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PHARMACOLOGICAL CHALLENGES AND OUTCOMES IN DIABETIC PATIENTS UNDERGOING DENTAL PROCEDURES: A CLINICAL STUDY IN A TERTIARY CARE CENTRE OF JHARKHAND

Dr. Aakriti[1*], Dr. Saurabh Sahay[2], Dr. Vidushi Sharma[3]

[1*]Assistant Professor, Department of Conservative Dentistry and Endodontics, Laxmi Chandravanshi Medical College and Hospital, Palamu, Jharkhand
[2]Postgraduate (1st Year), Department of Pathology, Himalayan Institute of Medical Sciences, Dehradun, Uttarakhand
[3]Assistant Professor, Department of Radiodiagnosis, Laxmi Chandravanshi Medical College and Hospital, Palamu, Jharkhand

[*]**Corresponding Author:** Dr. Aakriti
[*]Assistant Professor, Department of Conservative Dentistry and Endodontics, Laxmi Chandravanshi Medical College and Hospital, Palamu, Jharkhand

Abstract:

Background: Diabetes mellitus is a chronic metabolic disorder associated with impaired immune response, altered pharmacokinetics, and delayed wound healing, all of which complicate dental management and pharmacological decision-making. Diabetic patients undergoing dental procedures are at increased risk of postoperative infection, delayed tissue repair, and adverse drug interactions, particularly in the presence of poor glycemic control. This study aimed to evaluate the pharmacological challenges encountered during routine dental procedures in diabetic patients and to assess clinical outcomes, including pain control, wound healing, infection rates, and drug-related complications, in relation to glycemic status.

Materials and Methods: This hospital-based clinical study was conducted over six months (January 2025 to June 2025) in the Department of Dentistry at Laxmi Chandravansi Medical College and Hospital. A total of 120 adult patients with type 1 or type 2 diabetes mellitus undergoing routine dental procedures were included. Data regarding demographic characteristics, glycemic status, dental procedures performed, pharmacological agents used, and clinical outcomes were recorded. Associations between pharmacological factors, glycemic control, and clinical outcomes were analyzed using the Chi-square test or Fisher's exact test, with a p-value <0.05 considered statistically significant.

Results: Dental extractions were the most common procedures performed (37.5%). Local anesthesia with vasoconstrictors was used in 70.8% of patients, while analgesics and antibiotics were prescribed to 91.7% and 50% of patients, respectively. Adequate intraoperative pain control was achieved in 93.3% of cases. Delayed wound healing ($p = 0.01$) and postoperative infections ($p = 0.04$) were significantly more common in patients with poor glycemic control. Drug–drug interactions and hypoglycemic episodes were infrequent and managed conservatively without major complications.

Conclusion: Diabetic patients can safely undergo routine dental procedures with satisfactory outcomes when pharmacological management is individualized. Poor glycemic control remains a significant risk factor for delayed healing and postoperative infections, highlighting the importance of metabolic optimization and interdisciplinary care in dental practice.

Keywords: Diabetes mellitus, Dental procedures, Pharmacological challenges, Glycemic control, Wound healing, Postoperative infection etc.

Introduction:

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia due to defects in insulin secretion, insulin action, or both. Its global prevalence continues to rise, affecting multiple organ systems, including the oral cavity. Patients with diabetes have a higher prevalence of oral complications such as periodontal disease, dental caries, xerostomia, mucosal lesions, and delayed wound healing compared to non-diabetic individuals. These manifestations are attributed to altered immune function, microvascular changes, and the deleterious effects of sustained hyperglycemia on tissue integrity and inflammatory responses [1,2].

The relationship between diabetes and periodontal disease is well documented, showing a bidirectional association whereby poor glycemic control exacerbates periodontal destruction, and severe periodontal inflammation negatively impacts metabolic control [3,4]. This interplay underscores the importance of considering systemic metabolic status in dental care.

Management of dental patients with diabetes presents unique pharmacological challenges. Local anesthetics, essential for pain control during dental procedures, may have variable effects in diabetic patients, especially when combined with vasoconstrictors [5]. Analgesics, antibiotics, and anti-inflammatory agents must be used cautiously to avoid adverse effects and drug–drug interactions in patients often receiving multiple systemic medications [6,7]. Nonsteroidal anti-inflammatory drugs (NSAIDs) can potentiate hypoglycemic effects of oral antidiabetic drugs, while antibiotics may influence drug metabolism and gut microbiota, affecting glycemic control [8].

Antibiotic prophylaxis prior to oral surgical procedures in patients with diabetes remains controversial, with existing evidence largely based on expert opinion rather than robust clinical trials [9].

Given these considerations, dental clinicians must balance effective pharmacotherapy with an understanding of altered drug responses and interactions in diabetic patients. However, there is limited clinical data detailing the pharmacological challenges and outcomes following routine dental procedures in this population. The present study aims to evaluate the pharmacological challenges encountered in diabetic patients undergoing dental procedures and to analyze the associated clinical outcomes, including pain control, wound healing, infection rates, and drug-related complications.

Materials and Methods:

This hospital-based clinical study was conducted in the Department of Dentistry at Laxmi Chandravansi Medical College and Hospital, Bishrampur, Palamu**,** Jharkhand, over a six-month period from January 2025 to June 2025. Ethical approval was obtained from the Institutional Ethics Committee of Laxmi Chandravansi Medical College and Hospital, and written informed consent was obtained from all participants prior to enrollment. Adult patients aged 18 years and above with a known diagnosis of type 1 or type 2 diabetes mellitus who attended the dental outpatient department during the study period and required dental treatment were screened for inclusion. A total of 120 diabetic patients undergoing routine dental procedures were enrolled**,** including those undergoing dental extractions, restorations, periodontal therapy, endodontic procedures, and minor oral surgical interventions.

Patients with uncontrolled systemic illnesses such as chronic kidney disease, hepatic disorders, malignancy, or immunocompromised states, those receiving long-term corticosteroids or immunosuppressive therapy, pregnant and lactating women, and patients unwilling to participate

were excluded from the study. A detailed medical and dental history was recorded for each participant, including the duration of diabetes, type of antidiabetic treatment, recent glycemic status, and the presence of diabetes-related complications. Random or fasting blood glucose values documented within one week prior to the dental procedure were noted from patient records.

Details of the dental procedures performed and pharmacological agents prescribed were documented, with particular emphasis on local anesthetics, use of vasoconstrictors, analgesics, antibiotics, and anti-inflammatory drugs. Clinical outcomes assessed included adequacy of intraoperative and postoperative pain control, wound healing, occurrence of postoperative infections, drug-related adverse effects, and episodes of hypoglycemia or hyperglycemia following dental treatment. Patients were followed up during subsequent visits to assess post-procedural outcomes.

Data were entered into Microsoft Excel and analyzed using SPSS software version 20. Categorical variables were expressed as frequencies and percentages, and associations between pharmacological factors and clinical outcomes were assessed using the Chi-square test, as appropriate. A p-value of less than 0.05 was considered statistically significant.

Results:

A total of 120 adult patients with diabetes mellitus, who required routine dental procedures, were enrolled in this hospital-based clinical study**.** Table 1 presents the demographic characteristics of the study participants**.** Among the 120 diabetic patients enrolled in the study, 65 (54.2%) were male and 55 (45.8%) were female. The majority of participants were aged 31–50 years (41.7%), followed by those over 50 years (45.8%) and 18–30 years (12.5%), with no significant difference in age distribution between males and females ($\chi^2 = 0.35$, $p = 0.84$). Most patients had type 2 diabetes (76.7%) compared to type 1 (23.3%), and the distribution of diabetes type was comparable across genders ($\chi^2 = 0.02$, $p = 0.88$). Regarding glycemic control, 65% of patients had fair to good control, while 35% had poor control, and the proportion was similar between males and females ($\chi^2 = 0.01$, $p = 0.91$). Overall, these findings indicate that age, type of diabetes, and glycemic status were evenly distributed across genders in the study population.

Table 1: Demographic Characteristics by Gender with Chi-square Analysis (n = 120)

Characteristic		**Male (n = 65)**	**Female (n = 55)**	**Total (n = 120)**	**χ^2**	**p-value**
Age (years)	18–30	8	7	15	0.35	0.84
	31–50	28	22	50		
	>50	29	26	55		
Type of Diabetes	Type 1	15	13	28	0.02	0.88
	Type 2	50	42	92		
Glycemic Control*	Fair/Good	43	35	78	0.01	0.91
	Poor	22	20	42		

*Fasting Blood Sugar <140 mg/dL or Random Blood Sugar <180 mg/dL considered fair/good control.

The distribution of dental procedures among the 120 diabetic patients is shown in Figure 1. Dental extractions were the most commonly performed procedures (45, 37.5%), followed by periodontal therapy (30, 25%), restorations (20, 16.7%), endodontic procedures (15, 12.5%), and minor oral surgical interventions (10, 8.3%). When analyzed by gender, 25 males and 20 females underwent extractions, 15 males and 15 females received periodontal therapy, 10 males and 10 females underwent restorations, 10 males and 5 females underwent endodontic procedures, and 5 males and 5 females underwent minor oral surgical interventions. Chi-square analysis indicated no statistically

significant differences in the distribution of dental procedures between males and females ($p > 0.05$), suggesting that the type of dental treatment was evenly distributed across genders in the study population.

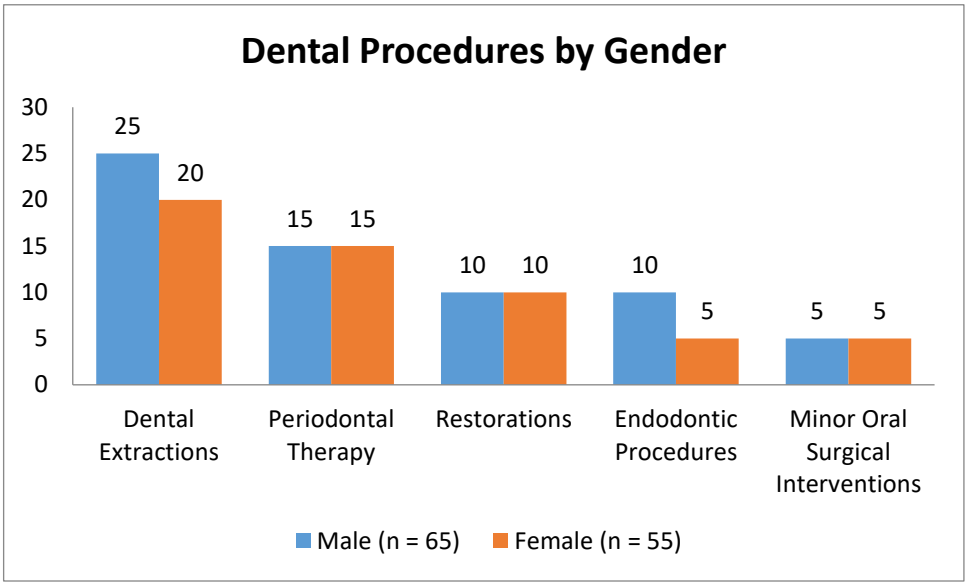

Figure 1: Distribution of Dental Procedures by Gender

Table 2 summarizes the pharmacological agents used during dental procedures in the study population. Local anesthesia with vasoconstrictors was administered in 85 (70.8%) patients, while 35 (29.2%) received local anesthesia without vasoconstrictors. Analgesics, including NSAIDs and other agents, were prescribed to 110 (91.7%) patients to ensure adequate postoperative pain control. Antibiotics were administered to 60 (50%) patients, primarily for procedures with higher risk of infection or in those with comorbidities. Dose adjustments due to underlying comorbid conditions or renal impairment were required in 25 (20.8%) patients to optimize safety and prevent adverse drug reactions. These findings highlight the careful pharmacological management tailored to the needs and systemic status of diabetic patients undergoing dental procedures.

Table 2: Pharmacological Agents Used (n = 120)

Pharmacological Agent	Number (n)	Percentage (%)
Local Anesthesia with Vasoconstrictor	85	70.8
Local Anesthesia without Vasoconstrictor	35	29.2
Analgesics (NSAIDs/others)	110	91.7
Antibiotics	60	50.0
Dose Adjustments Due to Comorbidities	25	20.8

Table 3 shows the clinical outcomes of diabetic patients undergoing dental procedures and their relationship with glycemic control. Adequate intraoperative pain control was achieved in 112 (93.3%) patients, including 72 with fair/good glycemic control and 40 with poor control, with no significant difference between the groups ($p = 0.64$). Postoperative pain requiring additional analgesics occurred in 25 (20.8%) patients, distributed as 18 with fair/good control and 7 with poor control, also showing no significant difference ($p = 0.83$). Satisfactory wound healing was observed in 110 (91.7%) patients, while 10 (8.3%) experienced delayed healing. Delayed wound healing was significantly more common in patients with poor glycemic control ($p = 0.01$). Postoperative infections occurred in 8 (6.7%) patients, with 6 cases in the poor glycemic control group and 2 in the fair/good group, indicating a significant association between poor glycemic control and infection ($p = 0.04$). Drug-related minor adverse effects were reported in 12 (10%) patients, evenly distributed between the groups ($p = 0.33$). Transient hyperglycemia occurred in 15 (12.5%) patients and

hypoglycemia episodes were rare (2 patients), with no significant differences between groups ($p > 0.05$). These findings suggest that poor glycemic control is an important factor for delayed wound healing and postoperative infection**,** while other clinical outcomes, including pain control and adverse drug effects, were not significantly influenced by glycemic status.

Table 3: Clinical Outcomes and Association with Glycemic Control (n = 120)

Clinical Outcome	Fair/Good Glycemic Control (n = 78)	Poor Glycemic Control (n = 42)	Total (n = 120)	χ^2	p-value
Adequate Intraoperative Pain Control	72	40	112	0.21	0.64
Postoperative Pain Requiring Analgesics	18	7	25	0.05	0.83
Satisfactory Wound Healing	75	35	110	5.87	**0.01**
Delayed Wound Healing	3	7	10		
Postoperative Infection	2	6	8	4.05	**0.04**
Drug-Related Minor Adverse Effects	6	6	12	0.95	0.33
Transient Hyperglycemia Post-Procedure	7	8	15	3.02	0.08
Hypoglycemia Episodes	1	1	2	0.04	0.84

Table 4 summarizes the pharmacological challenges encountered during dental procedures in diabetic patients. Dose adjustments due to comorbidities or renal function were required in 25 (20.8%) patients, mainly involving analgesics or antibiotics, to prevent potential drug toxicity. The use of vasoconstrictors in local anesthesia was a common consideration, applied in 85 (70.8%) patients, with careful monitoring of blood pressure and heart rate; no adverse cardiovascular events were observed. Potential drug–drug interactions were noted in 30 (25%) patients, primarily involving NSAIDs and oral antidiabetic medications, and these were managed conservatively without complications. The risk of hypoglycemia due to analgesic or antibiotic use was low, occurring in 5 (4.2%) patients and managed successfully with oral glucose. Altered pain perception or inadequate analgesia was observed in 8 (6.7%) patients, contributing to the 25 patients who required additional postoperative analgesics. Antibiotic prophylaxis was administered in 60 (50%) patients, with decisions individualized based on the type of procedure and patient risk profile. Overall, these findings highlight the importance of careful pharmacological planning and monitoring to safely manage diabetic patients undergoing dental procedures.

Table 4: Pharmacological Challenges Observed (n = 120)

Pharmacological Challenge	Number (n)	Percentage (%)	Remarks / Outcome
Need for dose adjustment due to comorbidities or renal function	25	20.8	Adjusted analgesics or antibiotics to prevent toxicity
Concerns regarding vasoconstrictor use in local anesthesia	85	70.8	Monitored BP and heart rate; no adverse events observed
Potential drug–drug interactions	30	25.0	Mainly NSAIDs with oral antidiabetics; managed conservatively
Risk of hypoglycemia due to analgesic/antibiotic use	5	4.2	Mild episodes observed; treated with oral glucose
Altered pain perception or inadequate analgesia	8	6.7	Required additional analgesics in 25 patients overall
Antibiotic prophylaxis decisions	60	50.0	Individualized based on procedure and patient risk

Discussion:

Diabetes mellitus is well recognized as a systemic condition that significantly influences oral health, healing capacity, and response to pharmacological agents. In the present clinical study involving 120 diabetic patients undergoing routine dental procedures, we evaluated common pharmacological challenges and correlated them with short-term clinical outcomes. The findings reinforce the importance of individualized drug selection and meticulous peri-procedural monitoring in this medically vulnerable population. Effective intraoperative pain control was achieved in the majority of patients (93.3%), irrespective of glycemic status. This observation is consistent with earlier reports suggesting that commonly used local anesthetics remain effective in diabetic patients when administered judiciously [5]. Although vasoconstrictors in local anesthesia are often viewed with caution due to concerns regarding cardiovascular and glycemic effects, their use in our study population did not result in adverse events when appropriate monitoring was ensured. Similar conclusions have been reported by Malhotra et al., who emphasized that controlled use of vasoconstrictors is generally safe in diabetic individuals without significant cardiovascular instability [5].

A key finding of this study was the significant association between poor glycemic control and delayed wound healing, observed predominantly in patients with uncontrolled diabetes. Hyperglycemia impairs leukocyte function, collagen synthesis, and angiogenesis, all of which are critical for tissue repair [10,11]. Guo and DiPietro described prolonged inflammatory phases and impaired fibroblast activity as central contributors to delayed healing in diabetic wounds [12]. Clinical dental studies have similarly demonstrated delayed epithelialization and compromised healing following extractions and periodontal surgery in poorly controlled diabetic patients [13,14]. In addition, postoperative infections were significantly more frequent among patients with poor glycemic control. Impaired neutrophil chemotaxis and phagocytosis in hyperglycemic states increase susceptibility to infection, a mechanism well established in both medical and dental literature [11,15]. de Molon et al. reported higher infection rates and poorer periodontal outcomes in diabetic patients with inadequate metabolic control, findings that closely parallel the results of the present study [10]. Saini et al. also emphasized glycemic status as a critical determinant of postoperative dental infections [16].

The use of antibiotics in diabetic dental patients remains controversial. In our study, antibiotics were prescribed to half of the patients, mainly for invasive procedures or when additional risk factors were present. Evidence suggests that routine antibiotic prophylaxis for all diabetic patients is not justified; however, selective use based on glycemic control, surgical complexity, and comorbidities may be beneficial [16,17]. Lockhart et al. cautioned against indiscriminate antibiotic use, highlighting limited benefits in preventing bacteremia and the growing concern of antimicrobial resistance [9].

Drug–drug interactions were observed in one-quarter of the study population, predominantly involving NSAIDs and oral hypoglycemic agents. NSAIDs may potentiate hypoglycemia and exacerbate renal dysfunction in susceptible diabetic patients, particularly those with long-standing disease. These findings are consistent with established pharmacological data and clinical guidelines emphasizing cautious analgesic selection in diabetic patients receiving polypharmacy [6,18]. Episodes of hypoglycemia were infrequent and mild, occurring in only two patients. This supports previous reports by Little et al. that hypoglycemia during dental procedures is uncommon when meals, insulin, and oral hypoglycemic agents are appropriately coordinated [19]. Nonetheless, preparedness for prompt recognition and management of hypoglycemia remains essential in dental practice. A subset of patients experienced altered pain perception or inadequate analgesia, requiring additional postoperative analgesics. Vinik and Casellini reported that chronic hyperglycemia–induced diabetic neuropathy alters nociceptive signaling and pain thresholds, leading to variable analgesic responses [20]. Callaghan et al. similarly attributed altered pain perception in diabetic patients to diabetes-related nerve dysfunction [21].

The bidirectional relationship between diabetes and periodontal disease is also clinically important. Preshaw et al. showed that periodontal inflammation can worsen glycemic control, while poor metabolic control accelerates periodontal destruction [22]. Genco and Borgnakke described this as a self-perpetuating cycle that affects both disease progression and treatment outcomes, underscoring the need for integrated medical–dental care in diabetic patients [23].

The limitations of this study include its single-center design, and limited long-term follow-up. Future multicenter studies incorporating longer observation periods are warranted. Overall, this study demonstrates that diabetic patients can safely undergo routine dental procedures when pharmacological management is individualized. However, poor glycemic control remains a key predictor of delayed healing and infection, underscoring the importance of metabolic optimization and interdisciplinary collaboration.

Conclusion:

This study demonstrates that diabetic patients can safely undergo routine dental procedures when pharmacological management is individualized and glycemic status is carefully considered. Adequate pain control was achieved in most patients; however, poor glycemic control was significantly associated with delayed wound healing and increased postoperative infections. Careful selection and dosing of local anesthetics, analgesics, and antibiotics, along with monitoring for drug interactions and glycemic fluctuations, are essential to minimize complications. Optimizing glycemic control before invasive dental procedures and fostering close medical–dental collaboration can improve clinical outcomes and enhance the quality of care for diabetic patients.

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Conflicts of interest: None

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