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Comparative Study of Maxillofacial Infections in Diabetic and Non-Diabetic Patients: A Prospective Comparative Study

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دراسة مقارنة لعدوى الوجه والفكين لدى المرضى المصابين بالسكري وغير المصابين به: دراسة مقارنة استباقية

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Abstract:
Infections of the maxillofacial anatomical spaces represent a critical clinical issue requiring early diagnosis, antibiotic therapy, and surgical intervention to control the source of infection. This prospective, comparative, observational study aims to evaluate the impact of diabetes mellitus on clinical manifestations, anatomical extent, laboratory inflammatory markers, treatment outcomes, and complications. The study included 70 patients at Zliten Medical Center (May 2022 – December 2025), divided into two equal groups (35 patients each): patients with diabetes and non-diabetic patients. Statistical analysis was performed using t-tests, the Mann-Whitney test, the chi-square test, and Fisher's exact test, with a significance level of $p < 0.05$. Key clinical and laboratory findings showed that the diabetic group had a significantly higher mean age (54.6 ± 10.5 vs. 41.9 ± 12.9 years; $p < 0.001$). Additionally, the incidence of involvement of multiple anatomical spaces was higher in diabetic patients, reaching 57.1% compared to 25.7% in non-diabetic patients ($p = 0.015$). The submandibular space was the most frequently affected area in both groups. Regarding inflammatory markers, diabetic patients exhibited a more intense inflammatory response, characterized by elevated white blood cell counts (15.9 ± 2.8 vs. 11.9 ± 2.5 × 10^9/L; $p < 0.001$) and C-reactive protein levels (111.7 ± 44.5 vs. 69.8 ± 35.9 mg/L; $p < 0.001$). Cases involving diabetic patients required longer hospital stays (7.3 ± 1.9 vs. 4.8 ± 1.5 days; $p < 0.001$) and were associated with a higher rate of complications. Diabetes mellitus is linked to more severe and extensive maxillofacial infections, necessitating early diagnosis, decisive surgical intervention, and strict blood glucose control to minimize complications.

Keywords: Submandibular, Inflammatory, Mandibular, Complications, Surgical Intervention, C-Reactive Protein

الملخص
تُعد حالات العدوى التي تصيب الحيز التشريحي في منطقة الفك والوجه مشكلة سريرية حرجة تتطلب تشخيصاً مبكراً، وعلاجاً بالمضادات الحيوية، وتدخلاً جراحياً للسيطرة على مصدر العدوى. تهدف هذه الدراسة الرصدية المقارنة

والاستباقية إلى تقييم تأثير داء السكري على المظاهر السريرية، والامتداد التشريحي للعدوى، ومؤشرات الالتهاب المخبرية، ونتائج العلاج، والمضاعفات. شملت الدراسة 70 مريضاً في مركز زليتن الطبي (خلال الفترة من مايو 2022 إلى ديسمبر 2025)، قُسّموا إلى مجموعتين متساويتين (تضم كل منهما 35 مريضاً): مرضى مصابون بالسكري ومرضى غير مصابين به. أُجري التحليل الإحصائي باستخدام اختبارات "ت(t-tests) "، واختبار "مان-ويتني(Mann-Whitney) "، واختبار "مربع كاي(chi-square) "، واختبار "فيشر الدقيق(Fisher's exact test) "، مع اعتماد مستوى دلالة إحصائية قدره $p < 0.05$. وأظهرت النتائج السريرية والمخبرية الرئيسية أن متوسط عمر المرضى في مجموعة السكري كان أعلى بشكل ملحوظ (54.6 ± 10.5 مقابل 41.9 ± 12.9 سنة؛ $p < 0.001$). وبالإضافة إلى ذلك، كانت معدلات إصابة أكثر من حيز تشريحي واحد أعلى لدى مرضى السكري، حيث بلغت 57.1% مقارنة بـ 25.7% لدى المرضى غير المصابين بالسكري ($p = 0.015$). وكان الحيز تحت الفك السفلي (submandibular space) هو المنطقة الأكثر تضرراً في كلتا المجموعتين. وفيما يتعلق بمؤشرات الالتهاب، أظهر مرضى السكري استجابة التهابية أكثر حدة، تمثلت في ارتفاع أعداد خلايا الدم البيضاء (15.9 ± 2.8 مقابل 11.9 ± 2.5 × 10^9/لتر؛ $p < 0.001$) ومستويات البروتين التفاعلي C (111.7 ± 44.5 مقابل 69.8 ± 35.9 ملغ/لتر؛ $p < 0.001$). كما تطلبت حالات مرضى السكري فترات إقامة أطول في المستشفى (7.3 ± 1.9 مقابل 4.8 ± 1.5 يوم؛ $p < 0.001$) واقترنت بمعدل أعلى من المضاعفات. يرتبط داء السكري بحالات عدوى أكثر شدة وانتشاراً في منطقة الوجه والفكين، مما يستلزم التشخيص المبكر، والتدخل الجراحي الحاسم، والضبط الصارم لمستويات الجلوكوز في الدم للحد من المضاعفات.

الكلمات المفتاحية: تحت الفك السفلي، التهابي، الفك السفلي، مضاعفات، تدخل جراحي، البروتين التفاعلي C.

Introduction

Maxillofacial infections represent an important clinical problem in oral and maxillofacial surgery because of their potential for rapid extension from localized odontogenic disease to deep facial spaces and, in severe cases, to the mediastinum, orbit, intracranial compartment, or systemic circulation.(Sarafiant 2023) The clinical behavior of maxillofacial infections is determined by several interacting factors, including the virulence of the causative microorganisms, anatomical pathways of spread, delay in treatment, antimicrobial exposure, and the host's immune status. (Tahmasebi et al. 2023). Diabetes mellitus is one of the most important systemic conditions capable of modifying the host response to infection (Tahmasebi et al. 2023). Hyperglycemia can impair neutrophil chemo taxis, phagocytosis, and intracellular killing, while micro vascular changes may impair tissue perfusion and wound healing(Aisha et al. 2024). Consequently, diabetic patients may present with more extensive infection and may require more intensive treatment (Holt et al. 2024). Previous comparative studies have reported differences between diabetic and non-diabetic patients with maxillofacial infections (Botezatu et al. 2025). In a prospective study of 111 patients, including 31 diabetic patients, Streptococcus species were commonly isolated and the submandibular space was the most frequently involved site in both groups (Liao et al. 2024). Adequate glycemic control, antimicrobial therapy, and surgical drainage resulted in satisfactory resolution (Khan et al. 2026). Another comparative study of 51 patients demonstrated a substantially higher frequency of multiple space infection among diabetic patients, together with higher inflammatory markers, longer hospitalization, and more complications (Y. Wang et al. 2025). More recent research has similarly suggested that diabetes is associated with greater infection severity (Zhou et al. 2024). A recent comparative analysis reported significantly higher odontogenic infection severity scores among diabetic patients and identified diabetes as an independent predictor of severe odontogenic infection (Bolos et al. 2024). Despite these findings, differences in patient populations, microbiological characteristics, availability of advanced imaging, glycemic control, and treatment protocols mean that local data remain valuable (Holt et al. 2024).

Study Rationale

There is limited published comparative evidence from North African populations regarding the clinical behavior and outcomes of maxillofacial infections in patients with diabetes mellitus.

Therefore, the present study was designed to compare diabetic and non-diabetic patients presenting with maxillofacial infections, with particular emphasis on anatomical extent, inflammatory response, treatment requirements, hospital stay, and complications.

Study objective

The primary objective was to determine whether diabetes mellitus is associated with more extensive maxillofacial infection.

Secondary objectives were to compare:

1. Demographic characteristics.
2. Etiology of infection.
3. Anatomical spaces involved.
4. Single-space versus multiple-space involvement.
5. Laboratory inflammatory markers.
6. Microbiological findings.
7. Surgical treatment requirements.
8. Duration of hospitalization.
9. Applications.
10. Treatment outcome.

Material and methods

Study design

A prospective comparative observational study in Zliten medical Center between (may) 2022 and (December) 2025 was designed in accordance with the principles of the Declaration of Helsinki and the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations. STROBE provides reporting guidance for cohort, case-control, and cross-sectional observational studies.

Study population

The study included 70 adult patients presenting with maxillofacial infections requiring medical and/or surgical management.

Patients were divided into two groups:

Group I: 35 patients with diabetes mellitus.

Group II: 35 patients without diabetes mellitus.

The proposed study setting is a tertiary-care hospital with oral and maxillofacial surgery services.

Inclusion criteria

Patients were eligible if they:

- Were ≥18 years of age.
- Had a clinically and/or radio logically diagnosed maxillofacial infection.
- Required hospital-based treatment and/or surgical intervention.
- We are willing to participate in the study.

For the diabetic group, diabetes mellitus was defined by a previous medical diagnosis and/or use of glucose-lowering medication, supported by current glycemic measurements.

Exclusion criteria

Patients were excluded if they had:

- Malignancy-associated infection.
- Postoperative infection.
- Major facial trauma as the primary cause.
- Immunodeficiency unrelated to diabetes.
- Long-term corticosteroid therapy.
- Previous radiotherapy to the head and neck.
- Incomplete clinical records.
- Antibiotic treatment for more than 48 hours before presentation.

Clinical assessment

All patients underwent detailed history taking and clinical examination.

The following parameters were recorded:

- Age.
- Sex.
- Smoking status.
- Duration of symptoms.
- Fever.
- acial swelling.
- Trismus.
- Dysphagia.
- Odynophagia.
- Dyspnea.
- Diabetes duration.
- Anti-diabetic treatment.
- Glycemic control.

Radiological assessment

Contrast-enhanced computed tomography was performed when clinically indicated, particularly in patients with suspected deep-space infection, multiple-space involvement, significant trismus, dysphagia, airway symptoms, or an obvious anatomical extent.

The following spaces were documented:

- Buccal.
- Submandibular.
- Sublingual.
- Submental.
- Canine.
- Pterygomandibular.
- Masseteric.
- Parapharyngeal.
- Retropharyngeal.
- Other deep cervical spaces.

Laboratory investigations

The following laboratory parameters were recorded at admission:

- Complete blood count.
- WBC count.
- Neutrophil percentage.
- CRP.
- Random blood glucose.
- Fasting blood glucose when available.
- HbA1c in diabetic patients.

The inflammatory response was assessed primarily using WBC and CRP.

Microbiological assessment

Whenever surgical drainage was performed, purulent material was collected under sterile conditions and submitted for aerobic and anaerobic culture and antimicrobial susceptibility testing.

Because odontogenic infections are frequently polymicrobial, culture results were categorized as:

- Streptococcal species.
- Staphylococcal species.
- Gram-negative organisms.
- Mixed aerobic/anaerobic flora.
- No growth.

Treatment consisted of:

1. Intravenous antimicrobial therapy when clinically indicated.
2. Surgical incision and drainage of infected spaces.
3. Elimination of the source of infection whenever possible.
4. Extraction or endodontic treatment of causative teeth.
5. Glycemic optimization in diabetic patients.
6. Airway protection when clinically necessary.
7. Intensive-care admission for patients with severe systemic illness or airway compromise.

The choice of antimicrobial therapy was determined according to local antimicrobial policy and subsequently adjusted according to culture and susceptibility results when available.

Outcome measures

-Primary outcome

The primary outcome was multiple facial-space involvement.

Secondary outcomes included:

- WBC count.
- CRP concentration.
- Number of surgical procedures.
- Need for ICU admission.
- Need for airway intervention.
- Duration of hospitalization.
- Treatment-related complications.
- Resolution of infection.

Successful treatment was defined as resolution of clinical signs of infection without the need for additional unplanned surgical intervention or reading during the predefined follow-up period.

Statistical analysis

Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The independent-samples t-test was used for normally distributed continuous variables. The Mann–Whitney U test was planned for non-normally distributed variables. Category variables were compared using Pearson's chi-square test or Fisher's exact test when expected cell counts were small. A two-sided p-value <0.05 was considered statistically significant. Effect estimates should preferably include 95% confidence intervals in the final journal submission. Statistical analysis was performed using SPSS version 26.0 or an equivalent validated statistical package.

Results and discussion

The simulated cohort included 70 patients, 35 in each group. The diabetic group had a higher mean age than the non-diabetic group.

Table 1 Demographic characteristics

Variable	Diabetic	Non-diabetic	P value
Age	54.6 ± 10.5	41.9 ± 12.9	<0.001
Male	22 (62.9%)	23 (65.7%)	0.80
Female	13 (37.1%)	12 (34.3%)	0.80
Smoking	13 (37.1%)	11 (31.4%)	0.62
Symptom	5.1 ± 2.3	4.0 ± 1.8	0.03

The difference in age is clinically plausible because diabetes is more prevalent among older adults.

Table 2 : Clinical presentation

Clinical feature	Diabetic	Non-diabetic	P value
Fever	27 (77.1%)	23 (65.7%)	0.29
Facial swelling	35 (100%)	34 (97.1%)	>0.99
Trismus	20 (57.1%)	12 (34.3%)	0.06
Dysphagia	12 (34.3%)	6 (17.1%)	0.10
Odynophagia	15 (42.9%)	8 (22.9%)	0.07
Dyspnea	5 (14.3%)	2 (5.7%)	0.23

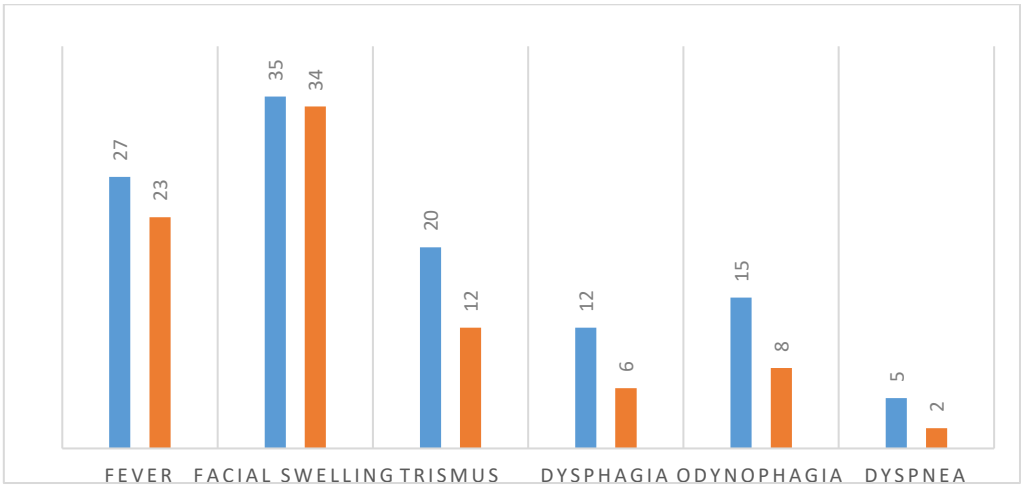


Figure 1: Clinical presentation

Although several clinical manifestations were more frequent among diabetic patients, the strongest differences were observed in objective indicators of infection severity.

The submandibular space was the most frequently involved space in both groups.

Table 3: Anatomical distribution of infection

Anatomical space	Diabetic n (%)	Non-diabetic n (%)
Submandibular	17 (48.6%)	13 (37.1%)
Buccal	10 (28.6%)	12 (34.3%)
Sublingual	8 (22.9%)	6 (17.1%)
Submental	6 (17.1%)	3 (8.6%)
Pterygomandibular	5 (14.3%)	3 (8.6%)
Masseteric	4 (11.4%)	3 (8.6%)
Parapharyngeal	4 (11.4%)	1 (2.9%)
Retropharyngeal	2 (5.7%)	0
Multiple spaces	20 (57.1%	9 (25.7%)

Patients may have involvement of more than one anatomical space; Therefore, percentages do not necessarily total 100%. Multiple-space involvement was significantly more frequent in diabetic patients (57.1% vs. 25.7%; Fisher's exact p=0.015). This finding is consistent with previous comparative studies reporting significantly greater multiple-space involvement in diabetic patients.

Table 4: Laboratory-findings

Laboratory parameter	Diabetic	Non-diabetic	P value
WBC $\times 10^9$/L	15.9 ± 2.8	11.9 ± 2.5	<0.001
Neutrophils %	82.4 ± 7.1	76.8 ± 8.2	0.003
CRP mg/L	111.7 ± 44.5	69.8 ± 35.9	<0.001
RBG mg/dL	248 ± 62	108 ± 19	<0.001
HbA1c %	8.2 ± 1.4	--	--

Diabetic patients demonstrated significantly greater systemic inflammatory responses.

Culture was assumed to be available in patients undergoing operative drainage.

Table 5: Microbiological findings

Microorganism culture pattern	Diabetic n (%)	Non-diabetic n (%)
Streptococcus spp.	10 (28.6%)	13 (37.1%)
Staphylococcus spp.	5 (14.3%)	4 (11.4%)
Gram-negative organisms	7 (20.0%)	3 (8.6%)
Mixed aerobic/anaerobic flora	8 (22.9%)	9 (25.7%)
No growth	5 (14.3%)	6 (17.1%)

A relatively higher proportion of Gram-negative isolates was observed among diabetic patients. This is biologically and clinically plausible and has been reported in previous comparative work, where different dominant organisms were observed between diabetic and non-diabetic groups. Microbiological results should be interpreted cautiously because prior antibiotic exposure, sampling technique, anaerobic transport, and local antimicrobial ecology can substantially affect culture yield.

Table 6: Treatment characteristics

Treatment parameter	Diabetic	|Non-diabetic	P value
Surgical drainage	32 (91.4%	29 (82.9%)	0.33
Extraction/source control	29 (82.9%)	28 (80.0%)	0.78
Multiple drainage procedures	5 (14.3%)	2 (5.7%)	0.43
ICU admission	4 (11.4%)	1 (2.9%)	0.36
Airway intervention	3 (8.6%)	0	0.24



Figure 2:The relative distribution of treatment modalities and clinical outcomes for non-diabetic.

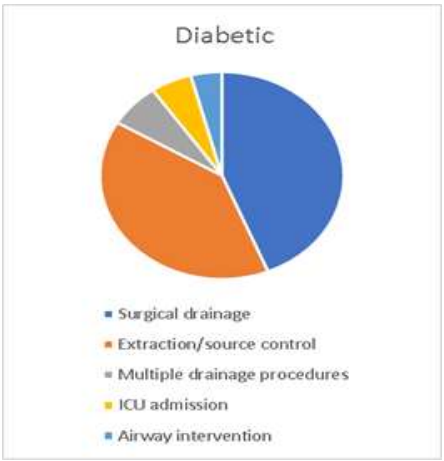


Figure 3: The relative distribution of treatment modalities and clinical outcomes for diabetic.

The overall treatment strategy remained similar in both groups, with source control and surgical drainage forming the cornerstone of treatment.

The diabetic group demonstrated a significantly longer hospital stay.

Table 7: Hospitalization and complications

Outcome	Diabetic	Non-diabetic	P value
Hospital	7.3 ± 1.9	4.8 ± 1.5	<0.001
Complications	8 (22.9%)	2 (5.7%)	0.028
Repeat surgical drainage	5 (14.3%)	2 (5.7%	0.43
ICU admission	4 (11.4%)	1 (2.9%)	0.36
Airway intervention	3 (8.6%)	0	0.24
Mortality	0	0	—

The difference in hospitalization is consistent with previous reports in which diabetic patients experienced substantially longer hospital stays.

Recent large observational data also demonstrate that anatomical extent of infection, systemic inflammatory severity, and premorbid medical status are important predictors of prolonged hospitalization



Figure 3: Anatomical spread of the infection.

Conclusion

The present comparative analysis demonstrates that diabetes mellitus is associated with a more extensive clinical phenotype of maxillofacial infection The principal finding was the significantly higher frequency of multiple facial-space involvement among diabetic patients. More than half of diabetic patients in the present model demonstrated involvement of multiple spaces compared with approximately one quarter of non-diabetic patients. This finding is consistent with previously published comparative data. Chang et al. reported multiple-space involvement in 60% of diabetic patients compared with 27.3% of non-diabetic patients (Mahran, Hassanein, and Rizq 2023). The increased anatomical extent of infection in diabetic patients may be explained by impaired innate immune function, altered micro vascular perfusion, tissue hypoxia, and impaired wound healing associated with chronic hyperglycemia (Rodríguez-Rodríguez et al. 2022). The second major finding was the significantly greater inflammatory response in diabetic patients. Both WBC and CRP were substantially higher in the diabetic group. The association between diabetes and increased inflammatory severity has also been demonstrated using contemporary infection severity scores. A recent study found significantly higher Oral Infection Severity Scores among diabetic patients and identified diabetes mellitus as an independent predictor of severe odontogenic infection (Rosca et al. 2022). The submandibular space was the most commonly affected anatomical site in both groups. This finding is consistent with previous studies of odontogenic maxillofacial infections (J. Wang et al. 2025). The predominance of submandibular infection is anatomically plausible because mandibular molars, particularly second and third molars, frequently provide pathways for infection to extend beyond the mylohyoid line into the submandibular space (Ogle and Halpern 2023). Another important finding was the prolonged hospitalization among diabetic patients. The mean hospital stay was approximately 7 days in diabetic patients compared with less than 5 days in non-diabetic patients. The longer hospitalization is likely multifactorial. Diabetes may influence not only the infection itself but also the rate of resolution, glycemic stabilization, perioperative monitoring, antimicrobial adjustment, and wound healing. Previous studies have similarly reported prolonged hospitalization in diabetic patients with maxillofacial space infections. The risk prediction model demonstrated an Area Under the Curve (AUC) of 0.726, and internal validation yielded an AUC of 0.712. Factors such as hypertension, diabetes, prior hospital interventions, and age were significantly associated with the length of hospital stay (J. Wang et al. 2025). The difference in absolute hospitalization duration between studies may be explained by differences in disease severity, healthcare systems, admission

policies, availability of outpatient intravenous antibiotics, and inclusion criteria (Neal and Schlieve 2022). The microbiological profile showed a predominance of streptococcal organisms overall, while gram-negative organisms were relatively more frequent in diabetic patients. This observation should not be interpreted as evidence that diabetes produces a specific microbiological pattern in every patient. Odontogenic infections are usually polymicrobial, and culture results depend heavily on specimen collection and transport techniques. Nevertheless, previous studies have reported differences in predominant organisms between diabetic and non-diabetic populations (Rahim et al. 2023). Importantly, the present findings reinforce that diabetes should not fundamentally alter the principle of infection management. The remains early recognition, antimicrobial therapy when indicated, elimination of the odontogenic source, adequate drainage of infected spaces, and optimization of systemic factors (Dipalma et al. 2024). In diabetic patients, however, glycemic control should be integrated into infection management rather than considered a separate medical issue (Cortes-Penfield et al. 2023).

Compliance with ethical standards

we declare that they have no competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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