

The Effect of Smoking on Postoperative Complications Following Mandibular Third Molar Operations: Clinical Research

Sigaranın Mandibular Üçüncü Molar Operasyonlarından Sonra Postoperatif Komplikasyonlar Üzerine Etkisi: Klinik Araştırma

Özgün YILDIRIM^a, Nilay BİLGİN ERDEN^b, Nur MOLLAOĞLU^c

^aDepartment of Oral and Maxillofacial Surgery, Çankırı Karatekin University Faculty of Dentistry, Çankırı, Türkiye

^bClinic of Oral and Maxillofacial Surgery, Sancaktepe Oral and Dental Health Center, İstanbul, Türkiye

^cDepartment of Oral and Maxillofacial Surgery, Gazi University Faculty of Dentistry, Ankara, Türkiye

ABSTRACT Objective: Extraction of impacted mandibular third molars are the most common operations in oral and maxillofacial surgery. The most common postoperative complications of this operations are pain, edema, trismus and alveolitis. It has been previously reported that smoking may cause delayed wound healing and increase the risk of postoperative complications. Therefore, the aim of the present study is to compare the severity of postoperative pain, edema, trismus and alveolitis following third molar surgery between smoking and non-smoking otherwise healthy patients. **Material and Methods:** Total of 100 otherwise healthy patients who were complained of impacted third molars were participated in this study. Subjects were divided into 4 groups according to the number of cigarette a day smoking. Pain was assessed using a visual analogue scale during the postoperative 7 days, edema and trismus were evaluated by using reference points on postoperative 2nd and 7th days, following that the number of patients with alveolitis and the symptoms of alveolitis were noted. **Results:** It was determined that postoperative pain, edema, trismus and alveolitis formation were statistically higher in smokers. **Conclusion:** According to the data obtained postoperative pain, edema and incidence of alveolitis were found to be significantly increased by statistically on patients who were smoking.

ÖZET Amaç: Gömülü mandibular üçüncü molar dişlerin çekimi, oral ve maksillofasiyal cerrahide en sık yapılan operasyonlardandır. Bu ameliyatlarda en sık görülen postoperatif şikâyetleri ağrı, ödem, trismus ve alveolittir. Sigaranın yara iyileşmesini geciktirdiği ve postoperatif komplikasyon riskini artırdığı daha önce bildirilmiştir. Bu nedenle bu çalışmanın amacı, üçüncü molar cerrahisi sonrası postoperatif ağrı, ödem, trismus ve alveolitin şiddetini sigara içen ve sigara içmeyen sağlıklı hastalar arasında karşılaştırmaktır. **Gereç ve Yöntemler:** Bu çalışmaya gömülü üçüncü büyük azı dişlerinden şikâyetçi olan ve sağlıklı toplam 100 hasta dâhil edildi. Denekler bir günde içtikleri sigara sayılarına göre 4 gruba ayrıldı. Postoperatif 7. gün ağrı görsel analog skala ile değerlendirildi, postoperatif 2. ve 7. günlerde referans noktaları kullanılarak ödem ve trismus değerlendirildi, ardından alveolitli hasta sayısı ve alveolit semptomları not edildi. **Bulgular:** Sigara içenlerde ameliyat sonrası ağrı, ödem, trismus ve alveolit oluşumunun istatistiksel olarak daha yüksek olduğu belirlendi. **Sonuç:** Elde edilen verilere göre ameliyat sonrası ağrı, ödem ve alveolit insidansı sigara içen hastalarda istatistiksel olarak anlamlı derecede artmış olarak bulundu.

Keywords: Smoking; impacted third molar; postoperative complications

Anahtar Kelimeler: Sigara içmek; gömülü üçüncü molar; ameliyat sonrası komplikasyonlar

Impacted lower third molar, with an incidence of 66-77%, is the most common impacted tooth.¹ Surgical extraction of impacted lower third molar teeth is a day case surgery performed by the oral and maxillofacial surgeons.^{2,3} Impacted third molar removal is one of the common minor oral surgical procedures performed in routine dental practice.⁴ Several

complications are associated with extraction of impacted mandibular third molars.⁵ The most common postoperative complications are pain, edema and trismus whose severity can be affected by various factors and variables.^{2,3}

It has been scientifically proven that smoking may cause an important, deadly diseases.⁶ It may

Correspondence: Özgün YILDIRIM

Department of Oral and Maxillofacial Surgery, Çankırı Karatekin University Faculty of Dentistry, Çankırı, Türkiye

E-mail: ozgunyldrm89@gmail.com



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damage almost all the organs of the body and may associated by coronary heart diseases, stroke, atherosclerosis, respiratory diseases such as chronic obstructive pulmonary disease and pneumonia, and various carcinomas as well.⁷ Many studies have already been conducted to assess the effect of smoking on different cell types and found to have negative effects on the host immune system, including neutrophil and macrophage function. And, it has been determined that nicotine can increase the risk of bacterial colonization by affecting the phagocytic activities of these cells.²

It is also known that smoking can negatively affects wound healing.⁶ Fibrinolytic activity is less in smokers than in non-smokers, which delays wound healing.² Previous researchs indicated that smokers are at greater risk of experiencing complications during and following the surgery.^{8,9}

Although impacted third molar surgery is the most frequently performed procedure in oral surgery, the relationship between smoking and postoperative complications has not been adequately studied until today. In the previous studies, postoperative complications such as edema and trismus were evaluated by subjective methods without investigating patients daily cigarette consumption. In this study, the effect of daily cigarette consumption of patients on complications following impacted lower third molar tooth operation was investigated by using objective methods.

In this study, the sample size was calculated at the 95% confidence level by using the G. Power 3.1.9.2 program (HHU, Germany). As a result of the analysis, the minimum sample size was calculated as 90 in total.

MATERIAL AND METHODS

PREOPERATIVE PREPARATION AND EVALUATION

This research was carried out at Gazi University School of Dentistry, Department of Oral and Maxillofacial Surgery. A total of 100 patients were referred to have their lower impacted third molar tooth to be operated and accepted to participate in this study voluntarily, complying with inclusion and exclusion criteria were included. Patients selection was done randomly.

INCLUSION CRITERIAS

- 18-40 age range.
- American Society of Anesthesiologists I (No systemic disease, no continuous drug use).
- Individuals with impacted lower third molar tooth in Parant II or III classification according to Parant classification.¹⁰

EXCLUSION CRITERIAS

- Patients using psycholeptic, antipsychotic, anxiolytic or hypnotic drugs.
- Individuals with uncontrolled systemic disease.
- Patients who used antibiotics in the last 3 months.

STUDY DESIGN

Patients included in the study were informed in detail about the study and then signed an informed consent forms. This study was approved by the Ethics Committee of Gazi University Faculty of Medicine (date: March 24, 2014, no: 174). This study was conducted in accordance with the Declaration of Helsinki.

SURGICAL PROTOCOL

All patients were operated by the same surgeon (NB) using standard surgical techniques. Regional mandibular anesthesia and vestibule infiltrative anesthesia were performed by using articaine hydrochloride (Maxicaine Forte ampoule, Vem drug, Turkey) containing 1/100000 epinephrine as a local anesthetic solution.

Mucoperiosteal triangular flap was raised by doing horizontal and buccal vertical incisions using scalpel no.15. Under saline irrigation, the bone was removed by conventional drilling method and the tooth was reached to be removed using standard surgical techniques. The socket was curetted and irrigated by saline solution to remove the dental follicle residues, and then the mucoperiosteal flap was closed in its original position using 3-0 silk sutures. The time between first incision and the last suture was recorded as the operation time. Postoperatively, the patients were prescribed 1,000 mg of amoxicillin 2×1 daily, and mouthwash containing chlorhexidine gluconate

3×1 daily (except on the day of the operation) and flurbiprofen 100 mg 2×1 daily to use if analgesic was needed.

CLINICAL FOLLOW-UP

All the patients participating in the present study were controlled at the 2nd and 7th days following the operation and the measurements done for the edema-pain assessment, trismus evaluation, alveolitis and smoking were recorded according to Ustün et al.¹¹

EDEMA ASSESSMENT

The distances between the extraoral points were measured using a paper ruler on the preoperative and postoperative 2nd and 7th days between the following points;

1. Tragus-angulus oris,
2. Tragus-pogonion,
3. Canthus-angulus mandibula.

PAIN ASSESSMENT

Visual analog scale (VAS) was used for the postoperative pain assessment, 0 indicating no pain while 10 indicating the most severe pain level. Patients were asked to fill the VAS according to the pain they experienced once a day, at the same time every evening for 7 days, starting from the evening of the operation day. In addition, patients were also asked to note the amount of analgesics they used during the postoperative 7 days to the form given.

TRISMUS EVALUATION

In order to determine the trismus, interincisal distance of the patients were determined by measuring the distance between the incisal edges of the lower and upper central teeth using a ruler. Measurements between tragus-angulus oris, tragus-pogonion, canthus-angulus mandibula and interincisal distance were made preoperatively and postoperatively on the 2nd and 7th day.

OPERATION DIFFICULTY LEVEL

Difficulty of the operation after the extraction of the impacted tooth was determined according to the Parant scale.¹⁰ Parant scale was categorized I, II, III and IV. Parant I was simple forceps extraction, II was

extraction requiring osteotomy, III required crown sectioning and IV requiring root section. Only impacted lower wisdom teeth classified as Parant II and III were included to the present study.

EVALUATION OF ALVEOLITIS

Patients who came for postoperative control on the 2nd and 7th days, existence of alveolitis were evaluated clinically in terms of yes/no answers according to the following symptoms exist or not for the diagnosis of alveolitis.

1. Any pulsative-spreading pain that starts 2-5 days after the operation.
2. Any pain that wakes you up at night.
3. Empty socket appearance without clot with or without odor.

EVALUATION OF SMOKING

Patients participating in this study were divided into 4 groups according to their daily cigarette consumption.

- 1st group, non-smokers,
- 2nd group, those who smoke up to 10 cigarettes a day,
- 3rd group, those who smoke 11-20 cigarettes a day,
- 4th group, those who smoke more than 20 cigarettes a day.

Patients were instructed not to smoke for 48 hours after the operation. However, if they smoke, patients in the 2nd, 3rd and 4th groups were asked to record the number of smoking a day to the form given.

STATISTICAL EVALUATIONS

Statistical evaluations were performed using SPSS statistical program 21.0 (IBM, USA). Evaluations were made at 5% significance level with 95% confidence interval. Kolmogorov-Smirnov test was applied all the parameters in order to analyzed whether the distribution satisfies the assumption of normality. Parametric tests were used for those with normal distribution, and non-parametric statistical techniques were used for parameters that did not provide the normality assumption. Comparison of categorical vari-

ables was done by chi-square or Fisher's exact chi-square tests. The Mann-Whitney U test was used to examine the effect of smoking on alveolitis formation. Similarly, the Kruskal-Wallis test was applied to examine the effect of smoking to the other parameters as well.

RESULTS

Total of 49 of the individuals participating in the study were female and 51 were male. It was observed that there were 81 patients in the 18-28 age range and 19 patients in the 29-39 age range.

The distribution of the individuals participating in the study according to their education level is 1 primary school graduates, 11 secondary school graduates, 67 high school graduates and 21 university graduates. According to the occupational distribution of the patients, it was seen that 47% were students, 32% worked in the private sector, 15% were government employee and 2% were housewives, only the 4% was not working.

Among all the removed impacted wisdom teeth, right site of wisdom teeth (tooth no: 48) were the mostly taken (60%) and the rest were left sided ones (tooth no: 38th) (40%). Total of 48 teeth were in Parant II classification while 52 of them were in Parant III classification.

Distribution of the duration of the operation was taken between 10-14 minutes for 28 patients, 15-19 minutes for 30 patients, 20-24 minutes for 22 patients, 25-29 minutes for 9 patients, 30-34 minutes for 6 patients and 35-40 minutes for 4 patients according to statistical design.

ASSESSMENT OF THE POSTOPERATIVE PAIN, EDEMA, AND TRISMUS

The Kruskal-Wallis test was applied to assess whether there was a difference between the study

groups for the postoperative pain, edema, and trismus (Table 1). It was found that there was a statistically significant difference;

1. Between VAS scores for the pain (Figure 1 and Table 2),
2. Edema between tragus-angulus oris on the 2nd and 7th days,
3. Edema between tragus-pogonion on the 2nd day,
4. And significant difference for interincisal distance on the 2nd and 7th days for the trismus according to the smoking habits of the study subjects ($p<0.05$).

However, there was no statistically significant change was observed;

1. Edema between tragus-pogonion on the 7th day,
2. Edema between canthus-angulus on the 2nd and 7th days ($p>0.05$).

Mann-Whitney U test was applied to examine the existence of trismus between the Parant II and Parant III classification when the interincisal distance was measured on the 2nd and 7th days postoperatively. It was found that there was no statistically significant difference between the interincisal distance measured on the 2nd and 7th days ($p>0.05$).

ALVEOLITIS EVALUATION RESULTS

As the result of the test was $p<0.05$, it was concluded that there was a statistically significant relationship between the occurrence of alveolitis according to the smoking habits of the individuals. When the Table 3 is examined, it has been observed that alveolitis formation is more common in smokers than in non-smokers. It is seen that the formation of alveolitis increases in direct proportion to the increase in the amount of smoking.

TABLE 1: Measurements for edema and trismus preoperatively and 2nd and 7th days postoperatively.

	Preoperative (cm)	Postoperative Day 2 (cm)	Postoperative Day 7 (cm)
Tragus-angulus oris	11.26	11.59	11.34
Tragus-pogonion	14.28	14.58	14.35
Canthus-angulus mandibula	9.70	10.03	9.82
Interincisal distance	43.55	27.10	34.99

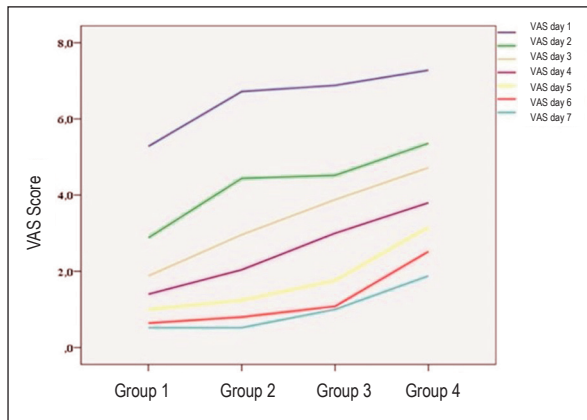


FIGURE 1: Distribution of VAS scores of the groups during the postoperative 7 days.
VAS: Visual analog scale.

The Mann-Whitney U test was applied to examine whether there was a difference between the oc-

currence of alveolitis according to the smoking habits of the study subjects. There found to be a statistically significant difference between the preoperative 1st day to the postoperative 7th day ($p < 0.05$).

In order to determine whether there is a relationship between the number of cigarettes smoked per day and the formation of alveolitis, chi-square was performed and the results were displayed in Table 3. However, there was no statistically significant change between Parant classification and alveolitis. Moreover, there was no statistically significant change between the mean operation time and alveolitis either ($p > 0.05$).

OPERATION DIFFICULTY LEVEL

There found to be no statistical difference between Parant II and III ($p > 0.05$).

TABLE 2: VAS scores; number of smoking and use of pain killer a day.

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
VAS scores	6.54	4.30	3.36	2.56	1.79	1.26	0.98
Smoking	3.20	4.02	4.49	5.09	5.27	5.48	5.85
Pain killer	1.85	1.57	1.28	0.91	0.60	0.49	0.34

VAS: Visual analog scale.

TABLE 3: Relationship between alveolitis and smoking.

Identifiers		Alveolitis formation		
		No	Yes	Total
Group 1	n	24	1	25
	Due to smoking %	96.0%	4.0%	100.0%
	Due to alveolitis %	28.2%	6.7%	25.0%
	Total %	24.0%	1.0%	25.0%
Group 2	n	23	2	25
	Due to smoking %	92.0%	8.0%	100.0%
	Due to alveolitis %	27.1%	13.3%	25.0%
	Total %	23.0%	2.0%	25.0%
Group 3	n	21	4	25
	Due to smoking %	84.0%	16.0%	100.0%
	Due to alveolitis %	24.7%	26.7%	25.0%
	Total %	21.0%	4.0%	25.0%
Group 4	n	17	8	25
	Due to smoking %	68.0%	32.0%	100.0%
	Due to alveolitis %	20.0%	53.3%	25.0%
	Total %	17.0%	8.0%	25.0%
Total	n	85	15	100
	Due to smoking %	85.0%	15.0%	100.0%
	Due to alveolitis %	100.0%	100.0%	100.0%
	Total %	85.0%	15.0%	100.0%

$p = 0.029 < 0.05$

DISCUSSION

Removal of impacted third molar teeth is one of the most frequently performed operations in oral and maxillofacial surgery, and smoking is closely related to complications, mainly after tooth extraction.^{12,13}

Pain is an unpleasant sensory and emotional experience associated with potential tissue damage.¹⁴ Following the anesthesia to perform the impacted third molar operation, pain increases within the first 3 to 5 hours and continues for the next 2 to 3 days, then gradually decreases by the end of the 7th day.¹⁵ In this study, postoperative pain was measured using VAS in different groups, and it was found that the pain mainly was heavier in the first 3 days then gradually decreased, confirming the results of the previous studies. In addition, it was found that the pain was significantly less in nonsmokers than in the other three groups ($p \leq 0.05$). While Heng et al. reported that smoking increases postoperative pain, Al-Delayme reported that smokers had more postoperative pain than nonsmokers, but no statistically significant difference was observed.^{6,16} Larrazábal et al. stated that smoking before the operation of lower third molar was not associated with pain, but smoking for 1 week postoperatively caused more pain at the 24th hour after the operation.³ Considering the number of decreased painkillers used within 7 days postoperatively, results of this study are confirming the previous results given above.

Heng et al. stated that smoking might be responsible for the increase in postoperative edema.¹⁶ Al-Delayme used edema measurement techniques similar to this study, but although edema was higher in smokers than in nonsmokers, no statistically significant difference was found.⁶ In this study, for edema measurement, tragus-angulus oris, tragus-pogonion, and canthus-angulus mandibula distances were measured preoperatively and at the 2nd and 7th days postoperatively as well. While there was a statistically significant difference between the groups in tragus-angulus oris measurements on the 2nd and 7th days, and in the evaluation of tragus-pogonion edema on the 2nd day ($p \leq 0.05$), however no difference was found in the edema assessment of the canthus-angulus mandibula and tragus-pogonion on the 7th day ($p \geq 0.05$).

In a study by López-Carriches et al., it was stated that trismus was significantly higher in smokers following lower third molar surgery, and they needed longer rest.² In Al-Delayme study, it was reported that although trismus was higher in smokers than in nonsmokers after performed third molar surgery, no statistically significant difference was found.⁶ In this study, interincisal distance of the patients was measured on preoperative, postoperative 2nd, and 7th days. In preoperative measurements, it was observed that all patients had average interincisal distance values, and there was no limiting factor. Nevertheless, it was found that smoking significantly affected the trismus (on the 2nd and 7th days), and the interincisal distance was statistically less in smokers ($p \leq 0.05$). Moreover, in this study, we include only Parant II and III cases. Although trismus did not differ statistically between these two groups, it was observed that trismus was statistically higher in Parant III classification ($p \geq 0.05$).

According to López-Carriches et al. smoking reduces post-extraction alveolar blood flow, therefore dry socket is more common in smokers.² Similar results were demonstrated in a series of 70 patients by Larsen.¹⁷ López-Carriches et al. suggested that infection and alveolitis are more common in smokers than nonsmokers and that this is due to the adverse effects of tobacco products on wound healing due to disruption of polymorphonuclear cell function.² The present study, also determined smoking increased the formation of alveolitis in a statistically significant way. It was observed that the formation of alveolitis increased in direct proportion to the increase in the amount of smoking ($p \leq 0.05$), and it was also found that smoking during postoperative 7 day period affected the formation of alveolitis statistically ($p \leq 0.05$). Studies indicate that the risk of developing alveolitis increases with daily smoking, and the incidence of alveolitis is highest in individuals who smoke on the day of the operation or the first postoperative day.¹⁸ For example, in a study in which 1,305 tooth extractions were performed in 805 patients, the incidence of alveolitis was 5.1% in smokers and 2.1% in nonsmokers ($p \leq 0.05$).¹⁹

In the study of Abu Younis and Abu Hantash, surgical extractions showed a statistically higher in-

idence of alveolitis, the incidence of alveolitis after non-surgical extractions were 1.7%, while it was 15% after surgical extractions.¹⁹ In the study conducted by Eshghpour and Nejat on patients with impacted wisdom teeth removed, the operative difficulty was determined by the preoperative radiological evaluation and the postoperative difficulty of the surgery by the surgeon, and it was found that all these factors showed a significant correlation with the incidence of alveolitis.²⁰ Although there was no statistically significant difference, 10 out of 15 patients with alveolitis were with Parant III classification and the rest 5 patients were with Parant II classification among individuals with alveolitis in the present study ($p \geq 0.05$).

Momeni et al. reported a higher incidence of alveolitis in women, but this was not statistically significant (0.08%-0.04%).²¹ Akinbami and Godspower also reported an insignificant incidence of alveolitis of 63.2% in women and 36.8% in men.²² Sweet and Butler found an 8-fold higher incidence of alveolitis in women than in men, while Tjernberg reported a 5:1 female-to-male ratio.^{23,24} In this study, the incidence of alveolitis was found to be 53.3% in women and 46.7% in men, and this difference was not statistically significant ($p \geq 0.05$).

CONCLUSION

In this study, it was determined that postoperative complications were more severe in smokers, and postoperative smoking had adverse effects especially,

when smoked during postoperative 7 days as expected at the beginning of the study, therefore we can claim that smoking can worsen all the postoperative prognosis. It could be more beneficial if wound healing would also be evaluated. Future studies need histological and histomorphometric evaluation of wound healing to be performed, and more patients to be included.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: Özgün Yıldırım, Nilay Bilgin Erden, Nur Mollaoğlu; **Design:** Özgün Yıldırım, Nilay Bilgin Erden, Nur Mollaoğlu; **Control/Supervision:** Özgün Yıldırım, Nilay Bilgin Erden, Nur Mollaoğlu; **Data Collection and/or Processing:** Özgün Yıldırım, Nilay Bilgin Erden, Nur Mollaoğlu; **Analysis and/or Interpretation:** Özgün Yıldırım, Nilay Bilgin Erden, Nur Mollaoğlu; **Literature Review:** Nilay Bilgin Erden; **Writing the Article:** Özgün Yıldırım; **Critical Review:** Nur Mollaoğlu; **References and Fundings:** Özgün Yıldırım; **Materials:** Özgün Yıldırım.

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