Original Article

COVID-19 Influence on Mandibular Dry Socket Occurrence

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ABSTRACT

Background: Alveolar osteitis (AO), commonly known as dry socket, is a recognized complication following tooth extraction, particularly prevalent after mandibular third molar extractions. Given the global pandemic of coronavirus disease (COVID-19) and its implications for endothelial and hematologic changes, investigating its potential impact on dry socket risk in patients undergoing mandibular third molar extraction is crucial.

Methods: We reviewed patient records from individuals undergoing mandibular third molar extraction at Mashhad Dental School, Mashhad, Iran in 2022. Data included demographics, medical history, smoking status, and COVID-19 details such as history, hospitalization, and vaccination status.

Results: Clinical examinations diagnosed alveolar osteitis, assessing for blood clot presence and local lymphadenitis. Out of 119 patients (82 females, 37 males), 49.6% developed dry socket post-extraction, with 94.1% having a history of COVID-19 and 32.7% requiring hospitalization due to the disease. 97.5% of patients were vaccinated against COVID-19. Additionally, 44.5% had systemic disease history, and 45.4% used related medications, with no observed associations with dry socket.

Conclusion: This study underscores the increased risk of dry socket following mandibular third molar extraction associated with corticosteroid use, oral contraceptive use, smoking, and COVID-19 hospitalization. Females exhibited a significantly higher risk compared to males. While no significant COVID-19 infection-dry socket link was found, the study highlights the need for further research, given the significant number of dry socket cases among COVID-19 patients and those hospitalized due to COVID-19.

KEYWORDS
COVID-19; Dry Socket; Surgery; Surgery, Oral Surgery; Postoperative Complications; Osteitis

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INTRODUCTION

Alveolar osteitis (AO), commonly referred to as dry socket, is among the most frequent complications following the extraction of permanent teeth [1]. The highest occurrence of dry socket is observed in individuals in their third and fourth decades of life [2]. The incidence rate of dry socket ranges from 1%-4% for all routine dental extractions and escalates to

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5%-30% for impacted mandibular third molars. Typically, dry socket manifests between the first and third day postoperatively and persists for 5 to 10 d [3]. Clinically, dry socket presents with intense, throbbing pain beginning 24-72 h after tooth extraction, often accompanied by halitosis and an unpleasant taste. Upon clinical examination, the extraction site appears devoid of a blood clot with exposed bone, covered by food particles, gingival swelling, or local lymphadenitis. The underlying cause is increased local fibrinolysis, which leads to the dissolution of the blood clot within the socket. This fibrinolysis is initiated by the activation of the plasminogen pathway, which can occur through either direct (physiological) or indirect (non-physiological) activators [4]. Direct activators are released following the damage of alveolar bone cells, while indirect activators are produced by bacteria [5].
The modified triangular flap significantly reduces the incidence of AO compared to the buccal envelope flap [6]. Additionally, the incidence of dry socket was higher in smokers than in non-smokers [5,7]. The incidence of AO in women is reported to be five times higher than in men. Furthermore, dry socket occurs three times more frequently in women who use oral contraceptives compared to those who do not [8]. This is because estrogen in oral contraceptives can enhance plasma fibrinolytic activity, thereby affecting clot formation after tooth extraction [9].
Acute respiratory syndrome coronavirus (SARS-CoV-2) commonly presents with clinical symptoms such as fever (not in all individuals), cough, sore throat, headache, fatigue, muscle pain, and shortness of breath. SARS-CoV-2 binds to the ACE2 receptor to enter and infect the epithelial cells of the respiratory tract [10-12]. The presence of ACE2 receptors on the epithelial cells of the oral mucosa and gingiva makes the oral cavity a potential target for viral infection [13]. Corticosteroids are administered to suppress severe immune responses in these patients; however, excessive use of glucocorticosteroids has increased the levels of Von Willebrand factor (VWF) in the plasma. This factor, produced and stored in endothelial cells, is crucial for platelet accumulation and adhesion. Consequently, its deficiency increases the risk of thrombosis and avascular necrosis due to endothelial damage caused by excessive glucocorticoid use [14,15].
A recent study on the patients with COVID-19 have highlighted a relatively higher risk of avascular necrosis associated with corticosteroid use[16]. Besides corticosteroids, SARS-CoV-2 infection itself can induce endothelial dysfunction, leading to excessive thrombin generation and fibrinolysis shutdown, thereby creating a hypercoagulable state[17]. Combined with hypoxia, hypercoagulability increases blood viscosity and activates hypoxia-induced transcription factor-dependent signaling, which further elevates the risk of thrombosis and osteonecrosis[18].
Given the global impact of the COVID-19 pandemic and the potential for unique complications in dental health, it is critical to understand the specific risks associated with dry socket in patients with a history of COVID-19. While only one international study has explored this risk, no research has been conducted in Iran to date. Therefore, we aimed to investigate the incidence of dry socket in patients with a history of COVID-19 following the extraction of mandibular third molars, to provide insights specific to the Iranian population and contribute to the global understanding of post-extraction complications in the context of COVID-19.

MATERIALS AND METHODS

This retrospective cross-sectional study included 119 patients referred to the Oral and Maxillofacial Surgery Department of Mashhad Faculty of Dentistry, Mashhad, Iran for mandibular third molar extraction, over a 12-month period from Oct 2022 to Oct 2023. Among these, 59 patients complained of dry socket.
The study involved examining patient archives. Only cases with complete information, including a history of COVID-19 infection, were included; those with incomplete data were excluded. Additionally, patients with a history of continuous use of non-steroidal anti-inflammatory drugs or uncontrolled systemic diseases were excluded from the study. The researchers ensured that all participants' information would remain confidential.
A checklist was designed for this study to evaluate patient information. The checklist consisted of two parts: the first part collected demographic information, medical history, and details about drug, tobacco, and cigarette usage; the second part gathered information on the history and frequency of COVID-19 infections, hospitalization history, duration of illness, types and quantities of drugs used during the illness, and the time elapsed since recovery.
To diagnose AO, patients experiencing severe and progressive pain along with halitosis and a bad taste

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in the mouth were clinically examined by the surgeon. The surgeon assessed the tooth socket for the presence or absence of a blood clot and for local lymphadenitis, which sometimes occurs with AO. The prevalence of dry socket was expressed as a percentage, and the patients' ages were reported as the mean and standard deviation. The Chi-square test was used to evaluate the relationship between COVID-19 and the incidence of dry socket, utilizing SPSS software ver. 23 (IBM Corp., Armonk, NY, USA) with a confidence interval of 95%. A significance level of under 0.05 was considered for the statistical tests. A mosaic chart was generated using RStudio (GNU, GPLv3).

RESULTS

Overall, 119 patients participated in this research, including 82 women (68.9%) and 37 men (31.1%), with an age range of 11 to 85 yr and an average age of 43.00 ± 15.33 yr. Among these patients, 59 (49.6%) experienced dry socket. Additionally, 53 patients (44.5%) had at least one type of systemic disease, with hypertension being the most common (37.5%), followed by diabetes (29.2%) and anemia (12.5%). Notably, 116 patients (97.5%) had received a COVID-19 vaccine.

The youngest patient was 17 yr old, and the oldest was 85 yr old. The mean age of patients with dry socket was 43.40 ± 16.46 yr, while the mean age of those without dry socket was 42.59 ± 14.22 yr; this difference was not statistically significant (P=0.775) (Table 1). Additionally, there was no significant relationship between dry socket and age grouping (P=0.653).

Table 1: Dry socket distribution based on patient parameters

Parameter	No Dry Socket (n, %)	Dry Socket (n, %)	Total (n, %)	Significance
Mean Age (years)	43.40 (SD=16.46)	42.59 (SD=14.22)	-	T=0.29, P=0.775
Age Group				
≤40	24 (40.0%)	26 (44.1%)	50 (42.0%)	χ^2=0.20, P=0.653
>40	36 (60.0%)	33 (55.9%)	69 (58.0%)	
Gender				
Female	38 (63.3%)	44 (74.6%)	82 (68.9%)	χ^2=3.89, P=0.049*
Male	22 (36.7%)	15 (25.4%)	37 (31.1%)	
Oral Contraceptive Pill Intake				
No	54 (90.0%)	30 (50.8%)	84 (70.6%)	χ^2=21.96, P<0.001*
Yes	6 (10.0%)	29 (49.2%)	35 (29.4%)	
Corticosteroid Intake				
No	56 (93.3%)	49 (83.1%)	105 (88.2%)	χ^2=12.44, P<0.001*
Yes	4 (6.7%)	10 (16.9%)	14 (11.8%)	
History of Hospitalization				
Have	13 (21.7%)	26 (44.1%)	39 (32.8%)	χ^2=6.77, P=0.009*
Have not	47 (78.3%)	33 (55.9%)	80 (67.2%)	
Smoking				
No	49 (81.7%)	39 (66.1%)	88 (73.9%)	χ^2=6.22, P=0.013*
Yes	11 (18.3%)	20 (33.9%)	31 (26.1%)	
COVID-19				
No	1 (1.7%)	6 (10.2%)	7 (5.9%)	P=0.061
Yes	59 (98.3%)	53 (89.8%)	112 (94.1%)	
Systemic Disorder				
No	31 (51.7%)	35 (59.3%)	66 (55.5%)	χ^2=0.71, P=0.401
Yes	29 (48.3%)	24 (40.7%)	53 (44.5%)	
History of Systemic Diseases				
<5	2 (6.9%)	1 (4.2%)	3 (5.7%)	P=0.674
5 to 9	8 (27.6%)	10 (41.7%)	18 (34.0%)	
10 to 19	15 (51.7%)	9 (37.5%)	24 (45.3%)	
>20	4 (13.8%)	4 (16.7%)	8 (15.1%)	

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There were significant differences in the incidence of dry socket based on gender, oral contraceptive use, corticosteroid intake, smoking, and hospitalizations. Women, oral contraceptive users, corticosteroid users, smokers, and those hospitalized due to COVID-19 had a higher incidence of dry socket compared to their counterparts ($P<0.05$). However, there was no significant difference in the incidence of dry socket with respect to COVID-19 infection, systemic diseases, or the history of systemic diseases. The incidence of dry socket was higher in women (74.6%) compared to men (25.4%), and this difference was statistically significant ($P=0.049$). Among patients with dry socket, 89.8% had been infected with COVID-19, compared to 98.3% of patients without dry socket; this difference was not statistically significant ($P=0.061$). Most patients with dry socket (97.5%) were vaccinated against COVID-19, yet there was no significant association between COVID-19 vaccination and dry socket (Figure 1).

The most frequently used medications for systemic diseases were losartan (33.3%) and metformin (29.2%), followed by folic acid and levothyroxine. There was no significant relationship between the type of medication used for systemic diseases and the incidence of dry socket ($P=0.428$).

DISCUSSION

The etiology of dry socket is multifactorial, with several identified risk factors including surgical trauma, pre-existing infection, and patient habits such as smoking. However, the impact of COVID-19 and its associated factors on the development of dry socket has not been extensively explored until recently[19].

Histological and electron microscopic examinations of individuals who died from COVID-19 have shown accumulation of viral components and inflammatory cells[12]. This suggests a systemic inflammatory response due to SARS-CoV-2 infection of blood vessel cells, leading to severe local inflammation. Some studies compare these symptoms to a cytokine storm, which can cause disseminated intravascular coagulation, a condition observed in critically ill COVID-19 patients[20]. Elevated D-dimer levels are commonly found in patients with severe COVID-19. The COVID-19 pandemic has posed significant challenges to healthcare, including the management of routine dental procedures[21]. Patients with a history of COVID-19 infection, hospitalization, and related treatments may be at increased risk of developing dry socket due to the systemic effects of the disease and associated medications[22].

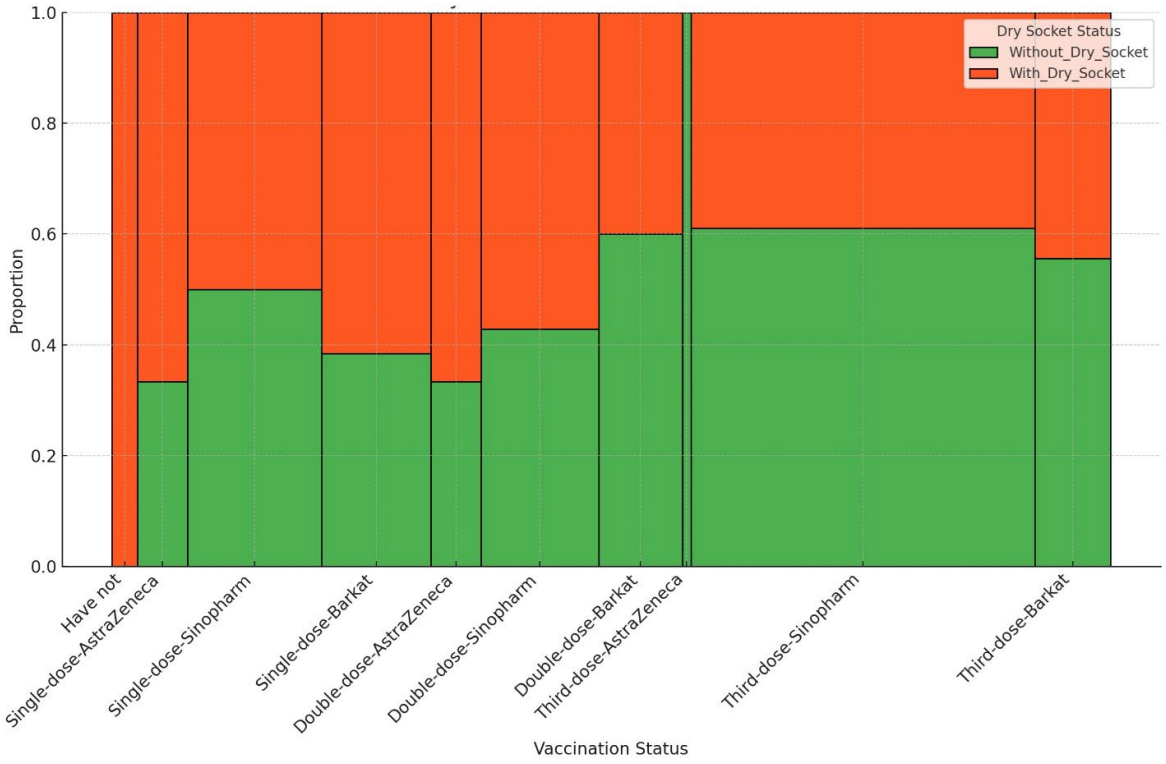

Figure 1: Dry socket distribution based on vaccination status

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Understanding the prevalence and risk factors associated with dry socket in COVID-19 patients is crucial for optimizing patient care and minimizing postoperative complications.

Eshghpour and Nejat [23] reported a dry socket prevalence of 14.19%, whereas our study reported a prevalence of 49.6%. Dry socket was a common postoperative complication in COVID-19 patients, noting an increase in dry socket cases during lockdowns, potentially due to increased patient anxiety and tampering with the surgical site [24].

The high prevalence of dry socket among patients with a history of COVID-19 infection (94.1%) and hospitalization due to COVID-19 (32.7%) suggests that the systemic effects of the disease may disrupt the normal healing process. The inflammatory response triggered by COVID-19 and potential immune function alterations may impair clot formation and stabilization, increasing the risk of dry socket. This finding is supported by recent literature, including a study which reported a significantly higher incidence of dry socket among patients recovered from COVID-19 compared to those without a history of the disease[2].

Moreover, Al Mahalawy et al. [25] found a higher incidence of dry socket among patients who required hospitalization for COVID-19 treatment, indicating that the severity of the illness and associated treatments may compound the impact on the healing process.

While the study did not specifically address the potential impact of COVID-19 vaccination on dry socket development, the majority of patients (97.5%) had received the COVID-19 vaccine. Although vaccination is crucial for protecting against severe illness, the immune response elicited by the vaccine may influence the healing process in some individuals. Further research is needed to evaluate the potential influence of different vaccine types and the timing of vaccination on wound healing.

The significant association between corticosteroid use and dry socket development (19.3%) aligns with existing literature suggesting that corticosteroids can impair wound healing and increase the risk of postoperative complications[25]. Recent studies on COVID-19 recovered patients have shown an increased risk of developing osteonecrosis with glucocorticoid use[3,26].

The association between oral contraceptive use and dry socket development (29.4%) is consistent with previous findings, as oral contraceptives can alter the coagulation cascade and potentially contribute to inadequate clot formation[1,27,28]. The incidence of dry socket in oral contraceptive users increases during the first 1-22 d of tablet consumption, while it significantly decreases during the last 23-28 d when the tablets are not consumed[29].

Smokers showed a higher incidence of dry socket compared to former smokers and non-smokers[2]. There were minimal differences between never smokers and former smokers. Larsen identified smoking as one of the most significant factors related to dry socket[30]. In contrast, Nishanth et al. [31] found no significant difference between smokers and non-smokers in developing dry socket, possibly due to inappropriate data collection methodology and a small number of smokers in their study.

Although our study did not find a statistically significant difference in age between patients who developed dry socket and those who did not, some previous studies have reported an increased risk of dry socket in older patients [23,28,31].

Future research should investigate the underlying mechanisms and long-term effects of COVID-19 on postoperative healing, as well as the potential impact of emerging variants, COVID-19 vaccination, surgical techniques, and patient-related factors such as gender and age.

CONCLUSION

The findings of this study underscore the necessity for enhanced preventive measures and postoperative care for patients with risk factors such as COVID-19 infection and hospitalization, corticosteroid use, oral contraceptive use, and smoking. Clinicians should adopt comprehensive pre-operative assessments, provide thorough patient education, and tailor postoperative management strategies to reduce the risk of dry socket and improve healing outcomes.

ETHICAL APPROVAL

The study was conducted after receiving approval from the Research Ethics Committee of Mashhad University of Medical Sciences, Mashhad, Iran with the registered code IR.MUMS.DENTISTRY.REC.1401.125.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interests.

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