing following surgery [12]. Tissue damage results in an inflammatory reaction. As leucocytes and fibroblasts infiltrated from the surrounding connective tissue, the blood clot was replaced by granulation tissue. Leucocytes eventually dissolve the clot within a week, enabling epithelium to begin developing on the surface. [13]. Patients with diabetes have elevated blood glucose levels when they fear dental operations. Agani et al. conducted a trial which revealed that dental operations, including tooth extractions, cause stress to patients. Blood sugar levels rise quickly during and after tooth extraction because the liver releases glucose in response to stress hormones like cortisol and glucagon. Furthermore, capillary abnormalities, such as basement membrane thickening, cause changes in permeability, impeded leukocyte movement, and impaired hyperemia, resulting in underperfusion under tissue stress and hypoxia. Poor, slow wound healing and wound infection are the results of these alterations. [14]. Chronic hyperglycemia induces the production of advanced glycation end products in tissues, which impairs polymorphonuclear leukocyte chemotactic and phagocytic activity. This triggers the creation of damaging inflammatory cytokines, which slows the healing process. [15]. In a single-center prospective observational analysis, Gadicherla et al. discovered no statistically significant difference in mean socket size on day 0 between non-diabetic and uncontrolled diabetes patients (P=0.101). On day 7, however, the diabetes group's socket size was bigger than the non-diabetic group's (P=0.011). Complications including edoema and infection were more common in diabetics. [16]. Fernandes et al. found no difference in wound healing after 60 days, even in poorly controlled diabetic patients [17]. In an Australian study on the healing of dental extraction sockets in insulin-dependent diabetic patients: a prospective controlled observational study, it was discovered that seven of 56 patients (12.5%) in the study group showed delayed healing following extraction, whereas only four patients (8.2%) in the control group suffered delayed healing. There was no statistically significant difference. Patients with Type 2 diabetes under control often recover well from tooth extractions and experience minimal post-extraction problems, such as infection [18]. Any kind of selective dental extraction requires a fasting blood glucose level of 180 mg/dl, according to a review study that included 36 research. However, in an emergency, a random blood glucose level of 234 mg/dl (13 mmol/l) is the cutoff limit for excision of teeth. [19]. There was no link established between a history of diabetes and the occurrence of abnormal bleeding and dry socket when socket blood sugar levels were <126 mg/dL. Another cross-sectional study studied the association between socket blood sugar and post-extraction problems in type II diabetic and non-diabetic individuals revealed that high blood sugar increased the chance of infection following tooth extraction in diabetes patients. [20]. A five-year research done in India looked at post-operative complications after simple tooth extraction in diabetes individuals who received prophylactic antibiotics or not. Prophylactic antibiotics were administered to group A, but not to group B. Prophylaxis revealed that group B had considerably greater rates of discomfort, haemorrhage, infection, and dry socket compared to group A. [21].

A Bosnian prospective observer-blinded study found no statistically significant difference in postextraction epithelialization rates between diabetic patients based on preoperative blood glucose levels, hemoglobin A1c levels, or patient history. Glycemic control had no effect on post-extraction healing in diabetic patients [22]. According to a Chinese prospective cohort study conducted from October 2018 to October 2019, pre-operative (Fastin Plasma Glucose (FPG) levels of less than 10.00 mmol/L and HbA1c levels of less than 8.5 percent are reasonable markers for assessing the risk of tooth extraction in elderly diabetic patients [23]. The dentist uses monitoring the glycosylated hemoglobin (HbA1C), random blood glucose (RBG), and fasting blood glucose (FBG) readings to help determine if the patient may safely have their teeth extracted. The permissible range for fasting blood glucose levels is 180 mg/dL, whereas the critical limit is 240 mg/dL, which raises the possibility of surgical problems such as superinfection or delayed socket repair. Antibiotic prophylaxis is advised for people with poorly managed diabetes. [18].

When organizing surgical operations, the Joint British Diabetes Societies (JBDS) Inpatient Care Group suggests aiming for a goal HbA1c of < 8.5. [24]. Risk assessment of fasting blood glucose level is shown in table 2 which illustrates that ketoacidosis occurs when fasting blood glucose levels approach 240 mg/dl [25]. The critical limit for fasting blood glucose is 240 mg/dL. If an emergency tooth extraction is performed at this level, the patient may incur severe infection, and the socket's recovery will be delayed. [21].

IV. DISCUSSION

This review included 8 studies (1 randomized, controlled trial, 4 cohort studies, case control study, cross sectional study, and systematic review) that examined extraction of teeth in uncontrolled diabetic patients in the dental clinic to determine the acceptable level of blood glucose for tooth extraction. We found that the maximum acceptable levels of blood glucose for tooth removal in diabetics are 180 mg/dl (before meal) and 234 mg/dl (2 h after a meal). The certainty of this result is tempered by other systematic review which have arrived at this same conclusion [19].. The current review also demonstrated that patients with diabetes have impaired leukocyte function, and the metabolic abnormalities of diabetes which lead to inadequate migration of neutrophils and macrophages to the wound, along with reduced chemotaxis. This can be interpreted as high blood sugar would predispose individuals to an increased risk of wound infection.

V. CONCLUSION

To sum up, the current systematic review revealed that a fasting blood glucose level of 240 mg/dl is critical for any dental treatment because diabetes warning signs appear. The maximum acceptable levels of blood glucose for tooth extraction in diabetics are 180 mg/dL (before meal) and 234 mg/dL. (2 h after a meal), and a target HbA1c of ≤ 8.5 when planning surgical interventions is recommended. Uncontrolled diabetics are at a high risk of infection due to elevated ketone levels in their blood. It is recommended that blood glucose levels be checked prior to emergency tooth extraction.

Conflicts of interest: The authors declare that there is no conflict of interest

Acknowledgment: The authors thank all the individuals who contribute and support this project.

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Table 1. Summary of selected studies (n=8)

Study	Duration	Setting	Quality	Number of Participants	Methodology	Outcome
1. **Retrospective Study of the Prevalence of Dry Socket in Patients with Mandibular Third Molar Extraction**	from June 2019 to March 2020	Saveetha Dental College and Hospitals in India	Excellent	This research includes 691 participants who had their mandibular third molars extracted between June 2019 and March 2020.	Retrospective study	The study discovered that the extraction (with forceps) method increases the risk of dry socket.
2. **The healing of dental extraction sockets in insulin-dependent diabetic patients: a prospective controlled observational study**	15-month period, March 2017 to June 2018	OMS Unit at the Adelaide Dental Hospital, South Australia	Fair	56 insulin-dependent diabetic patients	A prospective controlled observational study	Only four patients (8.2%) in the control group experienced delayed healing after extraction, compared to seven patients (12.5%) in the study group. There was no statistically significant difference. Two members of the research group experienced post-extraction infections, necessitating medications, drainage, and incision.
3. **Management of an emergency tooth extraction in diabetic patients on the dental chair**			Good	36 studies	Systematic review	A cut-off limit of 180 mg/dl is established for any selective dental extraction. Nonetheless, a random blood glucose level of 234 mg/dl (13 mmol/l) serves as the cutoff value for tooth extractions in an emergency.
4. **The Relationship between Socket Blood Sugar and Post-Extraction Complications in Type II Diabetic and Non-Diabetic Patients**	During 2010	Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Yazd University of Medical Sciences, Iran	Good	80 diabetic and 80 non-diabetic patients	Cross-sectional study	There were statistically significant differences (P<0.05) in the frequency of prolonged bleeding and incidence of dry socket between the two groups of blood sugar levels under and above 126 mg/dL, as well as in the frequency of prolonged pain, fever, and infection.
5. **Post-Operative Complications after Simple Tooth Extraction in Diabetic Patients with and without Antibiotic Prophylaxis** Mahmood	From November 2020 to October 2021	Department of Oral &Maxillofacial Surgery Liaquat University Hospital	Excellent	From November 2020 to October 2021. A total of 190 patients	Randomized Control Trial study	In comparison to group A who received prophylactic antibiotics, group B diabetic patients who did not received them had significantly higher rates of pain (28.4 percent vs. 12.6 percent; p=0.007), bleeding (25.3 percent vs.

Study	Duration	Setting	Quality	Number of Participants	Methodology	Outcome
		Hyderabad, India				11.6 percent; p=0.015), infection (20 percent vs. 6.3 percent; p=0.005), and dry socket (18.9 percent vs. 8.4 percent; p=0.035).
6. **Comparison of Extraction Socket Healing in Non-Diabetic, Prediabetic, and Type 2 Diabetic Patients**		Department of Oral and Maxillofacial surgery, Manipal College of Dental Sciences, Manipal, Karnataka, India.	Good	100 participants	A single-center prospective observational study	The diabetes group had a bigger socket size than the non-diabetic group, according to a post hoc analysis (P=0.011). Infection and edoema were more common in the diabetes group of complications.
7. **The Relationship of Glycemic Control to the Outcomes of Dental Extractions**	Between October 2007 and July 2008		Good	115 diabetic patients	Prospective observer-blinded study	Based on preoperative blood glucose levels, there was no statistically significant variation in the postextraction epithelialization rate amongst diabetes individuals. In diabetic patients, postextraction healing was unaffected by glucose management. patients.
8. **Correlation analysis of pre-operative glucose control targets and tooth extraction prognosis in elderly diabetic patients**	From Oct 2018 to Oct 2019.	Department of Oral and Maxillofacial Surgery, Peking University School and Hospital of Stomatology, China	Good	100 participants from Oct 2018 to Oct 2019.	A prospective cohort study To evaluate the prognosis of tooth extraction in elderly mellitus patients with fasting plasma glucose (FPG)>8.88 mmol/L and ≤10.00 mmol/	Pre-operative FPG values of ≤10.00 mmol/L and HbA1c levels of ≤8.5 percent are appropriate criteria for assessing the risk of tooth extraction for senior diabetes patients.

Fasting blood glucose level (FBG)	Risk level assessment
≥50 mg/dl	Dangerously low
70–90 mg/dl	Low
90–120 mg/dl	Normal range
120–160 mg/dl	Medium
160–240 mg/dl	High
240–300 mg/dl	Very High
≤300 mg/dl	Severely high

Table 2. Risk assessment of fasting blood glucose level [25]