

Complications of Wisdom Tooth Removal by Non-Oral and Maxillofacial Surgeons: Rate and Related Factors

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Abstract

Wisdom tooth removal has a wide range of potential complications. Most are insignificant, yet critical ones may result in irreversible consequences. In addition, the rate of complications varies widely and seems to be influenced by a variety of factors. However, there is limited knowledge about the complications, especially in contexts where oral and maxillofacial surgeons are unavailable. This retrospective cohort study aimed to determine the rate of complications in wisdom tooth removals by non-oral and maxillofacial surgeons and relating factors. Using a structured record form, this study collected data from dental records of patients who had their wisdom teeth removed between 2012 and 2017. Of the 898 teeth removed by nine non-oral and maxillofacial surgeons, 631 teeth (70.3 %) met the eligibility criteria. Ten types of signs and symptoms recorded in the operation, emergency and follow-up visits indicated the presence of complications. Multiple Logistic Regression and the Generalized Estimating Equation were used to analyze five potentially related factors. The findings showed that three-fourths of wisdom teeth were removed from female patients. The average age was 26.7 ± 9.36 years old. The rate of complications was 12.0 % (95%CI 9.6-14.8). The first three complications were severe pain (4.9 %), alveolar osteitis (2.5 %) and incomplete root removal (1.5 %). The increasing of age by five years would lead to 27 % of developing complications (OR_{adj}=1.27 95%CI 1.14–1.42 $p < 0.001$).

Keywords: Complication, Removal, Wisdom tooth, non-oral and maxillofacial surgeon

Received Date: Nov 1, 2018

Revised Date: Dec 11, 2018

Accepted Date: Jan 17, 2019

doi: 10.14456/jdat.2019.21

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Introduction

Wisdom tooth removal is one of the most common procedures¹ performed by oral and maxillofacial surgeons (OMSs) worldwide.² This procedure has some risks that lead to complications.³ Common complications of wisdom tooth removal are pain, alveolar osteitis (AO), and swelling.²

Nevertheless, rare but serious complications do occur, such as inferior alveolar nerve (IAN) injury.^{4,5} and deep space neck infection.^{6,7} The complications of wisdom tooth removal also include tissue injury, trismus, excessive bleeding, delayed healing, bone fracture, oroantral

communication, incomplete root removal, adjacent tooth damage, temporomandibular joint disorder and infection.^{4,6,7} These negative consequences can extend the treatment process or become life-threatening, which potentially leads to a lawsuit against the dentist.⁸ About one-seventh of dentists are taken to court every year, and the upward trend has been continuing.⁹

The rate of complications varies from 2.6 % to 30.9 %.² Many analytical studies also indicated a number of relating factors, for example gender, the age of the patients, the flap-opening technique, the tooth position, difficulty, the existing pathology, the experience of the dentist, the removal method, and systemic condition.^{1,10-13} The identification of these potential factors would be beneficial for treatment planning.¹⁴ Some complications can then be reduced or prevented.

Theoretically, wisdom tooth removal should be performed by skillful practitioners, not occasional surgeons.¹⁵ However, there has been a considerable shortage of dental professionals, especially in developing countries across Africa, Asia and Latin-America.¹⁶ Dental specialists, including OMSs, are commonly available only in certain contexts.^{17,18} In 2017, Thailand had a ratio of one dentist to 6,681 population¹⁹, and the number of OMSs was less than 400.¹⁸ In many parts of the world, patients are likely to experience dental services with general dental practitioners (GP) or non-OMSs.

Nevertheless, the quality of wisdom tooth removal in such a situation remains unclear. One study reported a longer operating time in wisdom tooth removal and a tendency of post-operative pain and alveolar osteitis among GPs.²⁰ In an era of high expectations and demand, there is an urgent need to understand and address the safety of this operation. Therefore, this study aims to determine the rate of complications of wisdom tooth removal by non-OMSs. Additionally, this study also attempts to obtain more knowledge in terms of complication types and various related factors.

Materials and Methods

This retrospective cohort study collected data from dental records of patients who had their wisdom teeth removed in a community hospital, Khon Kaen, Thailand, between 2012 and 2017. The hospital was purposively selected according to an area-based policy. Nine non-OMSs removed wisdom teeth with the same method and instruments. All removals were carried out under local anesthesia. If necessary, tooth sectioning and bone removal were performed using a sterile low-speed handpiece with sterile saline solution. A synthetically absorbable suture was used to close the flap. Patients undergoing simple extraction received Acetaminophen, whereas those undergoing tooth sectioning and/ or bone removal received Ibuprofen. Post-operative prophylactic antibiotic treatment was provided only in certain conditions, for example, at risk of infection. Follow up was done in seven days after the operation for every patient. All patients were advised to come back to the hospital in the case of an emergency involving the wisdom tooth removal. The total number of wisdom teeth removed was 898. This study applied two exclusion criteria, namely an incomplete record and no post-operation visit. The criteria here were used to collect only analyzable data which was important to reliable outcomes. A structured record form was developed to collect the data. This record form consisted of three parts: collection of general data, related factors, and complications in wisdom tooth removal. The record form was examined for content validity by two OMSs and one GP with 15 years of experience in dental surgery. The Index of Item Objective Congruence (IOC) of the instrument was 0.87. After revision, the record form was used to collect the data.

The primary outcome of this study was the complications of wisdom tooth removal. Undesirable or unintended consequences included those occurring during the operation, those bringing patients back for an emergency visit, or those found during the follow-up

visit. The secondary outcomes consisted of ten types of complications, namely severe pain, AO, infection, oroantral communication (OAC), temporomandibular joint disorder (TMD), IAN injury, incomplete root removal,

excessive bleeding, adjacent tooth damage and soft tissue injury. Each complication was carefully defined to form the complication criteria (Table 1). Only those meeting the criteria were certified as complications.

Table 1 *Complication criteria*

Complications	Criteria
Severe pain*	<ul style="list-style-type: none"> ● Emergency visit because of unbearable pain after wisdom tooth removal ● In follow up visit, patient still has unbearable pain ● Complains that prescription drug does not stop the pain ● Patient needs to take other medication to stop pain
AO**	<ul style="list-style-type: none"> ● Diagnosed with alveolar osteitis in emergency or follow up visit ● Presence of exposed alveolar socket ● Presence of smelly, yellowish-grey necrotic tissue in the socket ● Complains about sudden & continuous severe pain within 2-4 days after wisdom tooth removal ● Complains about chronic pain continuing for 10-14 days ● Socket irrigation and dressing with gauze & clove oil or gauze & Vaseline or Alvogyl® in emergency or follow up visits
Infection*	<ul style="list-style-type: none"> ● Diagnosed with wisdom tooth removal infection ● Presence of purulent discharge or abscess ● Antibiotics prescription in emergency or follow up visits
OAC*	<ul style="list-style-type: none"> ● Diagnosed with OAC in emergency or follow up visits ● Maxillary sinus perforation in operation visit ● Complains about false breath, salty taste with fluid going from mouth to nose when drinking ● Complains about whistling sound as air passes down the fistula into oral cavity ● Complains about difficulty in performing wind musical instrument ● Complains about pain on palpation at the area of cheekbone of the side of wisdom tooth removal
TMD**	<ul style="list-style-type: none"> ● Diagnosed with TMD in emergency or follow up visits ● Presence of limitation or decreasing in range of mandible movement ● Upper and lower teeth not properly fitting together ● Complains about pain or tenderness at preauricular area ● Complains about masticatory muscle pain when close or open mouth
IAN injury*	<ul style="list-style-type: none"> ● Diagnosed with paresthesia in emergency or follow up visits ● Complains about itching or numbness of lower lip, chin or tongue ● Complains about sensational difference between left and right side of lower lip, chin or tongue ● Vitamin B prescription in follow up visit
Incomplete root removal*	<ul style="list-style-type: none"> ● Diagnosed with retained root tip in emergency or follow up visits ● Unremoved fractured root tip in operation visit ● Presence of fractured root tip in the socket ● Presence of fractured root tip in film
Excessive bleeding*	<ul style="list-style-type: none"> ● Emergency visit because of unstoppable bleeding after wisdom tooth removal ● Excessive bleeding during operation ● Additional approach to stop bleeding rather than gauze & pressure ● Referring patient because of unstoppable bleeding

Complications	Criteria
Adjacent tooth damage*	<ul style="list-style-type: none"> ● Adjacent tooth damage caused by wisdom tooth removal ● Appointment to restore the damage on adjacent tooth caused by wisdom tooth removal ● Treatment of the damage on adjacent tooth caused by wisdom tooth removal
Soft tissue injury*	<ul style="list-style-type: none"> ● Presence of iatrogenic wounds of oral soft tissue during wisdom tooth removal ● Prescription or treatment for iatrogenic wounds in operation or follow up visits ● Emergency visit because of iatrogenic wound associated with wisdom tooth removal

* meet at least two criteria

** meet at least three criteria

For the demographic characteristics of the patients, frequency and percentage were used to describe categorical data, while mean, standard deviation, median, minimum value and maximum value were used to describe continuous data. The rate of complications was calculated as the number of wisdom teeth with at least one complication in relation to all teeth. The 95 % confidence interval (CI) was computed to estimate the proportion of dichotomous outcome in a single group. Frequency and percentage were used to describe complication types. This study explored five possible relating factors of the complications in wisdom tooth removal, which were the following: the age of patients, the gender of patients, existing pathology, experience of dentists and removal method. Existing pathology included pericoronitis, caries, odontogenic infection, periodontal disease, cysts, tumors, tooth fracture or other abnormalities. The experience of dentists was determined by the number of years in service as a dentist. The removal method was classified into simple extraction and surgical removal. Bivariate analysis was used to identify factors related to the complication. Then, the factors were analyzed using Multiple Logistic Regression. The Generalized Estimating Equation (GEE) was also used to account for the cluster effect. Stata version 14.0 (StataCorp, College Station, TX) was used to execute data analysis. The test statistics in this study were two-sided and less than 0.05 of *p*-value indicated a statistical significance. The study commenced after being approved by the Khon Kaen

Provincial Health Office Ethics Committee for Human Research (Ref. No. COA6092 KEC60142; March 22nd, 2018).

Results

From the total number of 898 wisdom teeth, 631 teeth (70.3 %) were available for the study according to the eligibility criteria (Fig. 1).

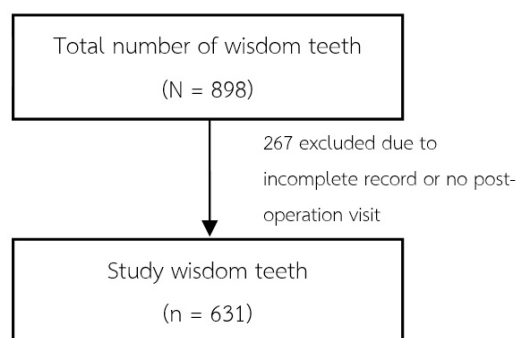


Figure 1 The flow chart of wisdom teeth in the study.

Demographic characteristics

Most wisdom teeth were removed from female patients (75.0 %), and the average age was 26.7±9.36 years old (Table 2). A small number of patients had systemic conditions. Most of them were non-smokers and non-drinkers. More than half of the teeth were surgically removed and disease-free. Three-fourths of the removals were lower teeth. The most frequent tooth angulation was vertical, followed by mesioangular. The numbers of wisdom tooth removals by dentists with six years or more of experience and dentists with less than six years of experience were relatively even.

Table 2 Characteristics of wisdom tooth removal.

Characteristics	Number n = 631
Gender	
Female	473 (75.0)
Male	158 (25.0)
Age of patients (years)	
Mean \pm s.d.	26.7 \pm 9.36
Range (Min: Max)	14: 77
Systemic conditions	
No	585 (92.7)
Hypertension	2 (0.3)
Diabetes	7 (1.1)
Hyperthyroidism	6 (1.0)
Diabetes with Hypertension	4 (0.6)
Other	27 (4.3)
Smoking	
No	583 (92.4)
Yes	48 (7.6)
Alcohol drinking	
No	549 (87.0)
Yes	82 (13.0)
Existing pathology	
No	357 (56.6)
Yes	274 (43.4)
Dental arch	
Upper	148 (23.5)
Lower	483 (76.5)
Classification	
Mesioangular	150 (23.8)
Horizontal	85 (13.5)
Vertical	322 (51.0)
Distoangular	20 (3.2)
Other	54 (8.5)

Characteristics	Number n = 631
Removal method	
Simple extraction	218 (34.5)
Surgical removal	413 (65.5)
Experience of dentists (year)	
≥ 6	323 (51.2)
< 6	308 (48.8)
Mean ± s.d.	6.5±5.86
Range (Min: Max)	0: 16
Median	7

Rate of complication in wisdom tooth removal

The rate of complications in wisdom tooth removal was 12.0 % (95%CI 9.6-14.8), as shown in Table 3. The first five complications were severe pain (4.9 %), AO (2.5 %), incomplete root removal (1.5 %), excessive

bleeding (0.9 %) and IAN injury (0.4 %). There were no cases of OAC in this study. In addition, two or more types of complications were found in six removals. Two cases were diagnosed as deep space neck infection and referred for proper treatment in the center hospital.

Table 3 Rate of complications in wisdom tooth removal.

Complications	Arch		Total N = 631	95%CI
	Upper n = 148	Lower n = 483		
No	141 (95.3)	414 (85.7)	555 (88.0)	
Yes	7 (4.7)	69 (14.3)	76 (12.0)	9.6-14.8
Severe pain	2 (1.4)	29 (6.0)	31 (4.9)	
AO	2 (1.4)	14 (2.9)	16 (2.5)	
Incomplete root removal	0 (0.0)	10 (2.2)	10 (1.5)	
Excessive bleeding	2 (1.4)	4 (0.8)	6 (0.9)	
IAN injury	-	3 (0.6)	3 (0.4)	
Severe pain & Excessive bleeding	1 (0.5)	1 (0.2)	2 (0.3)	
IAN injury & Incomplete root removal	-	2 (0.4)	2 (0.3)	
Severe pain & Infection	0 (0.0)	1 (0.2)	1 (0.2)	
Severe pain & Excessive bleeding & IAN injury	-	1 (0.2)	1 (0.2)	
Soft tissue injury	0 (0.0)	1 (0.2)	1 (0.2)	
Infection	0 (0.0)	1 (0.2)	1 (0.2)	
TMD	0 (0.0)	1 (0.2)	1 (0.2)	
Adjacent tooth damage	0 (0.0)	1 (0.2)	1 (0.2)	
OAC	0 (0.0)	-	0 (0.0)	

Related factors to the complications of wisdom tooth removal

The multiple logistic regression model is summarized in Table 4. The main factor relating to complication in wisdom

tooth removal was age of patients. After adjustment for other factors, an increase in age of five years would result in a rate of 27 % developing complications (OR_{adj} = 1.27 95%CI 1.14 – 1.42 *p* < 0.001).

Table 4 Related factors to the complications in wisdom tooth removal.

Factors	n	%	OR _c	OR _{adj}	95%CI	p-value
Gender						
Female	473	12.3	1	1	-	-
Male	158	11.4	0.92	0.79	0.41 - 1.51	0.48
Age of patients (Increase every 5 years)			1.23	1.27	1.14 - 1.42	0.00
Existing pathology						
No	357	12.0	1	1	-	-
Yes	274	12.0	1.00	0.88	0.33 – 2.32	0.80
Remove method						
Simple extraction	218	11.5	1	1	-	-
Surgical removal	413	12.4	1.09	1.41	0.87 – 2.27	0.12
Experience of dentists			0.99	0.99	0.95 – 1.02	0.54

Age of patients and the complications of wisdom tooth removal

There was a trend of increasing complications by age, as shown in Table 5. Wisdom teeth removed at

19 years old and younger developed less complications compared to other age groups. On the other hand, those wisdom teeth removed at 50 years old and over seemed to have higher rates of complications.

Table 5 Age of patients and the complications.

Age group (year)	n = 631	Complications n (%)
≤ 19	124	8 (6.5)
20 - 29	329	37 (11.3)
30 - 39	109	18 (16.5)
40 - 49	50	5 (10.0)
50 - 59	15	6 (40.0)
≥ 60	4	2 (50.0)

Experience of dentists and incomplete root removal/ IAN injury

Two complications in wisdom tooth removal,

namely incomplete root removal and IAN injury, were found to be higher by dentists with less than six years of experience (Table 6).

Table 6 Experience of dentists and incomplete root removal/ IAN injury.

Experience of dentists (year)	Incomplete root removal		IAN injury	
	Total	n (%)	Total	n (%)
≥ 6	323	2 (0.6)	238*	1 (0.4)
< 6	308	10 (3.3)	245*	5 (2.0)

* the number of teeth in lower arch

Tooth classification and complications

The complication rate of distoangular wisdom tooth removal was the highest (20.0 %) followed by the complication rates of horizontal and vertical wisdom tooth

removals respectively (16.0 % and 11.8 %). The vertical wisdom tooth removal had nine types of complications. Moreover, all infection and half of INA injury were found after the vertical wisdom tooth removal.

Table 7 Tooth classification and complications

Complications	Tooth classification (n = 631)				
	Mesioangular n (%)	Horizontal n (%)	Vertical n (%)	Distoangular n (%)	Others n (%)
No	134 (89.3)	71 (84.0)	284 (88.2)	16 (80.0)	50 (92.6)
Yes	16 (10.7)	14 (16.0)	38 (11.8)	4 (20.0)	4 (7.4)
Severe pain	8 (5.3)	5 (5.9)	12 (3.7)	3 (15.0)	3 (5.6)
AO	1 (0.7)	0 (0.0)	15 (4.7)	0 (0.0)	0 (0.0)
Incomplete root removal	2 (1.3)	4 (4.7)	3 (0.9)	1 (5.0)	0 (0.0)
Excessive bleeding	1 (0.7)	2 (2.4)	2 (0.6)	0 (0.0)	1 (1.85)
IAN injury	1 (0.7)*	0 (0.0)*	2 (0.9)*	0 (0.0)*	0 (0.0)*
Severe pain & Excessive bleeding	2 (1.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
IAN injury & Incomplete root removal	0 (0.0)*	1 (1.2)*	1 (0.4)*	0 (0.0)*	0 (0.0)*
Severe pain & Infection	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)
Severe pain & Excessive bleeding & IAN injury	0 (0.0)*	1 (1.2)*	0 (0.0)*	0 (0.0)*	0 (0.0)*
Soft tissue injury	0 (0.0)	1 (1.2)	0 (0.0)	0 (0.0)	0 (0.0)
Infection	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)
TMD	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)
Adjacent tooth damage	1 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
OAC	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

* calculation based on the number of teeth in lower arch

Discussion

This recent study determined the rate of complications in wisdom tooth removal by non-OMSs and related factors. The findings showed that about one-tenth of wisdom tooth removals developed complications. Additionally, complications progressively increased with the increasing age of patients.

The rate of complications (12.0 %) in this study corresponded with the range of previous studies (3.4 %²¹, 8.5 %, ¹³ 8.8 %²² and 18.9 %²⁴). The difference here might be caused by the types of complication.¹ This recent study collected ten types of complication, while the earlier studies collected only two to six types. The definition of complication plays an important part in the difference. Besides, one wisdom tooth removal could develop more than one type of complication. Although this study did not aim to investigate the relationship between complications and classifications, it was worth mentioning that the rate of complications after distoangular wisdom tooth removal was the highest among the five types of classification. Additionally, some complications, namely infection and IAN injury, stood out in vertical wisdom tooth removal.

Most complications found in this study were common, and there were no fatal cases. This might be explained as wisdom tooth removals performed by non-OMSs were not too complicated. However, there were six cases of IAN injury, which caused temporary paresthesia and resulted in a prolonged treatment process. All of the patients fully recovered within three to six months. In addition, there were two critical complications which occurred in this study. Two cases of deep space neck infection were referred to the center hospital for proper treatment. The only complication which did not occur in this study was OAC. The chance of OAC in wisdom tooth removal was lower than in 1st and 2nd molar removal but still higher than in premolar removal.²³

After controlling for other influences, an increase in age of five years would see 27 % developing complications in wisdom tooth removal ($OR_{adj} = 1.27$ 95%CI 1.14–1.42 $p < 0.001$). Post-operative complication increases with age, especially alveolar osteitis.¹² Patients in adulthood are more likely to develop complications than teenagers and young adults.²⁴ Bone property, such as blood circulation and healing potential, changes as humans grow.¹ Alveolar bone becomes harder but less flexible.^{7,10,25-27} Dental roots turn more brittle, while alveolar bone becomes more sclerosed, Glass in Concrete syndrome.⁶ These phenomena can cause longer procedures or widen the surgical site, which can eventually induce complications.¹³

Regarding gender, existing pathology, removal method and experience of dentists, none of these were significantly related to the complications in this study. With a smaller dental arch and hormonal disturbances in females, the wisdom tooth removal procedure can be more difficult and cause more tissue injury.²⁷ Nevertheless, due to the larger and thicker bone structure in males, the wisdom tooth removal procedure can also be more complicated.⁶ Existing pathology, such as pericoronitis or dental caries, has been shown to have no influence in developing complications. However, existing infection might cause certain kinds of complications, such as surgical site re-infection or blood clot disintegration, which can lead to AO.¹³ With regard to removal method, there was no association between this factor and complications. Nevertheless, bone cutting-off, tooth sectioning and flap opening may damage nearby structures, which eventually lead to more complications.²⁸ In addition, over removal of the alveolar bone can stimulate fibrinolysis, which can cause AO.¹⁰ This study found no relationship between the experience of dentists and complications. Despite that, certain complications, such as incomplete root removal and IAN injury, were prominent in the wisdom tooth removals

performed by the dentists with less than six years of experience. Certain complications might be associated with the experience of dentists.^{15,25}

At present, many dentists recommend their patients to remove an asymptomatic wisdom tooth,²⁶ even though there are still no clear-cut conclusions about removal for prevention.²⁹ Patient assessment and proper techniques are crucial to reduce complications.²¹ Nevertheless, dentists should keep in mind that complications cannot be completely prevented.^{7,15,21} In all cases, communication between patients and dentists must cover post-operative guidelines and the chance of undesirable outcomes.⁵ In addition, future research may need a larger sample size for rare outcomes such as OAC and should be conducted as a prospective study. There were limitations and advantages in this study. Some possible factors were not included because of insufficient cases. The main advantage of this study was the application of statistics that allow for the controlling of other factors, including the cluster effect.

Conclusion

To summarize, although the rate of complications of wisdom tooth removal by non-OMSs was not that low, it stood within the range of previous studies. Non-OMSs should focus on how to reduce and manage certain minor complications, especially severe pain and AO. In addition, age was found to be a relating factor to complications in wisdom tooth removal. The findings from this study indicated that older patients were at a greater risk compared to younger ones.

Acknowledgements

This study could not have been completed without contributions from Jakraphob Pomnapha (M.D.), Teerasak Phachan (Dr.P.H.), Piyaporn Sirisuwan (D.D.S.), Suwit Singsorn (D.D.S.) and Jirisuda Buaphan (D.D.S.). The author is grateful to the lecturers and staff members of the Epidemiology and Biostatistics Department, the Faculty of Public Health, Khon Kaen University.

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