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Does COVID-19 Affect Third Molar Surgery Complications?

—A Retrospective Cross-Sectional Study in Hospital Segamat of Southern Malaysia

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Abstract

Background: The surgical removal of impacted mandibular third molars is a routine oral and maxillofacial surgery frequently associated with a range of post-operative complications. The COVID-19 pandemic introduced significant disruptions to dental care, including delays in treatment and changes in clinical protocols. This study aimed to compare third molar surgeries conducted before and during the pandemic, focusing on patient characteristics, surgical factors, and post-operative complications. **Methods:** A retrospective cross-sectional study was conducted involving 253 patients who underwent mandibular third molar surgery under local anesthesia at the Oral and Maxillofacial Surgery Department of Hospital Segamat, Malaysia, between 2018 and 2021. Of these, 100 patients underwent surgery before the pandemic (2018-2019), and 153 during the pandemic period (2020-2021). **Results:** Most patients were young adults, and 31% were female. A significantly higher proportion of female patients received surgery during the pandemic ($p = 0.001$). The most frequently removed teeth were 38 (53.4%) and 48 (46%), with horizontal and mesio-angular impactions being most common. Difficult extractions (72%) were significantly associated with impaction depth and the pandemic period ($p = 0.003$). Surgery delays over 90 days occurred in 8% of cases, primarily during the pandemic. The overall complication rate was 28%, including pain (22%), swelling (12%), alveolar osteitis (10%), and trismus (7%). Bleeding was significantly more common pre-pandemic ($p = 0.016$), possibly due to stricter hemostasis during COVID-19. Complications were significantly associated with impaction depth ($p = 0.045$) and nerve proximity ($p = 0.047$), but not with the surgical period. **Conclusion:** The pandemic impacted case complexity and

treatment timing in third molar surgeries without significantly increasing complication rates. Findings highlight the importance of adaptive surgical planning and infection control during healthcare disruptions.

Subject Areas

Dentistry, Epidemiology, Public Health

Keywords

COVID-19 Pandemic, Third-Molar, Post-Operative Complications

1. Introduction

The surgical extraction of impacted mandibular third molars is among the most frequently performed dentoalveolar procedures in oral and maxillofacial surgery [1] [2]. It is commonly associated with a variety of post-operative complications [3]. These complications range from mild to severe, with inflammation-related outcomes such as pain, swelling, trismus, surgical site infection, alveolar osteitis (dry socket), and paresthesia being the most prevalent [4]. Although rare, more serious adverse events such as mandibular fractures, significant bleeding, and temporomandibular joint dislocation have also been reported [5] [6]. Given the high frequency of third molar surgeries, even uncommon complications can contribute to a substantial population morbidity burden. The most severe complications—such as permanent nerve injury and serious infections—are fortunately uncommon [7] [8].

The reported incidence of post-operative complications following third molar removal varies widely, ranging from 2.6% to 30.9% [9] [10]. These differences may be attributed to variations in surgical techniques, patient characteristics, and the definitions of complications used across studies [10] [11]. Moreover, discrepancies have been noted between surgeons' perceptions and patients' experiences of how third molar surgery impacts quality of life [12].

The emergence of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus in late 2019 and the subsequent declaration of the Coronavirus disease 2019 (COVID-19) pandemic by the World Health Organization (WHO) in early 2020 significantly disrupted healthcare systems globally [13]-[15]. Dentistry, particularly surgical procedures such as third molar removal, was notably affected. In the United Kingdom (UK), the General Dental Council (GDC) permitted both Aerosol Generating Procedures (AGPs) and non-AGPs under stringent conditions, including the availability of appropriate personal protective equipment (PPE) and adherence to infection prevention and control guidelines, such as post-AGP downtime [16]-[18]. Consequently, dental practices, including Oral and Maxillofacial Surgery departments, underwent significant changes during the pandemic. These included enhanced PPE use, reduced patient volume, and treatment delays, all of which potentially influenced surgical outcomes [19].

Given these changes, it is crucial to examine the pattern and incidence of post-operative complications in third molar surgeries conducted before and during the pandemic. The primary objective of this study is to evaluate the outcomes of impacted third molar surgery across these two periods, with a specific focus on determining the incidence and nature of post-operative complications and identifying factors that may contribute to their occurrence. By doing so, this descriptive and analytical study aims to assess the broader impact of the COVID-19 pandemic on the delivery and outcomes of third molar surgical care.

2. Methods

We conducted a retrospective cross-sectional study from 2018 to 2021, involving all patients who underwent surgical removal of mandibular third molars under local anesthesia at the Oral and Maxillofacial Surgery Department of Hospital Segamat. All patients who underwent the procedure during the study period were eligible for inclusion, except those who were immunocompromised. A total of 253 patients were ultimately included in the study. Of these, 100 patients (40%) had received treatment prior to the COVID-19 pandemic (2018-2019), while the remaining 153 patients (60%) underwent surgery during the pandemic period (2020-2021). Based on a literature review [20] [21], we conservatively assumed a post-operative complication prevalence of 20% to calculate the required sample size (See **Appendix A1**). Our final sample size 253 is adequate for estimating the incidence of post-operative complications and is only slightly below the recommended threshold for multivariate analysis using logistic regression.

We obtained ethical approval for the study from the National Medical Research Register (NMRR: RSCH ID-21-01399-XKV). Following approval, permission was granted by both the Hospital Director and the Head of the Oral and Maxillofacial Surgery Department at Hospital Segamat, Johor, to access patient records. Data were extracted using a structured data collection form developed in Microsoft Excel, and the dataset was subsequently compiled for analysis.

All statistical analyses were performed using the Statistical Package for Social Sciences (SPSS) for Windows, Version 22.0 (IBM Corp., Armonk, NY, released 2013). Descriptive analyses were conducted for all explanatory and outcome variables. To evaluate the association between the period of surgery (pre-pandemic vs. during pandemic) and the occurrence of post-operative complications, Chi-square tests were applied. For variables where more than 20% of the cells had expected frequencies less than five, Fisher's exact test was used. A p-value of less than 0.05 was considered statistically significant. Finally, we conducted logistic regression adjusting the predictors to verify whether the study period independently predicts the complications.

3. Results

Among the 253 participants enrolled in the study, the majority were young adults, with only six individuals (2.4%) aged 44 years or older. Less than one-third (31%)

were female, and most underwent surgery during the COVID-19 period (See Table 1).

Table 1. Relationship with the study period and demographic characteristic of the study participants.

	Pre-COVID-19 period (2018 and 2019)	COVID-19 period (2020 and 2021)	Total	p value
Age of the participants				
Below 24 years [17 to 23 years]	29 (29%)	37 (24%)	66 (26%)	0.326
24 to 33 years	55 (55%)	88 (58%)	143 (57%)	
34 to 43 years	12 (12%)	26 (17%)	38 (15%)	
44 years and above	4 (4%)	2 (1.3%)	6 (2.4%)	
Gender of the participants				
Male	99 (99%)	74 (48%)	173 (69%)	0.001
Female	1 (1%)	79 (52%)	80 (31%)	
Total	**100 (100%)**	**153 (100%)**	**253 (100%)**	

Nearly all participants (96%) were non-smokers, and 83% reported having no known medical conditions (See Table 2(a)). All 11 smokers were male and aged 33 years or younger. Participants with a history of medical illness were predominantly female and aged 43 years or younger (See Table 2(b)). Bivariate analysis revealed a significant association between gender and study period (p = 0.001); a higher proportion of female participants underwent surgery during the COVID-19 period compared to the pre-COVID-19 period (2018–2019).

Table 2. (a) Relationship with the study period and general history related to the participants; (b) Having general history related to the participants' age and gender.

(a)

	Pre-COVID-19 period (2018 and 2019)	COVID-19 period (2020 and 2021)	Total	p value
History of smoking				
Yes	5 (5%)	6 (4%)	11 (4.3%)	0.454
No	95 (95%)	147 (96%)	242 (95.7%)	
Any known medical history				
Yes	16 (16%)	27 (18%)	43 (17%)	0.436
No	84 (84%)	126 (82%)	210 (83%)	
Total	**100 (100%)**	**153 (100%)**	**253 (100%)**	

(b)

	Pre-COVID-19 period (2018 and 2019)	COVID-19 period (2020 and 2021)
Age and gender of smoker participants		
Below 24 years [17 to 23 years]	1 (20%)	0

Continued

24 to 33 years	4 (80%)	6 (100%)
34 to 43 years	0	0
44 years and above	0	0
Gender of the participants		
Male	5 (100%)	6 (100%)
Female	0	0
Total	**5 (100%)**	**6 (100%)**
Having known medical history by age and gender of participants		
Below 24 years [17 to 23 years]	2 (13%)	4 (14.8%)
24 to 33 years	12 (75%)	13 (48%)
34 to 43 years	1 (6.3%)	8 (29.6%)
44 years and above	1 (6.3%)	2 (7.4%)
Gender of the participants who have known medical history		
Male	16 (100%)	12 (44%)
Female	0	15 (56%)
Total	**16 (100%)**	**27 (100%)**

As shown in Table 3, the most frequently extracted teeth were mandibular third molars: tooth 38 (53.4%) and tooth 48 (46%). The most common types of impaction were horizontal (39%), mesio-angular (30%), and vertical (27%). In 70% of cases, the impaction depth was classified as Level A according to Pell and Gregory's classification. Notably, 72% of the extractions were considered difficult, even though the tooth size was normal in 98% of cases. In 66% of cases, the inferior alveolar nerve was positioned far from the tooth, and 87% of extracted teeth had two roots. A significant relationship was found between impaction depth and surgical difficulty with the study period ($p = 0.003$). Most participants (92%) were referred by primary dental clinics. The reason for extraction was also significantly associated with the study period ($p = 0.001$); during the COVID-19 period, 111 out of 253 surgeries (44%) were conducted based on clinical advice or for orthodontic purposes, while pre-COVID-19, nearly half (46%) of the surgeries were due to symptoms.

Table 3. Relationship with the study period and dental history of the participants.

	Pre-COVID-19 period (2018 and 2019)	COVID-19 period (2020 and 2021)	Total	p value
Position of extracted 3rd molar				
Molar teeth 18	0	1 (0.7%)	1 (0.4%)	0.675
Molar teeth 28	0	1 (0.7%)	1 (0.4%)	
Molar teeth 38	52 (52%)	83 (54%)	135 (53.4%)	
Molar teeth 48	48 (48%)	68 (44%)	116 (45.8%)	

Continued

Type of impaction				
Vertical	22 (22%)	46 (30%)	68 (26.9%)	0.171
Horizontal	48 (48%)	51 (33%)	99 (39.1%)	
Mesio-angular	27 (27%)	48 (31%)	75 (29.6%)	
Transverse	1 (1%)	1 (0.7%)	2 (0.8%)	
Distal angular	2 (2%)	7 (5%)	9 (3.6%)	
Depth of impaction				
Level A	80 (80%)	98 (64%)	178 (70.4%)	0.003
Level B	17 (17%)	54 (35%)	71 (28.1%)	
Level C	3 (3%)	1 (0.7%)	4 (1.6%)	
Size of tooth				
Normal	99 (99%)	149 (97%)	248 (98%)	0.343
Macrodont	1 (1%)	4 (3%)	5 (2%)	
Number of roots				
Single conical	13 (13%)	14 (9.2%)	27 (11%)	0.399
Two roots	86 (86%)	133 (87%)	219 (87%)	
Three roots	1 (1%)	4 (3%)	5 (2%)	
Single turbeculate	0	2 (1.3%)	2 (0.8%)	
Relation to nerve				
Far	71 (71%)	97 (63%)	168 (66.4%)	0.266
Overlapping	26 (26%)	44 (29%)	70 (28%)	
Through-through	1 (1%)	1 (0.7%)	2 (0.8%)	
Bending	2 (2%)	11 (7.2%)	13 (5.1%)	
Difficult to remove or not				
Easy to remove	10 (10%)	60 (39.2%)	70 (28%)	0.001
Moderate difficulty to remove	83 (83%)	83 (54.2%)	166 (66%)	
Difficult to remove	7 (7%)	10 (6.5%)	17 (7%)	
Referral source				
KP: Primary dental clinic	92 (92%)	140 (92%)	232 (91.7%)	0.542
Others: Specialist center or hospital	8 (8%)	13 (8%)	21 (8.3%)	
Reasons for removal of tooth				
Symptomatic removal	84 (84%)	33 (22%)	117 (46.2%)	0.001
Removal due to clinician advise	8 (8%)	106 (69%)	114 (45.1%)	
Removal due to orthodontic treatment	7 (7%)	5 (3.3%)	12 (4.7%)	
Others	1 (1%)	9 (5.9%)	10 (4%)	
Total	**100 (100%)**	**153 (100%)**	**253 (100%)**	

Table 4(a) shows significant associations between the study period and both the referral-to-surgery interval (p = 0.002) and operation duration (p = 0.012). In 8% of cases, surgery was delayed by more than 90 days, primarily during the COVID-19 period. Nevertheless, 87% of surgeries during this period were completed in under 45 minutes. As shown in Table 4(b), 82% of participants experienced pain, while 11% reported space infections pre-operatively. Only 25% received antibiotics before surgery. Regarding post-operative complications, no cases of osteomyelitis were reported in either period. During the COVID-19 period, 55 participants (22%) reported pain, 14 (5%) experienced infections, and 29 (12%) had swelling. Bleeding was reported in only 7 participants (3%) during the pre-COVID-19 period, showing a significant association with the study period (p = 0.016), possibly due to heightened surgical precautions during the pandemic.

Table 4. (a) Relationship with the study period and interval period between referral and surgery and length of operation; (b) Relationship with the study period and dental medical history of the participants before operation; (c) Relationship with the study period and history of post-operative complications of the participants.

(a)

	Pre-COVID-19 period (2018 and 2019)	COVID-19 period (2020 and 2021)	Total	p value
Interval between the time of referral and performing surgery				
Within 30 days	80 (80%)	95 (62%)	175 (69%)	0.002
Within 60 days	12 (12%)	26 (17%)	38 (15%)	
Within 90 days	7 (7%)	12 (7.8%)	19 (7.5%)	
More than 90 days	1 (1%)	20 (13.1%)	21 (8.3%)	
Length of operation				
Less than 45 min	96 (96%)	133 (87%)	229 (91%)	0.012
More than 45 min	4 (4%)	20 (13%)	24 (9%)	
Total	**100 (100%)**	**153 (100%)**	**253 (100%)**	

(b)

	Pre-COVID-19 period (2018 and 2019)	COVID-19 period (2020 and 2021)	Total	p value
Pain before operation				
Yes	85 (85%)	123 (80%)	208 (82%)	0.222
No	15 (15%)	30 (20%)	45 (18%)	
Space infection before operation				
Yes	7 (7%)	21 (14%)	28 (11%)	0.069
No	93 (93%)	132 (86%)	225 (89%)	
Have taken antibiotic before operation				
Yes	19 (19%)	44 (29%)	63 (25%)	0.053
No	81 (81%)	109 (71%)	190 (75%)	
Total	**100 (100%)**	**153 (100%)**	**253 (100%)**	

Continued

(c)				
	Pre-COVID-19 period (2018 and 2019)	**COVID-19 period (2020 and 2021)**	**Total**	**p value**
Pain after operation				
Yes	16 (16%)	39 (26%)	55 (22%)	0.050
No	84 (84%)	114 (74%)	198 (78%)	
Space infection after operation				
Yes	3 (3%)	11 (7.2%)	14 (5%)	0.125
No	97 (97%)	142 (92.8%)	239 (95%)	
Swelling after operation				
Yes	10 (10%)	19 (12%)	29 (12%)	0.353
No	90 (90%)	134 (88%)	224 (88%)	
Bleeding after operation				
Yes	6 (6%)	1 (0.7%)	7 (3%)	0.016
No	94 (94%)	152 (99.3%)	246 (97%)	
Alveolar osteitis after operation				
Yes	8 (8%)	18 (12%)	26 (10%)	0.228
No	92 (92%)	135 (88%)	227 (90%)	
Numbness after operation				
Yes	3 (3%)	3 (2%)	6 (2.4%)	0.446
No	97 (97%)	150 (98%)	247 (97.6%)	
Trismus after operation				
Yes	4 (4%)	13 (8.5%)	17 (7%)	0.126
No	96 (96%)	140 (91.5%)	236 (93%)	
Osteomyelitis after operation				
Yes	0 (0%)	0 (0%)	0 (0%)	
No	100 (100%)	153 (100%)	253 (100%)	
Post-operative complications				
No complication	75 (75%)	107 (70%)	182 (72%)	0.683
One complication	9 (9%)	16 (11%)	25 (10%)	
Two complications	8 (8%)	12 (8%)	20 (8%)	
Three complications	7 (7%)	11 (7.2%)	18 (7%)	
Four complications	1 (1%)	4 (2.6%)	5 (2%)	
Five complications	0	3 (2%)	3 (1.2%)	
Post-operative complications				
No complication	75 (75%)	107 (70%)	182 (72%)	0.232
Had complications	25 (25%)	46 (30%)	71 (28%)	
Total	**100 (100%)**	**153 (100%)**	**253 (100%)**	

Post-operative complications were diagnosed based on clinical and radio-

graphic criteria (See **Appendix A2**). As shown in Table 4(c), 26 participants (10%) developed alveolar osteitis, mostly during the COVID-19 period. Numbness was reported by six participants (2%)—three before and three during the pandemic. Trismus was reported in 17 participants (7%), primarily during the COVID-19 period. Overall, 182 participants (72%) did not experience any post-operative complications. Among the 71 (28%) who did, 46 underwent surgery during the COVID-19 period and experienced multiple complications. Bivariate analysis showed no significant association between the study period and the occurrence of post-operative complications. However, in Table 5, significant associations were found between complications and two variables: impaction depth ($p = 0.045$) and proximity to the nerve ($p = 0.047$). As noted earlier, impaction depth also showed a significant relationship with the study period.

Table 5. Relationship between the post-operative complications and dental history of the participants.

	Post-operative complications			
	No	**Yes**	**Total**	**p value**
Depth of impaction				
Level A	136 (74.7%)	42 (59.2%)	178 (70.4%)	
Level B	44 (24.2%)	27 (38%)	71 (28.1%)	0.045
Level C	2 (1.1%)	2 (2.8%)	4 (1.6%)	
Type of impaction				
Vertical	49 (26.9%)	19 (26.8%)	68 (26.9%)	
Horizontal	71 (39%)	28 (39.4%)	99 (39.1%)	
Mesio-angular	55 (30.2%)	20 (28.2%)	75 (29.6%)	0.726
Transverse	2 (1.1%)	0	2 (0.8%)	
Distal angular	5 (2.7%)	4 (5.6%)	9 (3.6%)	
Number of roots				
Single conical	19 (10.4%)	8 (11.3%)	27 (11%)	
Two roots	158 (86.8%)	61 (85.9%)	219 (87%)	0.879
Three roots	4 (2.2%)	1 (1.4%)	5 (2%)	
Single turbeculate	1 (0.5%)	1 (1.4%)	2 (0.8%)	
Relation to nerve				
Far	130 (71.4%)	38 (53.5%)	168 (66.4%)	
Overlapping	42 (23.1%)	28 (39.4%)	70 (28%)	0.047
Through-through	1 (0.5%)	1 (1.4%)	2 (0.8%)	
Bending	9 (4.9%)	4 (5.6%)	13 (5.1%)	
Difficult to remove or not				
Easy to remove	54 (29.7%)	16 (22.5%)	70 (28%)	
Moderate difficulty to remove	119 (65.4%)	47 (66.2%)	166 (66%)	0.136
Difficult to remove	9 (4.9%)	8 (11.3%)	17 (7%)	

Table 6. Result of logistic regression analysis.

Predictors	B	Sig.	Exp(B)	95% C.I. for EXP (B)	
				Lower	Upper
Female	1.300	<0.001	3.669	1.906	7.066
Smoker	2.180	0.001	8.846	2.365	33.085
Moderate difficulty to remove	0.761	0.041	2.140	1.031	4.440
Difficulty to remove	1.745	0.004	5.727	1.728	18.983

Significant predictors associated with post-operative complications were identified by binary logistic regression to estimate the probability of a binary response bas Out of 13 predictors, we found three factors have a significant correlation with post-operative complications. Compare to male, female had more likely to have post-operative complications (OR: 3.669). Compare to non-smoker, smoker had 9 times higher chance of having post-operative complications (OR: 8.846). Compare to easy to remove, the chance of having post-operative complications were 6 times (OR: 5727) higher among those who faced difficulty to remove and 2 times (OR: 2.140) higher among those who had moderate difficulty to remove (See **Table 6**).

4. Discussion

This study investigated the clinical characteristics, surgical parameters, and post-operative complications of third molar removal, with a specific focus on comparing outcomes before and during the COVID-19 pandemic. The results demonstrate notable differences in patient demographics, surgical practices, and complication profiles between these periods, reflecting the broader impact of the pandemic on oral and maxillofacial surgery services.

A key demographic finding was the predominance of young adults among the participants, with only 2.4% aged 44 or older. This is consistent with existing literature that identifies the third decade of life as the typical age for third molar removal, due to peak impaction-related symptoms and treatment indication during this time [22].

During the COVID-19 period, our study observed a significant increase in the proportion of female patients undergoing third molar surgery ($p = 0.001$). This trend may reflect shifts in healthcare access patterns and the prioritization of elective procedures based on clinical assessments rather than symptom presentation. This observation aligns with broader research indicating that the pandemic exacerbated existing gender disparities in healthcare access. Women often faced increased barriers to elective surgical procedures due to heightened caregiving responsibilities, economic challenges, and concerns about virus exposure [23]. These factors contributed to delays in seeking care and a reduction in elective surgeries among female patients during certain periods of the pandemic. Moreover, the prioritization of urgent and emergency cases during the pandemic may have inad-

vertently disadvantaged women, who are more likely to require elective surgeries [24]. This shift in prioritization could explain the observed changes in the demographic composition of patients undergoing surgeries like third molar extractions during the COVID-19 period. The record-keeping confirmed this pre-versus peripandemic gender imbalance and it did not happen due to selection bias.

Regarding the nature of impactions, horizontal and mesio-angular impactions were the most common, aligning with previous findings that these orientations are frequently associated with impacted mandibular third molars and may pose greater surgical challenges [25] [26]. Additionally, the majority of teeth (70%) were at Pell and Gregory's Level A, and a significant proportion (72%) of extractions were rated as difficult, even though most teeth were of normal size [27]. The difficulty of extraction showed a significant relationship with both the impaction depth and the COVID-19 period ($p = 0.003$), suggesting that cases handled during the pandemic may have been selectively complex, possibly due to the deferral of less urgent procedures [28].

The study also found significant delays in treatment during the COVID-19 period. Approximately 8% of surgeries were delayed by more than 90 days, and this delay was significantly associated with the pandemic ($p = 0.002$). This is consistent with global reports of disruptions in elective and outpatient dental services during COVID-19, as dental clinics prioritized emergency procedures and implemented strict infection prevention protocols [29] [30]. Interestingly, despite these delays, the majority of surgeries were completed in under 45 minutes, which may reflect adaptations to minimize exposure duration for both patients and providers.

Post-operative complications such as pain (22%), swelling (12%), alveolar osteitis (10%), and trismus (7%) were reported more frequently during the COVID-19 period, although the overall rate of complications (28%) was comparable with reported literature ranges for third molar surgeries [31] [32]. In our study, no cases of osteomyelitis were identified, and bleeding complications were significantly more common in the pre-COVID-19 group ($p = 0.016$). This reduction in bleeding incidents during the COVID-19 period may be attributed to heightened perioperative precautions, including more rigorous hemostasis measures and conservative surgical approaches implemented to minimize aerosol generation and potential virus transmission. These enhanced protocols likely contributed to improved bleeding control during dental surgeries in the pandemic era [33]. Furthermore, while osteomyelitis is a recognized complication in dental surgeries, its incidence did not increase during the COVID-19 period in our cohort. This aligns with broader observations that, although COVID-19 has been associated with various complications, the prevalence of osteomyelitis in dental contexts remained relatively unchanged, possibly due to the stringent infection control measures adopted during the pandemic [33]. Although no significant relationship was found between the overall occurrence of post-operative complications and the study period, complications were significantly associated with impaction depth ($p = 0.045$) and proximity to the inferior alveolar nerve ($p = 0.047$). These findings reinforce

existing evidence linking surgical complexity and anatomical factors to complication risk [11].

4.1. Clinical Implications

The pandemic has underscored the need for flexible and adaptive surgical planning. The increased difficulty of cases during COVID-19 highlights the importance of triaging based on impaction severity and medical urgency. Moreover, the findings support the implementation of enhanced infection control protocols and efficient surgical workflows that maintain quality care even in constrained settings.

4.2. Limitations

This study is limited by its observational design and reliance on retrospective data. Additionally, although demographic and surgical variables were well-documented, subjective patient-reported outcomes such as pain intensity or quality of life were not assessed. The influence of surgical experience or operator variability was also not examined.

5. Conclusion

The COVID-19 pandemic significantly influenced the profile and outcomes of third molar surgeries. While surgical complication rates remained within acceptable ranges, the shift in case selection, increased treatment delays, and modifications in clinical protocols reflect the broader healthcare disruptions during this period. Understanding these impacts is essential for improving surgical preparedness and patient management in future public health crises.

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Conflicts of Interest

Researchers declared that there is no conflict of interest.

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List of Abbreviation

AGP: Aerosol Generating Procedures
COVID-19: Coronavirus Disease 2019
GDC: General Dental Council
NMRR: National Medical Research Register
Non-AGP: Non-Aerosol Generating Procedures
PPE: Personal Protective Equipment
SARS-CoV2: Severe Acute Respiratory Syndrome Coronavirus 2
SPSS: Statistical Package for Social Sciences
UK: United Kingdom
WHO: World Health Organization

Appendix

Appendix A1: Sample Size Calculation

Our study aimed to determine the incidence and nature of post-operative complications and to identify factors contributing to their occurrence. Therefore, it was designed as a descriptive and analytical cross-sectional study.

To estimate a proportion *i.e.*, the incidence of post-operative complications with a certain margin of error, we used the following formula

$$n = Z^2 \times p \times (1 - p)/d^2$$

where:

- n = required sample size
- Z-score for 95% confidence = 1.96
- p = expected proportion (prevalence of complications)
- d = desired precision (margin of error, e.g., 0.05)

Based on a literature review, the incidence of post-operative complications after mandibular third molar surgery ranges from 10% to 25%**,** and in some cases, up to 30.9%**.** For our calculation, we conservatively assumed a prevalence of 20% (p = 0.20)

In this case, the required sample size will be

$$n = (1.96)^2 \times 0.20 \times (1 - 0.20 = 0.80)/(0.05)^2$$

$$n = 245.86 = 246$$

Thus, the required sample size is approximately 246 patients to estimate the incidence of post-operative complications with a ±5% margin of error at 95% confidence.

Our actual sample size of 253 patients meets this requirement and is therefore adequate for estimating the incidence.

In addition, we aimed to identify associated risk factors for post-operative complications using logistic regression analysis. We included the following 13 predictor variables: Age, gender, history of smoking, medical history, dental history such as position of extracted 3rd molar, type of impaction, depth of impaction, size of tooth, number of roots, relation to nerve, difficult to remove, surgical interval and length of operation.

According to the common rule of thumb for logistic regression, a minimum of 10 - 20 observations per predictor variable is recommended.

Using the upper bound: 13 predictors × 20 = 260 observations

Our sample size of 253 patients is slightly below this ideal threshold but remains close enough to support meaningful multivariate analysis, particularly if the number of events (*i.e.*, patients with complications) is sufficient to meet the "events per variable" (EPV) requirement.

Appendix A2: Clinical and Radiographic Criteria Used to Diagnose Post-Operative Complications

1) Pain

- **Clinical criteria**: Reported moderate to severe pain persisting beyond 48

hours' post-surgery, not relieved by standard analgesics.

- **Assessment**: Visual Analog Scale (VAS) score > 4 on post-operative day 3 or later.
- **Note**: Mild expected discomfort immediately after surgery was not classified as a complication.

2) Swelling

- **Clinical criteria**: Observable facial swelling involving the cheek or submandibular region lasting beyond 3 days post-operatively.
- **Assessment**: Measured subjectively through clinical observation and/or patient report of persistent facial fullness or asymmetry.

3) Alveolar Osteitis (Dry Socket)

- **Clinical criteria:**
  - Severe, throbbing pain starting 2 - 4 days after surgery
  - Partial or complete loss of the blood clot in the socket
  - Exposure of bone on clinical examination
  - Halitosis and foul taste may also be present
- **Assessment:** Diagnosed during clinical follow-up with visible socket inspection and reported symptoms.

4) Trismus

- **Clinical criteria**: Limited mouth opening (interincisal distance ≤ 25 mm) post-operatively, with or without associated pain.
- **Assessment:** Measured with a caliper or ruler during follow-up visits.

5) Infection

- **Clinical criteria**:
  - Presence of purulent discharge from the surgical site
  - Local erythema, warmth, and swelling
  - Fever > 38˚C
- **Radiographic support**: Not routinely used unless deep infection or osteomyelitis was suspected.

6) Paresthesia

- **Clinical criteria**: Numbness, tingling, or altered sensation in the distribution of the inferior alveolar or lingual nerve lasting beyond 7 days.
- **Assessment**: Based on patient self-report and clinical sensory testing (light touch, pinprick).
- **Radiographic support**: Pre-operative and post-operative imaging (e.g., panoramic radiograph or CBCT) were reviewed to assess proximity to the inferior alveolar canal.

7) Bleeding

- **Clinical criteria**: Bleeding that persisted beyond 12 hours post-operatively or required intervention (e.g., additional suturing or hemostatic agents).
- **Assessment**: Reported by the patient or observed during review.