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Ten-Year Retrospective Analysis of the Prevalence of Alveolar Osteitis Following Surgical Extraction of Mandibular Third Molars

Alexey Gurin, DDS, PhD, DMS[a], Patrick Angelo Lim, DMD[a], Mahmoud Mahdavian, DDS[a], Adeyemi Falegan, DDS, BDS, MDR[a], Carlos Moretta, DDS[b], Udochukwu Oyoyo, MPH[c], and So Ran Kwon, DDS, MS, PhD, MS[a]

[a]Division of General Dentistry, Loma Linda University School of Dentistry, Loma Linda, CA, USA; [b]Department of Oral and Maxillofacial Surgery, School of Dentistry, Loma Linda University, Loma Linda, CA, USA; [c]Dental Educational Services, School of Dentistry, Loma Linda University, Loma Linda, CA, USA

ABSTRACT

Background: This retrospective study investigated the prevalence and risk factors of alveolar osteitis (AO) following mandibular third molar extractions at Loma Linda University School of Dentistry (2013–2024).

Materials and Methods: Patient records were analyzed for AO associations with pericoronitis, hypertension, diabetes mellitus, smoking, and oral contraceptive use. Extractions were categorized by impaction type: complete bony (CBIT), partial bony (PBIT), soft tissue (STIT), or erupted (EMT). Statistical analysis employed binomial logistic regression and ANOVA with Tukey post-hoc tests.

Results: Among 3,999 patients, AO prevalence was 5.1%. Pericoronitis history significantly increased AO risk in PBIT cases ($p < 0.01$). Hypertension reduced AO risk for CBIT (OR 0.23) and PBIT (OR 0.22), as did diabetes (CBIT: OR 0.20; PBIT: OR 0.05). Smokers 33–52 years had elevated AO risk (OR 3.00).

Conclusion: Preoperative risk assessment should prioritize smokers and patients with pericoronitis history. Standardized documentation using ICD-10 coding and differential diagnosis of AO versus delayed healing is critical to improve prevention strategies.

Practical Implications: Clinicians should implement risk factor assessment during comprehensive or periodical oral examination (release or assumption of the risk) and proactive follow-up care for patients with a history of pericoronitis and smoking (33–52 age group).

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Alveolar osteitis; diabetes mellitus; dry socket; hypertension; risk factor; third molar extraction

Introduction

The surgical extraction of mandibular third molars (MTM) is one of the most frequently performed procedures in oral and maxillofacial surgery.[1] Indications for the removal of MTM are cases of acute recurrent or chronic pericoronitis[2,3]; orthodontic indications, such as changes to dental arch or anterior crowding; and prophylactic extractions, for example, before prosthetic treatment, so as to prevent the tooth from erupting under a denture.[4] Jaw cyst and third molar inclusion represent an indication for tooth extraction, too.[5,6] Despite being routine, these procedures carry a higher risk of complications compared to other dental extractions due to the complex anatomical relationships in the posterior mandible. The proximity to critical structures including cellular spaces, the inferior alveolar nerve, lingual nerve, and surrounding vasculature contributes to complication rates ranging from 3% to 30% in reported studies.[7]

Among postoperative complications, alveolar osteitis (AO) emerges as a particularly significant concern following MTM extractions.[8] This condition, commonly referred to as dry socket, presents with severe pain typically developing 2–4 days postoperatively while lacking the usual signs of infection such as purulence or systemic symptoms.[9] The etiology is not clear but may result from elevated levels of fibrinolytic activity in and around the extraction socket.[10] Different factors could influence AO, including age, gender, medical history, oral contraceptives, presence of pericoronitis, poor oral hygiene, smoking, type of impaction, relationship of MTM to the inferior alveolar nerve, surgical time and technique, surgeon experience, number of teeth extracted, use of perioperative antibiotics, use of topical antiseptics, use of intra-socket medications post-operatively, and anesthetic technique.[11,12]

Kostares and colleagues conducted a systematic review and meta-analysis of the prevalence of AO following the extraction of impacted MTM.[1] The study involved a comprehensive literature search and analysis of 28 studies, covering 41,859 extractions. The prevalence was 5.2% among studies conducted in Europe, 3.9% among studies conducted in Africa, and 6.7% among those conducted in America. Despite thorough analysis, no specific factors were identified as major contributors to this variability. The study emphasized the need for future, well-designed studies to better understand the causes of AO and improve management strategies for this common postoperative complication.

Therefore, the aim of the study was to provide a comprehensive retrospective analysis of AO prevalence

CONTACT So Ran Kwon sorankwon@llu.edu

following MTM extraction, with particular focus on identifying modifiable risk factors in patients treated at the Loma Linda University School of Dentistry (Loma Linda, CA, USA) in the years 2013 through 2024. We hypothesized that AO incidence following MTM extraction is significantly associated with pericoronitis, smoking, and systemic conditions (hypertension/diabetes), with variation across impaction types (complete/partial bony, soft tissue, and erupted).

Materials & Methods

Study Design & Research Compliance

This retrospective cohort study analyzed clinical records of patients who underwent MTM extractions at Loma Linda University School of Dentistry (Loma Linda, California, USA). The study was approved as a minimal risk study by the Institutional Review Board at Loma Linda University (IRB # 5240491).

Inclusion and Exclusion Criteria

The study included both fully erupted teeth and impacted teeth with varying levels of impaction, including soft tissue impaction, partial bony impaction, and complete bony impaction. Patient records from the Oral and Maxillofacial Department were included if they contained any of the following procedure codes performed between Jan. 1, 2013, and Oct. 1, 2024: D7210 (surgical removal of erupted tooth), D7220 (removal of impacted tooth-soft tissue), D7230 (removal of impacted tooth-partially bony), D7240 (removal of impacted tooth-completely bony), and D7241 (removal of impacted-surgical completely bony). Exclusion criteria comprised patients with decompensated systemic diseases, pregnant or lactating women, individuals undergoing bisphosphonate therapy, cases where extraction was performed concurrently with bilateral sagittal split osteotomy, and presence of dentigerous cysts associated with the MTM. These exclusion criteria were implemented to minimize confounding variables that could potentially influence postoperative outcomes.

Study Procedure & Variables

A total of 31,610 records were initially retrieved from the clinic administration, containing demographic data, procedure codes, and treatment dates. Following screening for MTM extractions, 3,999 eligible cases were identified and systematically compiled into a structured excel spreadsheet for analysis. Each record was manually reviewed by trained dental student researchers, with each reviewer assigned approximately 1,000 cases. Preoperative variables of interest included documented history of pericoronitis, smoking status, medical history (hypertension, diabetes), and oral contraceptive use. Surgical variables documented included impaction type. Postoperative outcomes were evaluated through follow-up clinical notes, with specific attention to pain severity (described qualitatively), clinical signs suggestive of AO (empty socket, exposed bone, food impaction), and management approaches. Notably, no cases were formally coded using ICD-10 (M27.3) for AO. However, 204 cases featured clinical descriptions consistent with AO, including key phrases such as "food impaction in socket" or explicit "dry socket" documentation (58/204). AO was defined as persistent, severe pain unresponsive to standard analgesics (ibuprofen, acetaminophen), occurring 3–5 days postoperatively, accompanied by an empty socket with exposed bone and/or food impaction, and without signs of infection such as purulence or systemic symptoms. Management typically involved socket irrigation with 0.12% chlorhexidine gluconate (Peridex) and, in select cases, placement of eugenol-based dressings. Therefore, risk factors analyzed for AO development included local factors (history of pericoronitis, impaction type), systemic conditions (hypertension, diabetes mellitus), and behavioral factors (smoking, oral contraceptive use).[8]

Data Analysis

Statistical analysis was performed using Jamovi 2.3.28 (Australia) and OriginPro 2024 software (Origin Inc., USA). For normally distributed variables, between-group comparisons were performed using ANOVA with Tukey's post-hoc test. Binomial logistic regression was used to assess associations between categorical risk factors and AO development.

Results

The study included 3,999 patients (2,056 women and 1,943 men) aged 13–72 years who underwent MTM extraction. Demographic characteristics are presented in Figure 1. The distribution of impaction types was as follows: 1,448 (41.67%) completely bony impacted (CBIT), 1,311 (30.88%) partially bony impacted (PBIT), 184 (4.41%) soft tissue impacted (STIT), and 1,056 (23.04%) erupted mandibular third molars (EMT) (Figure 2). The overall incidence of AO was 5.1% (204 cases), and the risk factor distribution across impaction types is illustrated in Figure 3 and Table 1.

Notably, no cases were formally coded as AO according to international classification of diseases (ICD-10: M27.3), though 58 cases were clinically documented as dry socket. Diagnosis was based on follow-up evaluations where patients reported persistent pain unresponsive to analgesics, accompanied by food impaction in the socket. Management consisted of socket irrigation with Peridex (chlorhexidine gluconate 0.12%) and, in select cases, placement of eugenol-based dressings.

Risk Factor Analysis

Binominal regression analysis showed that a history of pericoronitis was found to be a risk factor for PBIT group (OR 2.87, 95% CI 1.28–6.45, $p < 0.01$), with the EMT group as a reference. Smoking elevated AO risk in patients aged 33–52 years (OR 3.00, 95% CI 1.22–7.80, $p < 0.01$) compared to younger patients (13–32 years). According to results of our study, hypertension was associated with reduced AO risk for CBIT (OR 0.23, 95% CI 0.08–0.64, $p < 0.01$) and PBIT (OR 0.22, 95% CI 0.07–0.68, $p < 0.01$). Diabetes mellitus similarly showed protective effects for CBIT (OR 0.20, 95% CI 0.06–0.63, $p < 0.01$) and PBIT (OR 0.05, 95% CI 0.00–0.42, p

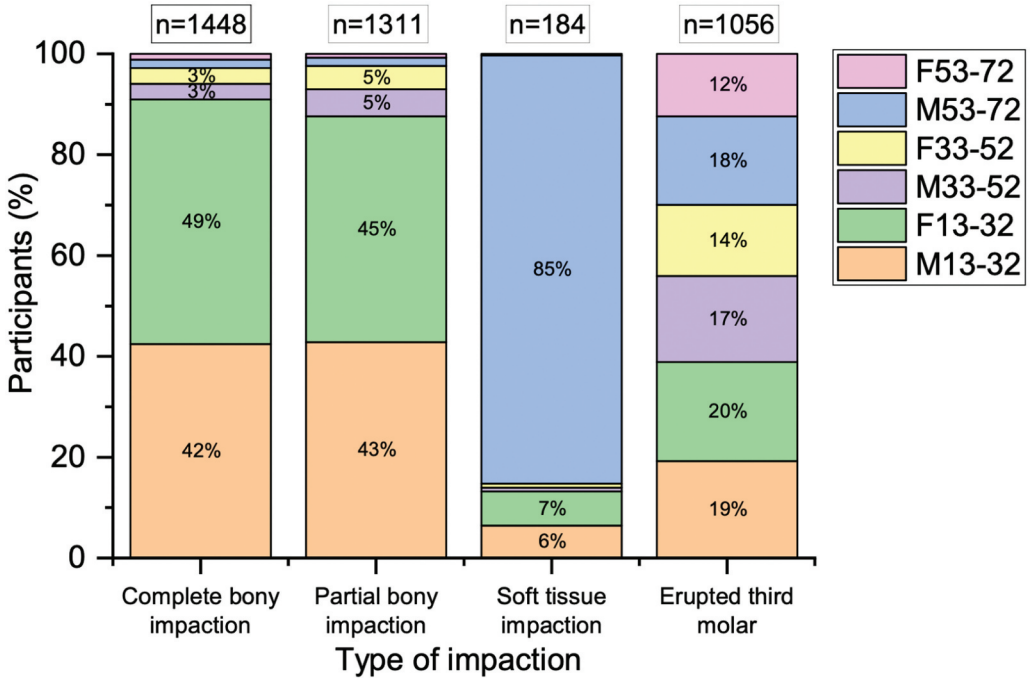

Figure 1. Demographic data of patients with MTM extractions.

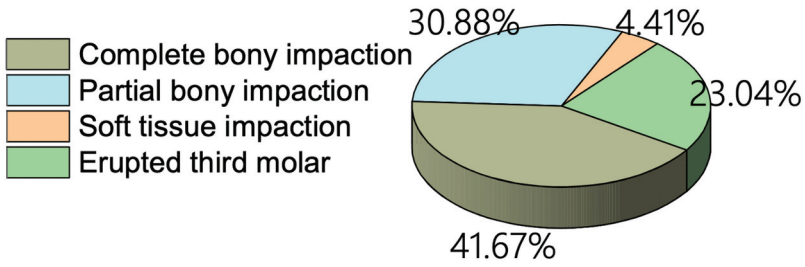

Figure 2. Distribution of the type of impaction of the lower third molar among patients with AO.

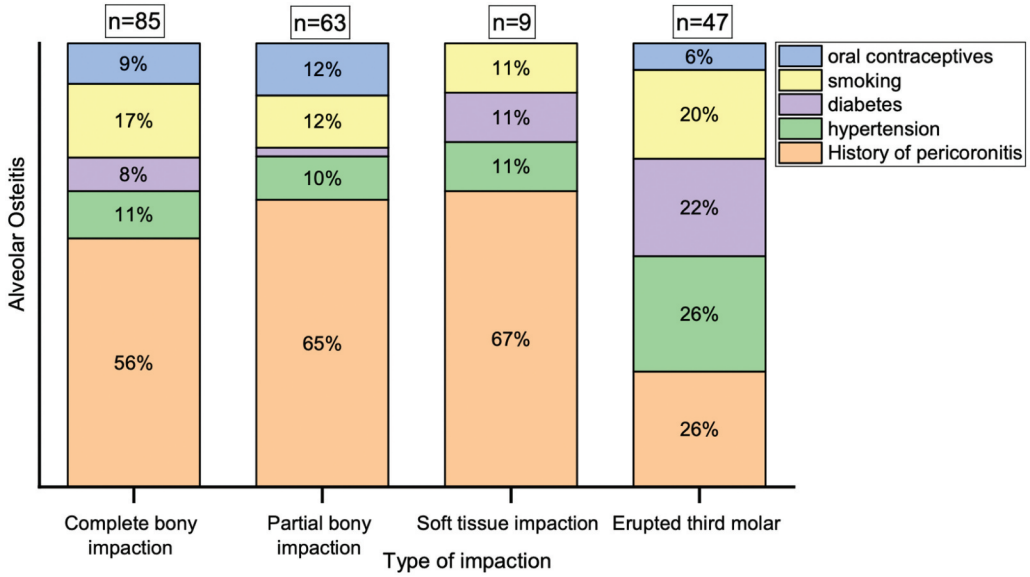

Figure 3. Distribution of risk factors in each group among patients with AO.

Table 1. Distribution of risk factors in each group among patients with AO ($N = 204$).

Type of impaction	History of pericoronitis	Smoking	Hypertension	Diabetes	Use of oral contraceptives
CBIT	37	11	7	5	6
PBIT	33	6	5	1	6
STIT	6	1	1	1	0
EMT	13	10	13	11	3

Note: CBIT: Complete Bony; PBIT: Partial Bony; STIT: Soft Tissue; EMT: Erupted.

< 0.01). ANOVA with Tukey's post-hoc analysis confirms these findings (Figures 4–7), revealing significant differences in pericoronitis history between EMT and PBIT ($p = 0.04$), protective effects of hypertension for CBIT ($p < 0.01$) and PBIT ($p = 0.01$) groups and diabetes mellitus in CBIT ($p < 0.01$) and PBIT ($p < 0.01$) cohorts.

Discussion

The overall incidence of AO in our study was 5.1%. A multicentered prospective observational study of Yamada S. et al. (2022) examines the prevalence and risk factors for postoperative complications following MTM extraction.[3] Conducted over six months in 2020, the study analyzed 1,826 lower third molar extractions across 20 institutions in Japan. The overall prevalence of postoperative complications was 10.0%. Tandon P. et al. analyzed the prevalence of AO and identifies associated risk factors following third molar extractions.[13] The study included 238 participants aged 18–40 years, with data collected over a 12-month follow-up period. Exclusion criteria included coagulopathies, pregnancy, vitamin deficiencies, and medications affecting healing. The results revealed that the prevalence of AO increased from 20.6% at 48 hours to 41.2% at two weeks post-extraction. The study by Kumo H. et al. demonstrated significant associations between AO and smoking ($p = 0.036$), diabetes ($p = 0.001$) and hypertension ($p = 0.001$).[14] The study of Halabi D. et al. assessed risk factors for AO through a prospective case-control analysis of 1,302 patients following dental extractions. Logistic regression identified traumatic extraction (OR = 13.1, 95% CI:5.4–31.7), tobacco use (OR = 3.5, 95% CI:1.3–9.0), and prior surgical site infection (OR = 3.3, 95% CI:1.4–7.7) as significant predictors of AO.[15]

In our study, smokers aged 33–52 years showed a significantly increased risk of AO (OR 3.00, 95% CI 1.22–7.80, $p < 0.01$). However, contrary to conventional risk expectations, hypertensive patients had a reduced risk of AO following the extraction of CBIT and PBIT groups (OR = 0.23 and 0.22, respectively). Similarly, diabetes was associated with a lower risk of AO in CBIT and PBIT groups (OR = 0.20 and 0.05, respectively). These findings conflict with those of Jallo L. et al., who reported that 29% of AO cases occurred in diabetic patients.[16]

The findings of this study both support and challenge our initial hypothesis regarding risk factors for alveolar osteitis (AO). While we confirmed significant associations between AO development and certain variables (particularly pericoronitis and smoking), other predicted relationships yielded unexpected results. The hypothesis that systemic conditions like hypertension and diabetes would increase AO risk was paradoxically contradicted by our data, which showed these conditions appeared protective – a finding that warrants further investigation through prospective studies.

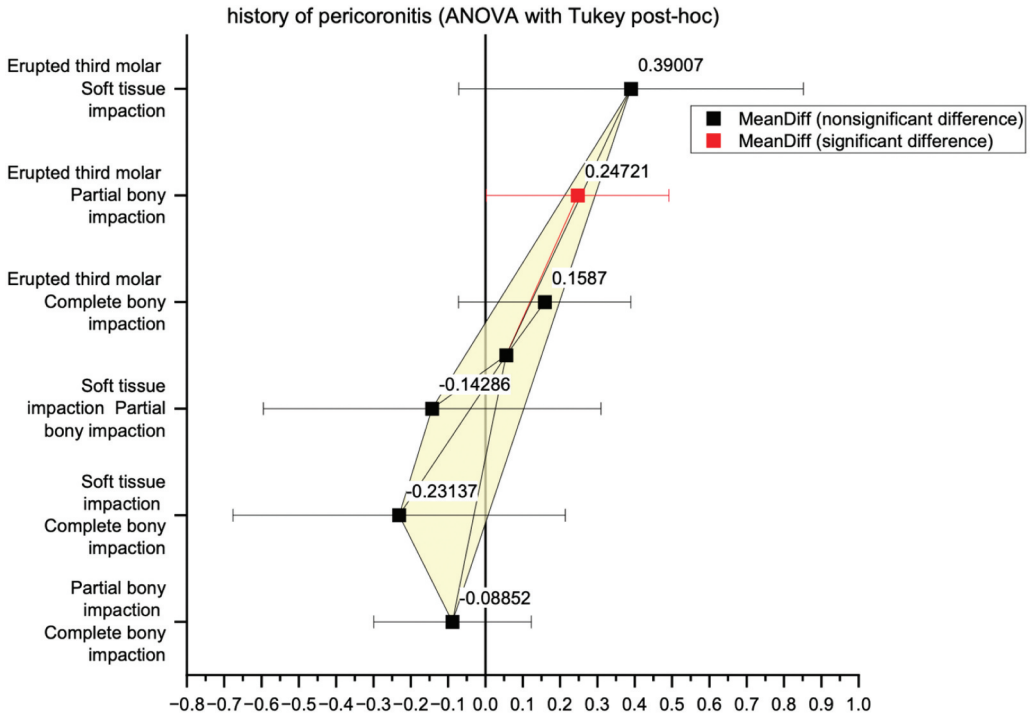

Figure 4. ANOVA with Tukey post-hoc analysis between groups (mean difference) using a history of pericoronitis as a criterion. Red color indicates statistically significant differences ($p < 0.05$).

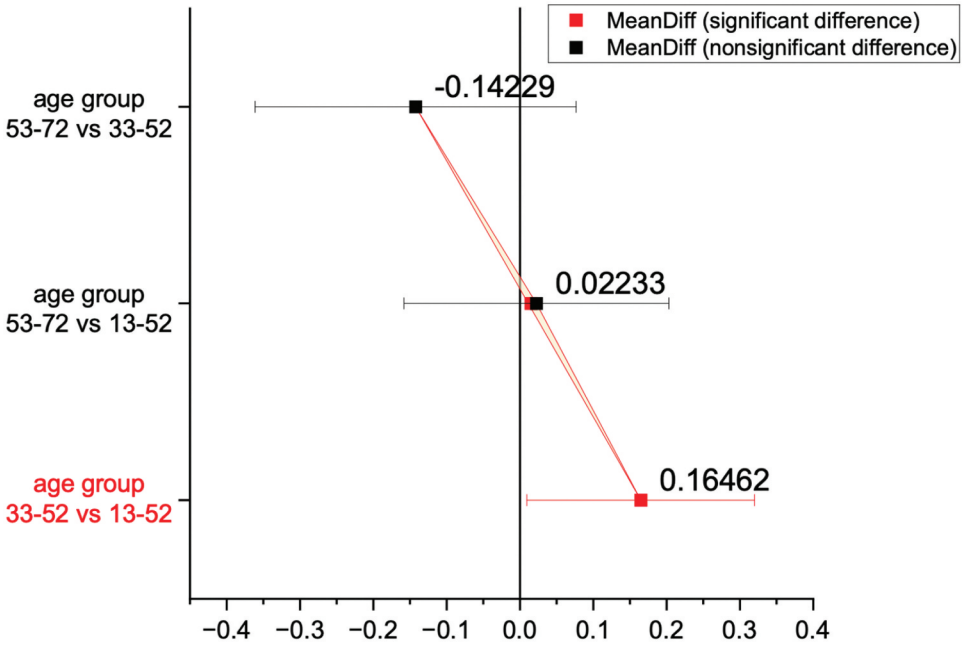

Figure 5. ANOVA with Tukey post-hoc analysis between groups (mean difference) using smoking as a criterion. Red color indicates statistically significant differences ($p < 0.05$).

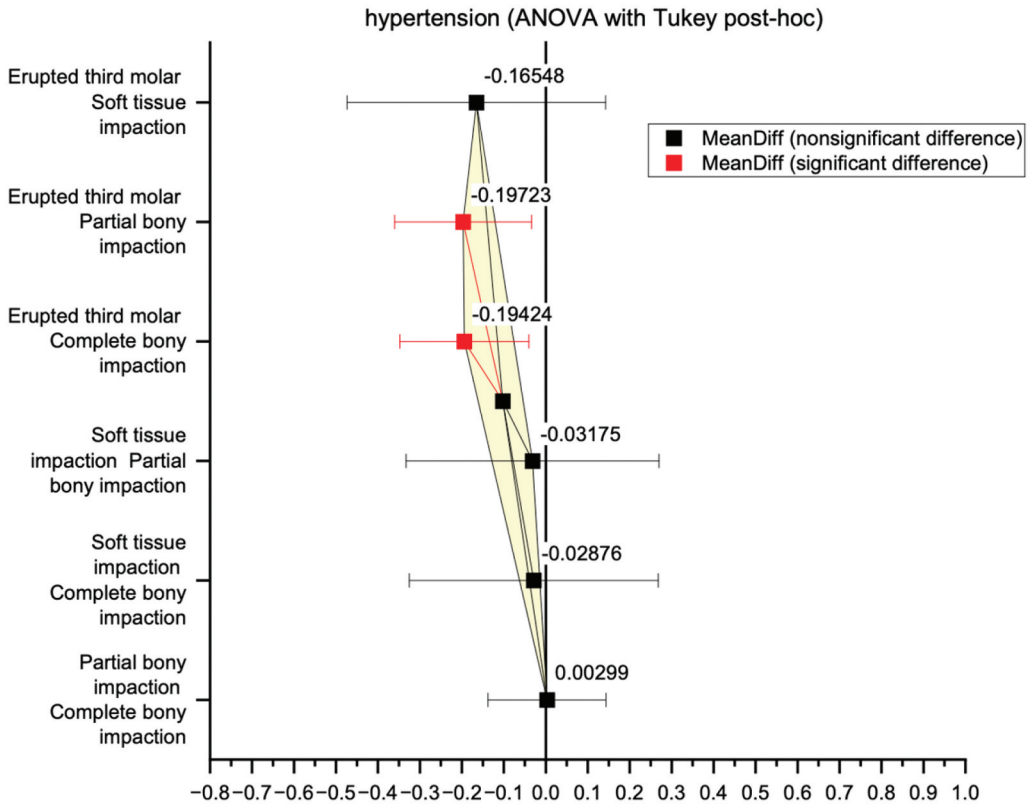

Figure 6. ANOVA with Tukey post-hoc analysis between groups (mean difference) using hypertension as a criterion. Red color indicates statistically significant differences ($p < 0.05$).

In our study, patients with a history of pericoronitis showed a higher likelihood of developing AO following extraction of partially bony impacted (OR 2.87). A high number of pathogens are accepted as risk factors in the progression of periodontal diseases. This is in correlation with a study by Oginni F. that found out of 942 patients,14.2% who were previously infected with pericoronitis developed dry socket compared to 6.6% of patients who were not previously infected with pericoronitis.[17]

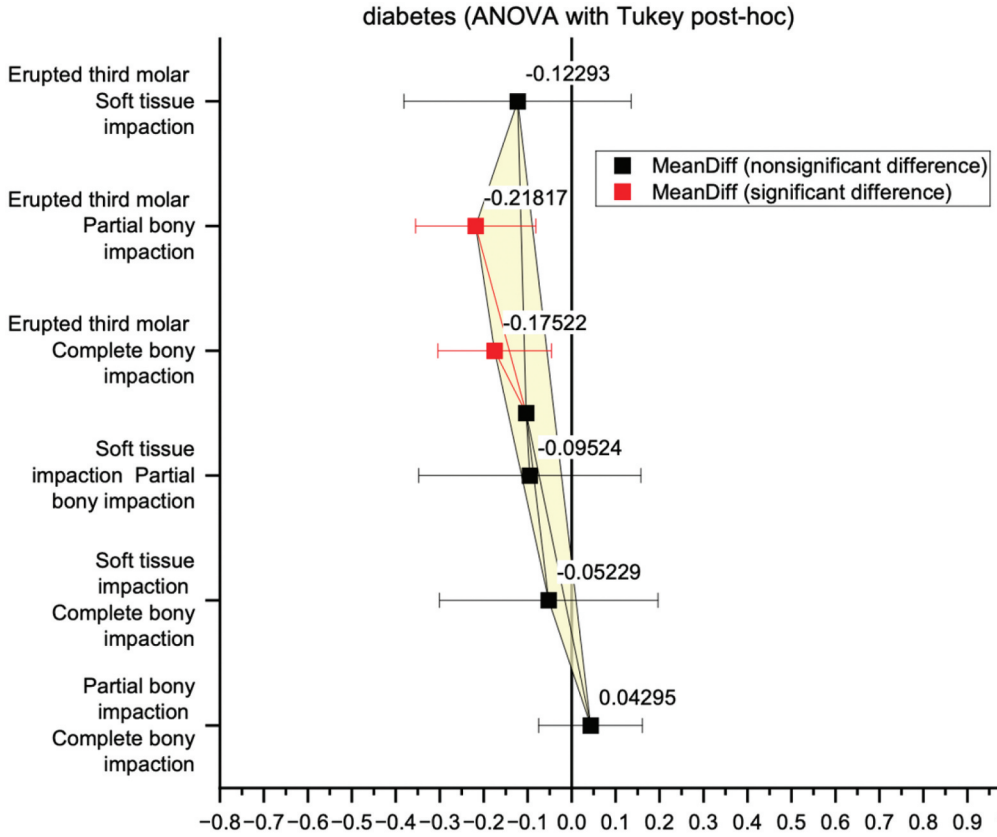

Figure 7. ANOVA with Tukey post-hoc analysis between groups (mean difference) using diabetes as a criterion. Red color indicates statistically significant differences ($p < 0.05$).

Sigron G. et al. determined that AO affected more females than males and was associated with previous pericoronitis.[18]

The lack of notes with differential diagnosis between dry socket, delayed healing, and international classification of diseases coding in the medical history highlights the need for improved documentation of post-operative care management. Levitin S. et al. analyzed electronic medical records and found that only 22% of cases contained code and appropriate notes of AO criteria.[19] Notably, 36.5% of cases presented with symptoms consistent with dry socket and received corresponding treatment, yet most lacked definitive documentation. This discrepancy suggests potential underreporting or misclassification of AO cases according to authors.

The reliance on subjective clinical phrases rather than standardized diagnostic criteria introduced significant variability in AO identification throughout our dataset. While we identified 204 cases exhibiting clinical symptoms consistent with AO, only 58 (28.4%) received explicit "dry socket" diagnoses, with the remainder documented through indirect descriptors like "food impaction." This diagnostic ambiguity likely reflects clinical uncertainty, as practitioners may hesitate to diagnose AO without definitive exposed bone despite characteristic pain symptoms. Such variability in diagnostic thresholds complicates both clinical management and research comparisons.

Conclusions

Our study highlights key risk factors for AO, supporting preoperative risk assessment particularly for smokers (aged 33–52) and patients with pericoronitis history. The unexpected protective association of hypertension/diabetes warrants validation through multi-centered studies. To improve tracking and management, standardized documentation should include ICD-10 coding for alveolar osteitis (M27.3) and electronic notes with an assessment section that differentiates alveolar osteitis from delayed healing. These findings can guide targeted prevention strategies and enhance postoperative care protocols.

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Disclosure Statement

No potential conflict of interest was reported by the author(s).

Notes on contributors

Alexey Gurin, DDS, PhD, DMS, is a senior dental student at Loma Linda University School of Dentistry.

Patrick Angelo Lim, DMD, is a senior dental student at Loma Linda University School of Dentistry.

Mahmoud Mahdavian, DDS, is a senior dental student at Loma Linda University School of Dentistry.

Adeyemi Falegan, DDS, BDS, MDR, is a senior dental student at Loma Linda University School of Dentistry.

Carlos Moretta, DDS, is an assistant professor at Loma Linda University School of Dentistry.

Udochukwu Oyoyo, MPH, is an assistant professor and statistician at Loma Linda University School of Dentistry.

So Ran Kwon, DDS, MS, PhD, MS, is a professor and director of the student research program at Loma Linda University School of Dentistry.

ORCID

Alexey Gurin http://orcid.org/0000-0002-2845-2434
So Ran Kwon http://orcid.org/0000-0002-7067-0603

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