

Evaluation of risk factors predisposing to complications after mandibular third molar surgery

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Abstract

Aim: The aims of the study is to assess the risk factors like age, gender, smoking etc. which predispose to complications in mandibular third molar surgery.

Materials and Method: Sixty two patients were selected for mandibular third molar extraction. The tooth was extracted using Ward's and modified ward's incision. The duration of the procedure was recorded. The parameters measured post-operatively included Pain, Swelling, Trismus, Infection, Nerve Injury and Dry socket. They were compared on the basis of Age, Gender, Smoking habit, Angulation of roots, type of Impaction etc.

Result: No significant effect of age was seen on the pain, swelling or trismus. Though, pain was recorded more in female patients, the male patients reported with higher swelling and trismus. All the parameters were high for the smoker group. The duration of the surgery was higher in less experienced surgeons.

Conclusion: Within the limitations of the study, it was concluded that Human factors like age, sex, smoking habit of the patient and expertise of the surgeon have a great role in the degree of complications which occur after third molar surgery. Anatomical risk factors i.e. the angulation of third molar, root form and proximity of the third molar root apex to the inferior alveolar nerve determines the difficulty in third molar extraction.

Keywords: Third Molar Impaction, Complications, Smoking, Age, Gender

Introduction

Third molar surgery is the most frequently done surgery by the Oral and Maxillofacial Surgeons worldwide. Incidence of third molar impaction is increasing day by day due to reduced jaw size and that is why most of these impacted teeth need to be addressed in terms of their removal or retention. Mandibular third molars are removed for a variety of reasons, but pericoronitis is the main reason for extraction in most cases. Post-operative complications after surgical removal of mandibular third molars like Alveolar osteitis, Infection, Pain, Swelling, Trismus, Bony spicule, Osteomyelitis, Temporo-mandibular joint disorders etc. have been reported in different frequencies and extents, ranging from mild discomfort after the operation to major complications that require further treatment, hospitalization and may result in permanent damage. Therefore, the routine extraction of mandibular third molars where there is no clear indication is discouraged.⁽¹⁾

The literature reports several factors that have a significant effect on the occurrence of complications after the surgical procedure. There are patient related factors including age, gender, smoking and the use of oral contraceptives.^(2,3) Anatomic related factors included the level of impaction, angulation and the preexisting inflammatory condition.^(4,5) In addition there are operation related factors including reflection of flap, bone removal, operation time, and seniority of the operator.^(5,6)

The purpose of this study was to study the frequency and risk factors associated with postoperative inflammatory complications among adult patients (age > 25years) undergoing removal of third molars.

Aims and Objectives

The aim and objective of the study is to assess the following risk factors which predispose to complications in mandibular third molar surgery.

1. Age
2. Gender
3. Medications such as corticosteroids, antibiotics or oral contraceptives
4. Smoking
5. Previous infection
6. Periodontitis
7. Poor oral hygiene
8. Surgeon's experience
9. Duration of extraction
10. Number of teeth extracted
11. Anesthetic technique
12. Positive medical history
13. Nerve proximity

Materials and Method

Study sample was taken as 62 patients. The predictable variables i.e. risk factors or exposures are grouped into following set of variables:-

- A) Demographic (age, gender)

- B) Anatomic (Angulation of mandibular third molar, Root form, Proximity of inferior alveolar nerve to the third molar root apex)
- C) Operative
 - 1. The operation used to remove the mandibular third molars:
 - Non-surgical
 - Surgical
 - 2. Anesthetic technique
 - Local
 - General
- D) Medical and Dental history

History is recorded as positive and negative. Conditions associated with wound healing problems, organ transplant, HIV infection, Diabetes and other immune disorders or blood dyscrasias were considered as positive finding.

A positive dental history was recorded if one or more of the following findings were present: bleeding gums, orthodontic treatment, difficulty with jaw movements, loose teeth, sensitive teeth and bruxism. Pre-operative signs and symptoms including pericoronitis, pain, swelling, caries, orthodontic treatment, damage to second molar, impacted teeth, unfavorable mandibular third molar functional anatomy (i.e. malopposed, unopposed or supra erupted teeth, opposing tooth to be extracted), periodontal disease or infection were also recorded. Preoperative use of medications: (oral contraceptives, systemic steroids or antibiotics) were also recorded. The presence or absence of tobacco and alcohol use was also documented.

Selection Criteria

- 1. Inclusion criteria were removal of One or more third molars and Complete postoperative follow-up (patients are recalled on the 1st day, 3rd day, 7th day)
- 2. Exclusion Criteria included Patients with bleeding disorders, Uncontrolled diabetic and hypertensive patients, Patient with active infection, Recent history of myocardial infarction.

Surgical Technique: The surgical area was prepared with betadine and patient was draped.

Inferior alveolar nerve block, lingual nerve block and long buccal nerve block were administered using 2% lignocaine hydrochloride with 1: 80,000 adrenaline.

Standard Ward’s incision was followed. The incision started from a point about ¼ inch down in the buccal sulcus approximately at junction of posterior third and middle third of second molar. The anterior line of incision started from the vestibule with blade pressed firmly down to bone. Incision then passed upwards to distobuccal angle of second molar at gingival margin.

Here the course of incision was passed cervically behind the tooth to the middle of its posterior surface if the third molar was not erupted. From this point, the cut was taken backwards and buccally, root directed straight upto ramus.

In its final continuation, the incision penetrated the

cheek tissue only at mucosal depth extended laterally for about 25.4mm (1 inch) (Fig. 1).

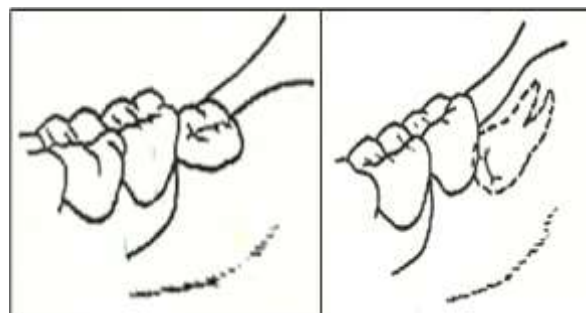


Fig. 1: Ward’s incision and Modified ward’s incision

The sharp end of Howarth’s periosteal elevator was inserted at the anterior end of incision and slide downwards along its edge into the sulcus to confirm that the scalpel had reached bone. The opposite blunt wide end was substituted and insinuated beneath the periosteum to reflect the soft tissues at correct plane of cleavage.

After achieving adequate exposure a straight fissure bur no. 702 was used for buccal guttering starting from the mesiobuccal line angle to the distobuccal line angle and vertically upto one-half of the root length from the cemento-enamel junction to the root apex. Now a Coupland’s elevator is applied to elevate the tooth, after the retrieval of the complete tooth irrigation of the socket is done with betadine solution. Now filing of the bony margins is done to remove any bony spicules. Following this, closure is performed by using a 3-0 silk suture (Fig. 2).

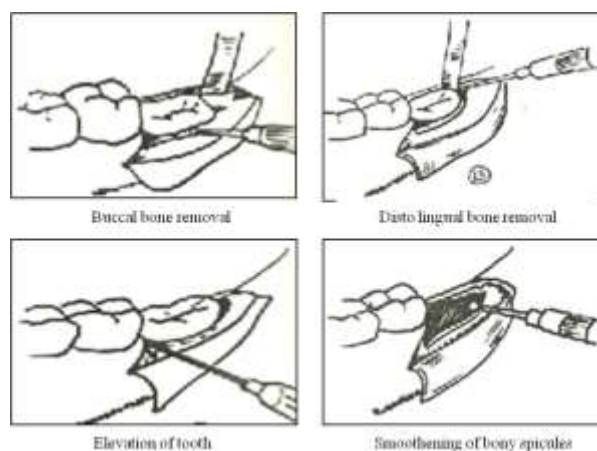


Fig. 2: Bone Guttering

Post Operative Measurements of Various Parameters:

Pain: It was evaluated by noting the intensity of pain with a Visual Analogue Scale (VAS). A scale of 0-10 was used to assess the intensity of pain. 0 means no pain, 1-3 means mild pain, 4-7 means moderate pain and >7 means severe pain. The patient was asked to

place a mark on the location of the line that best describes his or her pain post-operatively.

Swelling: Facial measurements were taken pre-operatively and post-operatively using a black suture material and a ruler, recorded in millimeters. Swelling will be measured by marking four points on the patient's face i.e. ala of the nose, tragus of the ear, gonion and menton (Fig. 3, 4).



Fig. 3: Swelling assessment (ALA of Nose to Tragus)



Fig. 4: Swelling Assessment (Gonion to Menton)

Trismus: Distance between the incisal edges of the maxillary and mandibular central incisors was measured when the mouth was open to the full extent. The amount of trismus was taken as a difference in the maximum opening of mouth before and after surgery using divider and a ruler in millimeters (Fig. 5).



Fig. 5: Inter incisal mouth opening assessment (for trismus)

Infection: Post-operative infection was assessed clinically by the presence or absence of suppuration and persistent pain or swelling on subsequent visits.

Nerve injury was assessed using Brush directional stroke test & Pinprick test.

Dry Socket: Dry socket is evaluated on the 3rd postoperative day. Clinical signs such as sloughing, tenderness, exposed bone, fetid odour were recorded.

Statistical Analysis: The software used for the statistical analysis were SPSS (statistical package for social sciences) version 16.0. The chi-square test was used for difference between the proportions. The level of significance was taken at 5% ($p < 0.05$).

Results

Out of 62 patients, 20 cases were performed non-surgically (removal of impacted mandibular third molar with a forcep or an elevator without giving an incision) while surgical extractions were performed on 42 cases. No significant post-operative complications were observed in non-surgical extraction. So, only surgically removed impacted third molars were statistically analyzed.

The demographic variables studied were age and gender.

1. Age: patients were divided into 3 groups- Group I: age 18-25 years. (24 patients)
 - Group II: age 26-35 years. (15 patients)
 - Group III: >35 years. (3 patients)

In the present study, no significant difference was found among different complications. But the duration of extraction of mandibular third molar were greater in group II and III patients. (Table 1).

Table 1: Comparison of swelling, pain, trismus and duration of extraction among different age groups

		Age Group	1 st Post-Operative day	3 rd Post-Operative day	7 st Post-Operative day
Swelling	Ala-tragus Swelling (mm)	18-25 years	54.20%	25.00%	0
		26-35 years	60.00%	20.00%	0
		>35 years	33.30%	33.30%	0
		P-Value	0.696	0.866	--
	Gonion-	18-25 years	91.70%	62.50%	0

	menton swelling (mm)	26-35 years	100.00%	93.30%	0
		>35 years	100.00%	100.00%	0
		P-Value	0.455	0.054	--
Pain		18-25 years	54.20%	66.70%	0
		26-35 years	46.70%	46.70%	0
		>35 years	66.70%	66.70%	0
		P-Value	0.852	0.449	0.819
Trismus		18-25 years	95.80%	91.70%	37.50%
		26-35 years	93.30%	93.30%	26.70%
		>35 years	100.00%	100.00%	0.00%
		P-Value	0.866	0.866	0.376
Duration of Extraction			<30Mins	>30Mins	
		18-25 years	54.20%	45.80%	
		26-35 years	40.00%	60.00%	
		>35 years	33.30%	66.70%	

Table 2: Comparison of swelling and trismus among males and females

	Gender	1st Post-Operative Day	3rd Post-Operative Day	7st Post-Operative Day
Swelling (mm)	Male	100.0%	78.6%	0
	Female	85.7%	71.4%	0
	P-Value	0.040	0.608	--
Trismus	Male	92.9%	92.9%	39.3%
	Female	100.0%	92.9%	14.30%
	P-Value	0.306	1.000	0.099

Table 3: Average time taken

Variable	Average time
Angulation	
- Mesioangular	25.50 minutes
- Distoangular	40.25 minutes
- Vertical	33.00 minutes
- Horizontal	51.50 minutes
Root form	
- Multiple	41.55 minutes
- Fused	30.00 minutes
Nerve proximity	
- Present	48.50 minutes
- Absent	20.50 minutes
Time taken by operator	
- Faculty	22.50 minutes
- P.G student	51.25 minutes

Table 4: Comparison of swelling, pain and trismus among smokers and non-smokers

		1st Post-Operative Day	3rd Post-Operative Day	7st Post-Operative Day
Swelling	Ala-tragus Swelling (mm)	Smokers	72.00%	56.00%
		Non-Smokers	29.41%	11.76%
		P-Value	0.006	0.004
	Gonion-menton swelling (mm)	Smokers	100.00%	88.00%
		Non-Smokers	88.24%	70.59%
		P-Value	0.158	0.156
Pain	Smokers	54.20%	66.70%	0

	Non-Smokers	46.70%	46.70%	0
	P-Value	0.852	0.449	0.819
Trismus	Smokers	100.00%	92.00%	52.00%
	Non-Smokers	92.00%	82.35%	26.10%
	P-Value	0.506	0.379	0.007

For Ala-Tragus swelling and gonion-menton swelling: among the 18-25 year age group swelling was present in 13 (54.20%) patients; among the 26-35 year age group swelling was present in 9 (60.00%) patients; among the >35 years age group swelling was present in 1 (33.30%) patients. The difference was found to be statistically not significant ($p>0.05$) on first, third and seventh post operative day.

For Trismus: Among the 18-25 year age group trismus was present in 23 (95.80%) patients; among the 26-35 year age group trismus was present in 14 (93.30%) patients; among the >35 years age group trismus was present in 3 (100.00%) patients. The difference was found to be statistically not significant ($p>0.05$) on first, third and seventh post operative day.

Pain: Among the 18-25 year age group 0 (0%) patients had no pain, 1 (4.20%) patients had mild pain, 10 (41.70%) patients had moderate pain and 13 (54.20%) patients had severe pain; among the 26-35 year age group 0 (0%) patients had no pain, 0 (0%) patients had mild pain, 8 (53.30%) patients had moderate pain and 7 (46.70%) patients had severe pain; among the >35 years age group 0 (0%) patients had no pain, 0 (0%) patients had mild pain, 1 (33.30%) patients had moderate pain and 2 (66.70%) patients had severe pain. The difference was found to be statistically not significant ($p>0.05$) on first, third and seventh post operative day.

Duration of extraction: Among the 18-25 year age group, duration of extraction was <30 minutes in 13 (54.20%) patients and >30 minutes in 11 (45.80%) patients.

Among the 26-35 year age group, duration of extraction was <30 minutes in 6 (40.00%) patients and >30 minutes in 9 (60.00%) patients. Among the >35 year age group, duration of extraction was <30 minutes in 1 (33.30%) patient and >30 minutes in 2 (66.70%) patients. The difference was found to be statistically not significant ($p>0.05$).

2. **Gender:** Out of a total of 42 patients, 28 were males and 14 were females. Again the most common complications were pain, swelling and trismus.

Swelling: Among the males and the females more swelling was observed in males as compared to females at the ala-tragus and at the gonion-menton region (Table 2). In males swelling was present in all 28 (100.00%) patients and in females swelling was present in 12 (85.7%) patients. The difference was statistically significant ($p<0.05$) on first post-operative day, but

became statistically not significant on third and seventh post operative day.

Trismus: Post-operative trismus was observed more in males as compared to females, by 7th post-operative day all patients returned to their normal mouth opening or the patients that reported with preoperative reduced mouth opening had an improved mouth opening by 7th post-operative day. Among the males, trismus was present in 26 (92.90%) patients; in the females, trismus was present in all 14 (100.0%) patients. The difference was found to be statistically not significant ($p>0.05$).

3. **Medical and Dental History:** Amongst all the conditions (risk factors/variables) only smoking was studied as a risk factor. The complications were observed in terms of swelling, pain and trismus. From a total of 42 patients, 19 were smokers and 23 were non-smokers. No case of alveolar osteitis was reported in this study. (Table 4)

Swelling: In the smokers group, swelling was present in 25 (100.0%) patients; in the non-smokers group, swelling was present in 15 (88.24%). The difference was found to be statistically not significant ($p>0.05$) on I and III post operative day. There was a constant decrease in swelling from 1st post-operative day to the 7th post-operative day both at the ala-tragus and gonion-menton region.

Trismus: In the smokers group, trismus was present in 23 (92.0%) patients; in the non-smokers group, trismus was present in 17 (100.0%). The difference was found to be statistically not significant ($p>0.05$) for I and III post operative day but increased significantly on VII post operative day. Reduced mouth opening (trismus) could be seen at the 7th post-operative day in case of smokers (13 patients).

Pain: Severe pain was observed at the 1st post-operative day which reduced significantly by the 7th post-operative day.

The anatomic variables or risk factors that were evaluated are: angulation of mandibular third molar, root form and nerve proximity.

The angulation of third molar was grouped as mesioangular, distoangular, vertical and horizontal. It was found that the distoangular and horizontal angulation of mandibular third molar took greater time for removal than the vertical and mesioangular angulation. The root form of mandibular third molar was divided into multiple or fused roots. It was found that the teeth with multiple roots took more time for removal than the teeth whose roots were fused (Table

3). In the study it was found out that in cases where the inferior alveolar nerve was in close proximity to the third molar root apex (no. of cases 9) took more time for extraction as compared to when inferior alveolar nerve was not related to third molar root apex (no. of cases 33). The time taken in various anatomical variables (angulation, root form and nerve proximity) is self-explanatory in terms of difficulty of extraction, which clearly is similar to the well established fact in literature i.e. distoangular, multirrooted and proximity to nerve will take more time and that is why will have more complications.

Surgical variables: All the patients were operated under local anesthesia, whereas the surgeon's experience as a variable was studied and observed, it was found that P.G students took more time than the faculty for the removal of mandibular third molar. The average time taken by faculty member was 22.5 minutes and average time taken by P.G student was 51.25 minutes. Fewer complications were observed when cases were performed by faculty as compared to a P.G student.

Discussion

Surgical removal of the third molar is one of the most common surgical procedures performed as a day case or as an inpatient.⁽⁷⁾ The literature reports several factors that have a significant effect on the occurrence of complications after the surgical procedure. There are patient related factors, including age, gender, smoking and use of oral contraceptives.^(2,3) Anatomic related factors include the level of impaction, angulation and pre-existing inflammatory condition.^(4,5) In addition, there are operation related factors including reflection of flap, bone removal, operation time and experience of the operator.^(4,5,8)

The aim of this study was to evaluate the risk factors predisposing to complications after mandibular third molar surgery. The major complications studied were pain, swelling, trismus, nerve injury, dry socket, etc. among these common complications were pain, swelling and trismus. In this study risk factors which were evaluated with complications were age, sex, smoking, duration of extraction and surgeon's experience.

The results of the present study show an increased rate of complications among the 26-35 year and >35 year age groups. This is in agreement with the results of Sung Kiang Chung et al.⁽⁹⁾ The duration of extraction for the removal of mandibular third molar was significantly increased in the higher age groups as compared to the 18-25 year age group. This shows that with increasing age the duration of extraction of mandibular third molar also increases which in turn is responsible for increased complication rate. These results are similar to the study of Ingibjorg S. Benediktssdottir et al⁽¹⁰⁾ & Chi H. Bui et al,⁽¹¹⁾ T. Renton et al⁽¹²⁾ & Ceib Phillips et al⁽¹³⁾ found that patients over

the age of 30 years were significantly more at risk of difficult extractions and delayed recovery than younger patients. Bruce et al⁽¹⁴⁾ reinforced the clinical impressions of surgeons performing third molar surgery; increased age leads to more clinical problems after surgery including an increased incidence of localized osteitis and delayed wound healing.

This positive correlation may be related to increased bone density, which may result in more manipulation during the operation. Peterson et al also linked bone density (measured radiographically) to age and increased surgical difficulty. In addition to changes in bone density, increased age is associated with complete root formation and diminished wound healing capabilities, which can result in higher operative and inflammatory complications.

Within limitations of this study it was concluded that higher rates of swelling and trismus were seen in males. This is not in agreement with the results of S.E. Fischer et al⁽¹⁵⁾ & Heasman and Jacobs.⁽¹⁶⁾ On the other hand, females reported with more pain values than males. This may be due to the difference in pain severity and tolerance between the sexes, or it may be that women are more honest in their recording of pain levels. This is in accordance with Ingibjorg S. Benediktssdottir et al.⁽¹⁰⁾

Tobacco use as a risk factor for post-operative complication after third molar removal has been extensively documented.⁽¹⁷⁾ Smoking tobacco exerts a variety of systemic effects. Nicotine is known to affect the nervous system, the heart, blood vessels and endocrine glands.⁽¹⁸⁾ It induces vasoconstriction in the peripheral circulation⁽¹⁹⁾ and production of lipids and lipoproteins is increased.⁽²⁰⁾

In the present study, significantly increased levels of pain, swelling & trismus on 7th post-operative day were recorded in smokers. This is in agreement with Sweet and Butler.⁽²¹⁾ They suggested that this might be due to disturbance of blood clot by the act of smoking. J.G. Meechan et al⁽²²⁾ suggested that smoking reduces the blood supply to the extraction socket.

Carmen Lopez Carriches et al⁽²³⁾ recorded increased trismus among smokers. Zaid H. Baqain et al⁽¹⁾ found that two factors significantly affected the development of trismus: level of impaction and lingual tissue retraction. Angulation of third molar and operation time were close to statistical significance. When compared with soft tissue impaction the risk of unexpected trismus for partial bony impaction was around four times and for total bony impaction around twenty times.

This study reported no cases of alveolar osteitis. This may be due to the fact that our patients followed the post-operative instruction regularly and were more cooperative. According to Meechan et al⁽²²⁾ smoking reduces alveolar blood supply after dental extraction, and dry socket was found to be more common among smokers.

In this study, it was observed that horizontal and distoangular impactions took more time for removal (51.50 minutes and 40.25 minutes respectively) as compared to mesioangular and vertical impactions that took less time (25.50 minutes and 33.00 minutes respectively). Horizontal impactions require greater amount of bone to be removed, therefore are more often related with complications. It was also observed that multi-rooted teeth took more time for removal (41.55 minutes) than teeth that had fused roots (30.00 minutes). In cases where the root apex of mandibular third molar was in close proximity to the inferior alveolar canal took more time for removal (48.50 minutes) as compared to when root apex was not related to the inferior alveolar canal (20.50 minutes). This study recorded only one case of inferior alveolar nerve damage and one case of lingual nerve damage. The nerve injuries resolved within 1 month. The inferior alveolar nerve injury was seen in a distoangular impaction with close approximation to the inferior alveolar canal. Excessive reflection of the lingual flap was the reason for the damage of the lingual nerve. These results are in agreement with the results of Ingibjorg S. Benediktsdottir et al.⁽¹⁰⁾ Zaid H. Baqain et al⁽¹⁾ showed that deeper impactions had a greater risk of developing trismus.

Operative factors such as inexperience of the surgeon and the use of general anesthesia have been related to increased post-operative complications, paresthesia included,⁽²⁴⁾ although other studies have failed to show any relationship between the experience of the surgeon or the use of general anesthesia and post-operative complications.⁽²⁵⁾

In the study, it was observed that a more experienced surgeon i.e. a faculty member took significantly less time (22.50 minutes) than a P.G student (51.25 minutes) for the removal of a mandibular third molar. Thus, fewer complications were observed when a case was performed by a faculty member. We observed only 2 cases of nerve damage in our study, one was inferior alveolar nerve injury and the other was lingual nerve damage. Both cases were performed by a P.G student. Thus, it would be safe to say that with greater experience and expertise, post-operative complications and duration of extraction can be significantly reduced.

According to Srinivas M. Susrala and Thomas B. Dodson,⁽²⁶⁾ increasing surgical experience decreases extraction time- experienced surgeons will have performed more extractions and have a higher skill level than those with less experience or those in training. Similarly, Sisk et al⁽⁵⁾ found a significant increase in the incidence of post-operative complications, including alveolar osteitis, after third molar removal when resident surgeons rather than more experienced faculty surgeons performed the surgery.

Conclusion

To conclude:-

1. Human factors like age, sex, smoking habit of the patient and expertise of the surgeon have a great role in the degree of complications which occur after third molar surgery.
2. Anatomical risk factors i.e. the angulation of third molar, root form and proximity of the third molar root apex to the inferior alveolar nerve determines the difficulty in third molar extraction.
3. Expertise of the surgeon plays a big role and it is concluded that the time taken by expert surgeon was less than the trainee and thereby less complications were observed in the cases operated by expert surgeon.
4. A large sample size is required to establish the concrete conclusion, whether these risk factors (demographic, anatomical, dental /medical history and surgical) really have the impact on the degree of complications after third molar surgery.

References

1. Zaid H. Baqain, Ashraf Abu Karaky, Faleb Sawair, Ameen Khaisat, Lamis D. Rajab: Frequency estimates and risk factors for postoperative morbidity after third molar removal: A Prospective Cohort study. *J Oral Maxillofac Surg* 66:2276-2283, 2008.
2. J.B Sweet and D.P Butler: The relationship of smoking to localized osteitis. *J Oral Surg* 37:732, 1979.
3. A.G Garcia, P.M Grana, F.G Sampedro et al: Does oral contraceptive use affect the incidence of complications after extraction of a mandibular third molar? *Br Dent J* 194:453, 2003.
4. M.P de Boer, G.M Raghoebar, B. Stegenga et al: Complications after third molar extractions. *Quintessence Int* 26:779, 1995.
5. A.L Sisk, W.B Hammer, D.W Shelton, et al: Complications following removal of impacted third molars: The role of experience of the surgeon. *J Oral Maxillofac Surg* 44:855, 1986.
6. G.E Lilly, D.B Osbon, E.M Rael, et al: Alveolar osteitis associated with mandibular third molar extractions. *J Am Dent Assoc* 88:802, 1974.
7. J.P Shepherd and M. Brickley: Surgical removal of third molars. *BMJ* 10:620, 1994.
8. W. Jerjes, El-Maaytah, B. Swinson et al: Experience versus complication rate in third molar surgery. *Head Face Med* 24:14, 2006.
9. Sung-Kiang Chuang, David H. Perrott, Srinivas M. Susarla and Thomas D. Dodson: Age as a risk factor for third molar surgery complications. *J Oral Maxillofac Surg* 65:1685-1692, 2007.
10. Ingibjorg S. Benediktdottir, Ann Wenzel, Jens K. Peterson and Hanne Hintze: Mandibular third molar removal: Risk indicators for extended operation time, postoperative pain and complications. *Otol Surg Oral Med Oral Pathol Oral Radiol Endod* 97:438-436, 2004.
11. Chi H. Bui, Edward B. Seldin and Thomas B. Dodson: Types, frequencies, and risk factors for complications after third molar extraction. *J Oral Maxillofac Surg* 61: 1379-1389, 2003.
12. T. Renton and M. McGurk: Evaluation of factors predictive of lingual nerve injury in third molar surgery.

- British Journal of Oral and Maxillofacial Surgery 39:423-428, 2001.
13. Ceib Phillips, Raymond P. White, Daniel A. Shugars and Xiaolei Zbou: Risk factors associated with prolonged recovery and delayed healing after third molar surgery. *J Oral Maxillofac Surg* 61: 1436-1, 2003.
 14. R. A Bruce, G. C Fredrickeson, G. S Small. Age of patient and morbidity associated with mandibular third molar surgery. *J Amm Dent Assoc* 101:240-245, 1980.
 15. S .E. Fischer, J.W. Frame, P.G.J. Rout and D.J. McEntegart: Factors affecting the onset and severity of pain following the surgical removal of unilateral impacted mandibular third molar teeth. *Br dent J* 1988; 164: 351
 16. P.A Heaseman and D.J Jacobs: A clinical investigation into the incidence of dry socket. *Br J Oral Maxillofac Surg* 22:115, 1984.
 17. Kirk L. Fridrich and Robert A. J. Olson: Alveolar osteitis following surgical removal of mandibular third molars. *Anesth Prog.*37: 42-47, 1990.
 18. Royal College of Physicians: Smoking or Health. Report of the Royal College of Physicians. 3rd ed., 39-51, 1977.
 19. M.G Mulinos and I. Shulman: The effects of cigarette smoking and deep breathing on the peripheral nervous system. *Americal Journal of Medical Sciences* 199:708, 1940.
 20. J.D Billimoria, H. Pozner, B. Metselaar, F.W Best and D.C.O James: Effects of cigarette smoking on lipids, lipoproteins, blood coagulation, fibrinolysis and cellular components of human blood. *Atherosclerosis* 21:61, 1975.
 21. Sweet J.B, Butler D.P: The relationship of smoking on localized osteitis. *J Oral Surg* 37; 732, 1979.
 22. J.G. Meechan, I.D.M. MacGregor, S.N. Rogers, et al: The effect of smoking on immediate post-operative socket filling with blood and on the incidence of painful socket. *Br J Oral Maxillofac Surg* 26; 402-409, 1988.
 23. Carmen López Carriches, Rafael Gómez Font, José M^a Martínez-González, Manuel Donado Rodríguez. Influence of smoking upon the postoperative course of lower third molar surgery. *Med Oral Patol Oral Cir Bucal* 11:56-60, 2006.
 24. Anwar B. Bataineh: Sensory nerve impairment following mandibular third molar surgery. *J Oral Maxillofac Surg* 59:1012-1017, 2001.
 25. Martin P. J. de Boer, Gerry M. Raghoebar, Boudewijn Stegenga, et al: Complications after mandibular third molar extraction. *Quintessence Int.* 26:779-784, 1995.
 26. Srinivas M. Susarla and Thomas B. Dodson: Risk factors for third molar extraction difficulty. *J Oral Maxillofac Surg* 62:1363-1371, 2004.