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Frequency of Alveolar Osteitis (Dry Socket) in Smokers after Mandibular Molar Extraction

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ABSTRACT

Alveolar osteitis (AO) is the infection of the alveolar bone of the maxilla or mandible. Alveolar osteitis is a frequent and delayed complication, causing extreme pain with disruption in social life, sleep and work. **Objectives:** To determine the smoking status and prevalence of dry socket in patients undergoing mandibular molar extraction. **Methods:** A prospective observational cohort study was undertaken in the Department of Oral and Maxillofacial Surgery at LUMHS, Jamshoro, Pakistan. Data acquisition was completed over a duration of six months using a non-probability convenience sampling strategy. Statistical evaluation was conducted through SPSS software version 26.0. The Chi-square test was utilized to determine associations between variables, with a p-value of less than 0.050 regarded as statistically significant. **Results:** Patients were 32.91 ± 8.61 years old on average. There were 59.6% male and 40.94% female. The frequency of dry socket in patients presenting for mandibular molar extraction at 7 days was 10.4% (31/298). The rate of dry socket was significantly high in smokers (61.1%) and ex-smokers (80%) cases compared to non-smokers (0.4%) patients. **Conclusions:** In individuals having their mandibular molars extracted, there was a significant correlation between smoking status and the occurrence of dry socket (p=0.001). These results highlight how important quitting smoking is for lowering the chance of this excruciating side effect and enhancing recovery after surgery.

INTRODUCTION

The inflammation of the bone in the alveolar region, or the alveolar process of the maxilla or mandible, is designated as alveolar osteitis, or dry socket [1]. Typically, it happens after exodontia. Extreme pain, poor healing, foul-tasting, inflammation, and a disrupted clot that leaves the socket unfilled are the hallmarks of this post-extraction problem [2]. This moderate to severe pain might spread to other areas of the head, including the neck, temple, eye, and ear. Usually beginning on the second or fourth day following the extraction, the pain might linger for 10 to 14 days [3]. Numerous preventive strategies have been developed as a result of recent developments in the pathophysiology of dry sockets. For example, using antimicrobials such as chlorhexidine has become a viable method of reducing the incidence of dry sockets. It functions by inhibiting bacterial development during extraction, which lessens the risk of infection and the blood clot's eventual disintegration [4]. Immunosuppression and diabetes are typical systemic

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illnesses that have been linked to an increased risk of postoperative sequelae like dry socket. Often, the etiology of dry socket is not clearly understood but seems to be multifactorial. Such factors include use of oral contraceptives, smoking, traumatic extractions, poor oral hygiene, and excessive local anesthetic vasoconstrictor use [5]. The routine procedure performed by oral and maxillofacial surgeons, involving a lot of post-operative complications, is the surgical removal of the impacted lower third molar. The most common signs and symptoms of complications are pain, swelling and trismus, which are affected to a certain degree by the severity of many factors and variables [6]. The body reacts by forming a blood clot in the alveolar socket immediately after tooth extraction. Studies have shown that smoking slows the healing of wounds, influences bone remodeling and impairs the reaction to healing [7]. A comprehensive systematic review published in 2022 that analyzed eleven studies meeting inclusion criteria found that tobacco smokers had a more than three-fold increase in the odds of developing dry socket compared to non-smokers (OR>3.0) [8]. The combined incidence of AO was approximately 13.2% in smokers compared to only 3.8% in non-smokers, indicating that smoking substantially elevates the risk of this painful complication [9]. In another study, smokers had a dry socket incidence of 12%, versus 4% in non-smokers [10]. Another study in Chile highlighted that tobacco smoking after extraction increased the odds of dry socket with an odds ratio of 3.5 (95% CI: 1.3–9.0) [11]. A cross-sectional observational study in Northern Saudi Arabia found 62.6% of dry socket cases occurred in cigarette smokers. The overall incidence of alveolar osteitis in their sample was 15.7%, suggesting a substantial association [12]. A study conducted at Peshawar, Pakistan, reports that among 356 patients, 89 (25.0%) patients had dry socket [13]. Tobacco contains cotinine, hydrogen cyanide, carbon monoxide, and nicotine, all of which are cytotoxic to different types of cells and prevent wounds from healing. Nicotine, which is the primary component of tobacco smoke, makes platelets stickier, raising the risk of tissue ischaemia and thrombotic microvascular occlusion. Moreover, it prevents macrophage and fibroblast growth [14].

Alveolar osteitis (dry socket) is one of the most common and painful complications following tooth extraction, particularly after mandibular molar removal. Several risk factors such as smoking, poor oral hygiene, and traumatic extraction have been reported; however, the magnitude of this association varies across different populations. Despite the high prevalence of smoking in many regions, limited local evidence is available regarding the frequency of dry socket among smokers compared with non-smokers following mandibular molar extraction. Therefore, further investigation is required to better understand this relationship and guide preventive strategies in clinical practice. Identifying the gaps in the literature in this domain showed that the frequency of alveolar osteitis in smokers vs. non-smokers after mandibular molar extraction is crucial for guiding future research and improving patient outcomes. Recognizing the connection between dry socket among smokers and non-smokers is essential for crafting comprehensive treatment plans for individuals undergoing dental extractions. This study aimed to determine the smoking status and prevalence of dry socket in patients undergoing mandibular molar extraction.

METHODS

A prospective observational cohort study was conducted at the Department of Oral and Maxillofacial Surgery of Liaquat University of Medical and Health Sciences (LUMHS), Jamshoro. Data were collected from October 19, 2022, to April 18, 2023, using a non-probability consecutive sampling method. The Research Ethics Committee granted ethical permission for the project (Reference No LUMHS/REC/165). All participating patients provided written informed consent before being included in the study. Calculation of Sample size was done by the Raosoft sample size calculator, taking the proportion of dry socket in 20% [15], 98% confidence interval, level of significance 6% and 4% was added as non-responses and unfilled questionnaires, so the calculated sample size was 298. The term smoker in this study indicates the person who has been a smoker of cigarettes for the last three years, a non-smoker identifies the person who has never smoked in the past 10 years, and an ex-smoker shows the person who has quit smoking in 1 past year. Patients between the ages of 20 and 60, those having their mandibular molar extracted, and healthy individuals not on medication were included in the study. Patients who were allergic to local anaesthetics at the time of procedure, antibiotics, pregnant women, patients with cardiovascular disease, or patients with any systemic disease or systemic pathology were excluded from the study. Patients' demographic information, including age and gender, was collected on a proforma. On preoperative assessment, they were asked about smoking status (smoking status indicates persons who were using cigarettes only). Smoking status was classified based on the smoke duration mentioned above in the paragraph. Smokers were operated under local anesthesia by the principal investigator. After the extraction surgical site was irrigated with normal saline using a conventional syringe, and pressure gauze was placed. The diagnosis of dry socket (alveolar osteitis) was primarily based on clinical criteria including the presence of intense postoperative pain that increased after the third day following extraction,

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exposed alveolar bone within the socket, and absence of suppuration A periapical radiograph was taken after extraction if conditions like a root left behind post-extraction, any chance of periapical lesion, a soft tissue lesion, food stagnation or any clinical symptoms associated with these conditions were examined and patients were evaluated in terms of pain and healing through visual analogue scale VAS [15] healing index, halitosis and erythema on 1st 4th and 7th postoperative day. Healing Scale, halitosis scale and erythema scales were used to assess the dry socket. The healing index in the context of a dry socket (alveolar osteitis) refers to a clinical tool used to evaluate the progress of healing after a tooth extraction, particularly when complications like dry socket occur. Clinical uses of a Healing Index in Dry Socket indicate monitoring recovery after treatment, evaluating treatment efficacy, assessing Pain Reduction over time, documenting healing progress in clinical notes, and guiding decisions for re-treatment or follow-up. Halitosis was noted as present or absent. Patients with dry socket often present with foul odor from the mouth and bad taste, due to tissue breakdown and bacterial colonization in the exposed socket. This makes halitosis a supporting symptom for diagnosing dry socket. Although not quantified formally, more pronounced halitosis could reflect more extensive tissue necrosis or infection, possibly indicating a more severe or advanced socket condition. The erythema scale measures redness around the socket, indicating inflammation. Erythema scale was assessed by visual inspection and by the palpation method, and its grading demonstrates grade 0 for no ulceration and grade 4 indicates hemorrhage, ulceration and necrosis of tissue. SPSS version 26.0 was used to input and analyze the data. Age and pain score were among the quantitative variables that were displayed as the standard deviation and mean. The qualitative information was displayed as frequency and percentages for the following conditions: erythema, dry socket, halitosis, smoking status, gender, occupation, and healing index. The relationship between a dry socket and smoking history was examined using the chi-square test. The p-values<0.050 were considered significant.

RESULTS

Results demonstrate demographic characteristics of patients, where the Mean ± SD of age was 32.91 ± 8.61 years. The gender breakdown showed that 176 people (59.06%) of the total were male and 122 people (40.94%) were female. On the seventh day, the mean ± standard deviation of the visual analogue pain score was 1.55 ± 1.61, and the median was 1.00 (Table 1).

Table 1: Demographic Information of Patients

Variables	Mean ± SD
Age	32.91 ± 8.61 Years
Gender	
Male	176 (59.06%)
Female	122 (40.94%)

The terms of smoking status and dry socket association show that 252 patients (84.66%) were non-smokers, 36 patients (12.08%) were smokers, and 10 patients (3.36%) were previous smokers (who had left smoking for 1 year), and a significant association was documented (p-value=0.001). The rate of dry socket was significantly high in smokers (61.1%) and ex-smokers (80%) cases compared to non-smokers (0.4%) patients (Figure 1).

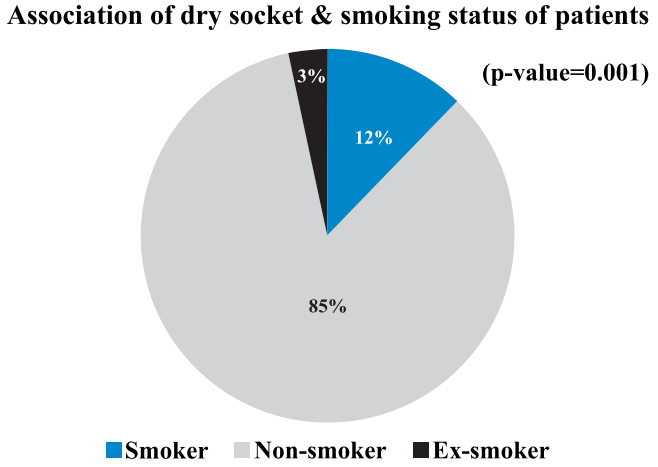

Figure 1: Smoking Status of Patients

Assessment of healing index, halitosis and erythema with respect to time was reported. The stratification analysis revealed a strong correlation between the rate of dry socket and the healing index (p-value=0.012) and a substantial correlation between gender, halitosis, and erythema (p-value=0.001) (Table 2).

Table 2: Assessment of Healing Index, Halitosis and Erythema with Respect to Time

Variables		1st Day n (%)	4th Day n (%)	7th Day n (%)	p-Value
Healing Index	Very Poor	1 (0.3%)	0 (0%)	0 (0%)	0.001
	Poor	80 (26.8%)	22 (7.4%)	28 (9.4%)	
	Good	124 (41.6%)	183 (61.4%)	6 (2%)	
	Very Good	93 (31.2%)	93 (31.2%)	40 (13.4%)	
	Excellent	0 (0%)	0 (0%)	224 (75.2%)	
Halitosis	Yes	6 (2%)	60 (20.1%)	23 (7.7%)	0.001
	No	292 (98%)	238 (79.9%)	275 (92.3%)	
Erythema	Yes	7 (2.3%)	43 (14.4%)	25 (8.4%)	0.001
	No	291 (97.7%)	255 (85.6%)	273 (91.6%)	

Association between dry socket and smoking status in patients with mandibular molar extraction stratified by age groups and gender, and a slightly significant association for

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age groups and female gender (p-value=0.019) and for male gender (p-value=0.001) (Table 3).

Table 3: Association of Dry Socket Stratified by Age Groups and Gender

Variables		AO-Dry socket		p-Value
		Yes, n (%)	No, n (%)	
Age Groups (Years)	20-25	14 (17.1%)	68 (82.9%)	0.019
	26-35	5 (4.2%)	115 (95.8%)	
	36-45	8 (11.1%)	64 (88.9%)	
	46-60	4 (16.7%)	20 (83.3%)	
Gender	Male	28 (15.9%)	148 (84.1%)	0.001
	Female	3 (2.5%)	119 (97.5%)	0.019

DISCUSSION

The participants in our study were 32.91 ± 8.61 years old on average. The cohort comprised 59.6% male and 40.94% female. Analysis of smoking habits revealed that 84.66% of individuals were non-smokers, 15.4% were current smokers, and 3.36% were former smokers. Our study concludes 10.4% of dry sockets in extracted teeth. Similarly, Sharma *et al.* evaluated 580 patients, among whom 230 were male and 350 were female, identifying dry socket in 5.1% of extracted teeth [16]. In a study by Singh *et al.* among 86 patients (46 male and 40 female), dry socket developed in 5 male and 4 female [17]. Chhabra *et al.* documented 293 third molar extractions in patients aged 18 to 45 years, reporting a dry socket incidence of 4.09% (12 cases out of 178 extractions) [18]. A higher prevalence was observed among smokers (8 cases) compared to non-smokers (4 cases). There was no discernible gender bias in the majority of dry socket cases, which were linked to the excision of mandibular third molars. Interestingly, smokers had a greater incidence after having their mandibular third molars surgically extracted. Their study reported a 10.4% dry socket incidence at 7 days' post-extraction. Current research showed a statistically significant correlation (p=0.001) involving cigarette consumption and the occurrence of dry socket after mandible molar removal. That result is critical for patient management and reinforces the necessity of preoperative education regarding potential post-extraction complications. Nusair YM and Younis MH reported 42% female participants and 58% male participants [19]. The mean age of their patients was 35.4 ± 14.95 years, with a range of 10 to 73 years. Additionally, they reported that smokers had a much greater frequency of dry socket (12%) than non-smokers (4%), and that there was a significant correlation between the prevalence of dry socket and the amount of tobacco used (p=0.002), which is in line with the findings of our study. Our study further highlighted that smokers exhibited a dry socket rate of 61.1%, while ex-smokers demonstrated an even higher rate of 80%, compared to a mere 0.4% among non-smokers. These findings strongly reaffirm the established link between tobacco use and increased risk of alveolar osteitis following molar extraction. A prior study that included 4000 removed through surgery third molars found that those who smoked half a pack of cigarettes per day had a four to five times higher incidence of alveolar osteitis (12%) than those who did not smoke (2.6%). Furthermore, the risk increased to more than 20% for patients who smoked a full pack every day and to as much as 40% for those who smoked the day of surgery [20]. Whether this elevated risk is attributable to systemic influences or direct local effects such as thermal injury or suction-induced disturbance at the extraction site remains to be fully elucidated [20]. The notable difference in the prevalence of dry socket between those who smoke and people who do not smoke, however, highlights the substantial influence of smoking on the healing process. Several mechanisms may explain this association. Firstly, toxic substances in tobacco smoke, including nicotine and various chemical agents, impair vascularization and tissue repair, both of which are essential for optimal socket healing. Smoking disrupts blood clot formation and hampers oxygen and nutrient delivery to the healing tissues, contributing to the development of dry socket [21, 22]. Apart from smoking, Nilesh and Pisal and Åström *et al.* found that female patients who used oral contraceptives had almost double the risk (16.66%) of alveolar osteitis as compared to both male and non-contraceptive female patients [23, 24]. The combined results of these studies highlight how crucial it is to put smoking cessation programs into place to reduce the likelihood of postoperative problems like dry socket as well as to enhance general health. Oral health practitioners should actively educate patients on the detrimental impact of smoking on surgical outcomes and provide necessary support for cessation. It is particularly vital to counsel patients who are active or former smokers about their heightened risk and encourage them to quit smoking before undergoing molar extractions or other invasive dental procedures.

This study has certain limitations that should be considered while interpreting the findings. The research was conducted at a single institution using a convenience sampling technique, which may limit the generalizability of the results to the broader population. In addition, other potential risk factors such as oral hygiene practices, extraction difficulty, and postoperative patient compliance were not extensively evaluated. Future multicenter studies with larger sample sizes and consideration of additional clinical variables are recommended to better understand the multifactorial causes of alveolar osteitis and improve preventive and management strategies.

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CONCLUSIONS

Our study finds a substantial correlation (p-value=0.001) between smoking status and the occurrence of dry socket in patients undergoing extraction of their mandibular molars. Dry sockets can be less common with appropriate prevention and control strategies, improving overall oral health and results.

Authors' Contribution

Conceptualization: ZK, MAS
Methodology: ZK, BL, NZ, RK
Formal analysis: ZK
Writing and Drafting: SM, AK, NZ, RK
Review and Editing: SM, AK, NZ, RK, ZK, BL, MAS

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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