ORIGINAL PAPER

THIRD MOLARS IMPACTION PATTERN WITH ASSOCIATED PATHOLOGIES IN PANORAMIC RADIOGRAPHS OF WEST JAVA, INDONESIAN POPULATION

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ABSTRACT

Introduction: Third molars have the most cases of tooth impaction associated with oral and dental pathologies. Assessment of third molar's impaction pattern and related pathological condition are important for treatment consideration.

Objectives: The present study aimed to observe the impaction pattern of third molars in West Java, Indonesian population, and analysed the correlation with the impaction-associated pathologies.

Material and methods: Digital panoramic radiographs of 83 subjects (52 females, 31 males), with mean age of 19.12 years, were obtained. From the sample, 313 third molars were classified according to Pell & Gregory's and Winter's impaction classifications. Pathological conditions were registered from medical records and radiograph examinations. Fisher's exact test was applied to determine the significance of variables, and correlation and odds ratio (OR) were calculated.

Results: Four pathological conditions were observed from the research sample, including caries, pericoronitis, osteoma, and periapical abscess. Analysis of Pell & Gregory's classification showed that there was significant evidence of caries in class A, with correlation of 0.26 (OR: 18.53; 95% CI: 3.61-95.00%), and pericoronitis in class IIA, with correlation of 0.31 (OR: 12.83; 95% CI: 4.38-37.60%). There was no significant pathologic conditions' incident related to Winter's classification.

Conclusions: Within the research sample, there was two pathological conditions significantly associated with Pell & Gregory's classification, which were caries with class A and pericoronitis with class IIA. While there was no pathologic condition associated with third molars' angulation according to Winter's classification. Future research should consider clinical examination with greater third molars' sample.

Key words: impaction, panoramic radiograph, third molar, third molar pathology.

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INTRODUCTION

Impaction is a blockage of normal tooth eruption's movement, causing the tooth unable to reach its' functional position in a certain time frame [1, 2]. Third molar, especially mandibular third molar, is the most commonly impacted tooth [2, 3]. From the overall population, 38.8% patients had at least one impacted third molar, with 22.8% prevalence for mandibular third molar impaction, and 15.9% for maxillary third molar impaction [3].

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Third molar is the last tooth to erupt, and generally starts erupting at the age of 18 to 20 years. There are several theories about the occurrence of tooth impaction, such as space deficiency, mechanical obstacles, and local factor (e.g., trauma), and systemic factor, including vitamin deficiency, malnutrition, and hormonal disorder [4]. Frequent occurrence of insufficient space of jaw arch for the third molar tooth to completely erupt occurs because the jaw arch is occupied by the other 28 fully erupted teeth [5]. Abnormal eruption also can occur as a result of physical obstacle, such as adjacent tooth, compact bone that blocked the eruption path, and redundant soft tissues [2]. Other factors to cause impaction of third molar are early physical maturation and late third molar mineralization [6].

Impacted third molar are commonly associated with several pathologic conditions. When a tooth starts to erupt, a narrow gap called peri-coronary gap is formed between the tooth crown and the oral mucosa [7]. Impacted third molar often has abnormal position and angulation, which leads to a greater gap between the third molar and adjacent second molar. Therefore, it becomes a favourable spot for bacteria and accumulation of food debris that form dental plaque. Due to a lack of ideal inter-proximal contact, dental plaque is difficult to clean [8, 9].

The accumulation of dental plaque plays integral role in causing oral diseases, including dental caries or inflammation of surrounding soft tissues, which result in pericoronitis, tooth and root resorption, and other periodontal diseases [10-12]. Impacted third molars also present an increased risk for cyst and tumour related with disorder of development process, such as dentigerous cyst, odontogenic keratocyst, ameloblastoma, and malignant tumours, including squamous cell carcinoma and odontogenic myxoma; although the incidence is very low [13].

Despite the high prevalence, studies of pattern of third molar impaction in Indonesian population are still limited. Research conducted in Manado, Indonesia showed that most impacted third molars occurring in maxilla and partially-impacted mesio-angular third molars had the highest prevalence compared with other angulations [14, 15]. Based on various research conducted in Indonesia, studies regarding pathological conditions associated with impacted third molars has not yet been published.

OBJECTIVES

The present study aimed to observe the impaction pattern of third molars in West Java, Indonesian population, and analysed the correlation with the impaction-associated pathologies.

MATERIAL AND METHODS

Digital panoramic radiographs of three hundred and thirteen molars were observed, with age range between 16.04 and 21.68 years. Radiographs were collected retrospectively from the Maranatha Dental Hospital. Inclusion criterion was the presence of at least one third molar. Exclusion criteria were insufficient image quality, developmental abnormalities visible on radiographs, and history of developmental disease in the medical records. Minimum sample size required to determine the correlation coefficient differed from zero, with $\alpha = 0.05$, $\beta = 0.20$, and correlation coefficient (R) from previous research on acute pericoronitis and mandibular third molar's position = 0.71, was 13 subjects [16, 17]. According to inclusion and exclusion criteria, 83 subjects (52 females, 31 males) were included in the study. Patients' identities were anonymized, and coding was assigned to identify each radiograph. Ethical clearance was obtained from the Faculty of Medicine, Maranatha Christian University Research Ethic Committee (Number: 046/KEP/III/2021).

All third molars were observed by an independent professional observer, and classified according to Pell & Gregory's and Winter's impaction classifications. Pell & Gregory classified the impaction according to the combination of relation of third molar with (1) Occlusal surface of adjacent second molar, and (2) Space availability between adjacent second molar ramus of mandible [18]:

The relation of occlusal surface:

I. There is sufficient space between the ramus and the distal of the second molar for accommodation of the mesio-distal diameter of the third molar.
II. Space between the distal of the second molar and the ramus of the mandible is less than the mesio-distal diameter of the third molar.
III. All or most of the third molars are in the ramus of the mandible.

Relation of space availability:

A. Highest portion of the third molar is on the same level with the occlusal plane of adjacent second molar.
B. Highest portion of the third molar is between the occlusal plane and the cervical line of adjacent second molar.
C. Highest portion of the third molar is on the level or below with the cervical line of adjacent second molar.

While Winter classified the third molar impaction based on the angulation between the long axes of third molar and adjacent second molar [4, 19]:

I. Vertical position, 0^{o} to 10^{o}.
II. Mesio-angular position, 11^{o} to 79^{o}.
III. Horizontal position, 80^{o} to 100^{o}.
IV. Disto-angular position, -11^{o} to -79^{o}.
V. Other, 111^{o} to -80^{o} (including mesio-invert, disto-invert, and disto-horizontal).
VI. Bucco-lingual position.

Radiographs' measurements of third molars' height and angulation compared with adjacent second molars were calculated using IC Measure software for Windows, version 2 (Figures 1 and 2). Pathological conditions related with third molar were recorded according to the diagnosis in medical records and radiographs' examination. Fisher's exact test was applied to determine the signifi-

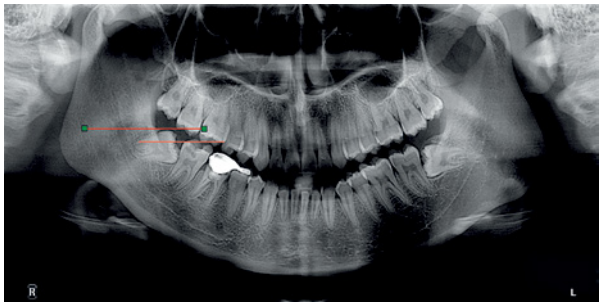

FIGURE 1. Illustration of tracing line of the highest portion of third molars (red line) in comparison with the highest occlusal plane of adjacent second molars (orange line) to determine Pell & Gregory's classification of A, B, and C

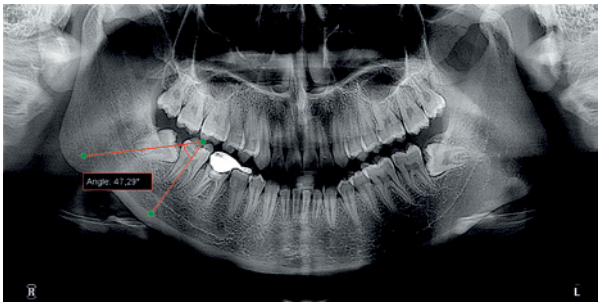

FIGURE 2. Illustration of third molars angulation was calculated between axis of third molars and adjacent second molars to determine Winter's classification of I, II, III, IV, V, and VI

cance of variables. Correlation and odds ratio (OR) were calculated from significant variables ($p \geq 0.05$). All analyses were performed using IBM SPSS Statistics software for Windows, version 25.

RESULTS

Age distribution of sample is presented in Figure 3, with the overall mean age of 19.12 years (females: 19.02 years; males: 19.29 years). The number of third molars observed from the maxilla and mandible were 152 and 161 third molars, respectively. According to Pell & Gregory's classification, most of maxillary third molars were classified as class C (37.5%), although the distribution was considerably uniform with class A (30.92%) and B (31.58%). Most of the mandibular third molars were classified as IIA (27.95%), followed by class IIIA (19.88%) and class IIIB (15.53%).

For Winter's classification, 63.16% of the maxillary third molars were classified as class I, followed by 26.32% as class IV. Majority of the mandibular third molars were classified as class II (44.08%) and class I (39.47%), and there was no mandibular third molar found as class VI.

There were 4 pathological conditions observed from the sample, including caries, pericoronitis, osteoma, and periapical abscess. Most of the pathological conditions were found in the mandible, with pericoronitis as the most frequent pathology present. While in the maxilla, the most frequent pathologic condition was dental caries (Table 1).

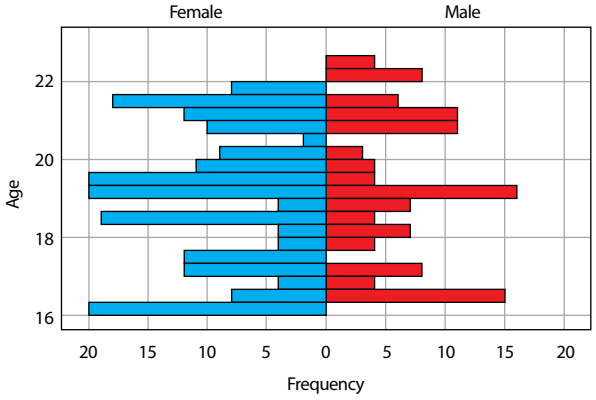

FIGURE 3. Number of subjects per age category of half-year

The pathological conditions of each classification according to Pell & Gregory are presented in Table 2. There were two classifications with significant incidence of pathology of class A with caries and class IIA with pericoronitis. Despite their significances, the correlations of both condition and classes were relatively low (R = 0.26 for caries, and R = 0.31 for pericoronitis). OR of caries incidence in class A was 18.53 (95% CI: 3.61-95.00%), and OR of pericoronitis in class IIA was

TABLE 1. Number of third molars with pathologic conditions in maxilla and mandible

Pathologic conditions	Number of teeth		*n*	Contingency coefficient**
	Maxilla	Mandible		
No pathology	145	142	287	–
Caries	6	2	8	0.079
Pericoronitis	1	15	16	0.194*
Osteoma	0	1	1	0.059
Periapical abscess	0	1	1	0.059

**Significant different proportion of pathologic condition between maxilla and mandible, p < 0.05.*
***Contingency coefficient was obtained from crosstabulation 2-by-2 table of each pathology condition, and no pathology with number of third molar in maxilla and mandible.*

TABLE 2. Number of third molars with pathologic condition in Pell & Gregory's classification

Pathologic condition	Pell & Gregory's classification													
	Maxilla			*n*	Mandible									*n*
	A	B	C		IA	IB	IC	IIA	IIB	IIC	IIIA	IIIB	IIIC	
No pathology	40	48	57	145	17	10	4	33	21	4	28	23	2	142
Caries	6*	0	0	6	0	0	0	2	0	0	0	0	0	2
Pericoronitis	1	0	0	1	0	0	0	10**	0	0	4	1	0	15
Osteoma	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Periapical abscess	0	0	0	0	1	0	0	0	0	0	0	0	0	1
n	47	48	57	152	18	10	4	45	21	4	32	25	2	161

**Significant caries incidence in class A compared to other class, $p < 0.05$.*
***Pericoronitis incidence showed significant difference in class IIA compared to other class, $p < 0.05$.*

TABLE 3. Number of third molars with pathological condition in Winter's classification

Pathologic condition	Winter's classification											
	Maxilla					*n*	Mandible					*n*
	I	II	III	IV	VI		I	II	III	IV	VI	
No pathology	91	13	1	39	1	145	51	65	24	2	0	142
Caries	5	1	0	0	0	6	2	0	0	0	0	2
Pericoronitis	0	0	0	1	0	1	6	2	4	3	0	15
Osteoma	0	0	0	0	0	0	0	0	1	0	0	1
Periapical abscess	0	0	0	0	0	0	1	0	0	0	0	1
n	96	14	1	40	1	152	60	67	29	5	0	161

12.83 (95% CI: 4.38-37.60%). On the contrary, there was no significant pathologic condition evidenced related to Winter's classification, although both caries and pericoronitis incidences appeared mostly in class I (Table 3).

DISCUSSION

Third molar impaction has been one of the most demanding cases associated with various complications, including life-threatening issues [20]. Third molar impaction's positions were diverse amongst different population due to the genetic characteristic, endogamy, and epigenetic factors [21, 22]. These positions had proved to be related with the risk of producing infectious, non-infectious, or neurological pathology, which can occur in untreated teeth [23, 24]. Therefore, the pattern of impaction's position and related pathological condition could become potential parameters to predict certain third molars, which should be prioritized to be extracted.

In agreement with previous studies, the present study showed that the mandibular third molar impaction prevalence was higher than the maxillary third molars [2, 25, 26]. According to Pell & Gregory's classification, maxillary third molars were classified according to the depth of highest portion of third molar's position compared with adjacent second molar (A, B, C), while mandibular third molars were classified as combination of the depth (A, B, C) and space availability between the ramus and distal of second molar for accommodation of mesio-distal diameter of third molars (I, I, III) [18]. The depth of impacted maxillary third molar is mostly found below the cervical of adjacent second molar or class C, based on Pell & Gregory's classification. Previous studies also found similar distribution in Brazilian, Lebanese, and Indian populations [22, 26, 27]. While study in Turkish population showed class B impaction as the most common in the maxilla. The variation was possibly due to the higher age of study sample (mean age of 33.5 years), which could affect further development of third molars.

Most of the mandibular third molars' impaction was classified as class IIA in this study. Similar result described Falci *et al.* in Brazilian population [28]. However, studies among another Brazilian populations by Primo *et al.* and Santos *et al.* showed different results, as most of mandibular third molars were classified as class IB and IIB, respectively [25, 26]. Several studies in other populations also presented various results in majority of impacted mandibular third molars according to Pell & Gregory's classification, such as IIB in Lebanese population, IIB in Indian population, and A in Indian and Saudi Arabian population [2, 22, 26, 29]. These variations indicated that

mandibular third molars had more diversity of development's pattern compared with maxillary third molars.

According to Winter's classification [19], most of maxillary third molars were in vertical position (class I), and mandibular third molars were in mesio-angular position (class II) in present study. However, the distribution between class I and class II in mandibular third molars were considerably even, which were 60 and 67 third molars, respectively. Research from Turkey, Brazil, and Saudi Arabia also indicated highest distribution of class I and class II positions. A study by Yilmaz *et al.* in Turkish population demonstrated that both maxillary and mandibular third molars impaction was classified as class I [25]. The majority of vertical position can be found from studies done among Brazilian population by Al-Dajani *et al.* on maxillary and mandibular third molars, and on Saudi Arabian population by Falci *et al.* on mandibular third molars [2, 28]. Studies among Lebanese population by Khouri *et al.* and another Brazilian population by Santos *et al.*, presented variation of mandibular third molars, which were mainly class II [26, 29].

In the present study, amongst 313 impacted third molars that were evaluated, 9.06% of third molars displayed pathological lesions. Because the sample was only evaluated radiographically, symptomatic pathological condition, such as pain or limited mouth opening, could not be evaluated. Pericoronitis was the most present pathology, with mandibular third molars having significant higher proportion in comparison with the maxilla (Table 1). However, despite the most occurrence, contingency coefficient of pericoronitis related to the number of third molars without pathological conditions was considered as weak.

Related with the jaw location, pericoronitis also demonstrated significant prevalence in class IIA in Pell & Gregory's classification compared with other classes, with OR of 12.83 (Table 2). The condition was highly related with a greater gap between the contact point of second and third molars in IIA position, which led to plaque accumulation and triggered inflammation or infection [8, 30]. It was in accordance with a study of Almendros-Marqués' *et al.*, who reported class IIA and IIB as the most susceptible to pericoronitis [24]. However, systematic review and meta-analysis by Galvão *et al.* noted that there was significant difference of pericoronitis chance between position I and II; however, both had higher chances comparing with position III. This study also mentioned that position A had higher chance of pericoronitis compared with position B; although the studies were limited [23], $R = 0.31$ for pericoronitis in class IIA was reported as 12.83 (95% CI: 4.38-37.60%).

Although caries was not significantly present in the maxilla, the pathological condition was significantly associated with third molars according to Pell & Gregory's classification (class A), with OR = 18.53. It was expected that third molars, which erupted to the occlusal plane were more susceptible to caries, but this chance was not particularly in third molars [23]. Study by Shugars *et al.* presented that 29% of patients with asymptomatic third molars were affected by occlusal caries, which increased to 33% after 3-year follow-up [31].

Despite the significant occurrence and high OR, both correlations of pericoronitis with class IIA and caries with class A were considered low ($R = 0.31$ and $R = 0.26$, respectively). Previous study by Leone *et al.* mentioned R of acute pericoronitis with variables of third molars' positions (height, encapsulation, distance of mid-ramus to distal surface of third molar, and to midline of arch) was 0.71, and was considered as high correlation [17]. These differences were probably due to the smaller number of third molars examined in previous study, which were 109 normal cases compared with 25 cases with acute pericoronitis. The present study had an increased number of sample ($n = 313$) of third molars, with 16 cases of pericoronitis, thus declined R to 0.31.

In contrast, there was no pathologic condition that was significantly associated with Winter's third molar's impaction classification. Therefore, it could be assumed that within the recent sample, the angulation of third molars did not affect the risk of pathology development. Most of previous studies showed higher probability of pericoronitis in third molars with vertical position, or class I in Winter's classification [23]. However, the angulation can be shifted through eruption process, which also influences pathological condition [32, 33]. Distal caries in mandibular second molar was prevalent in mesio-angular third molars, especially when third molars were partially or fully erupted [34]. Therefore, it can increase the risk of caries in adjacent part of the third molar.

CONCLUSIONS

Based on this study, it was concluded that the most frequent eruption pattern in the mandibular third molars was class IIA with mesio-angular angulation, while class C with vertical angulation was more often found in the maxillary third molars. The risk of mandibular third molar with pericoronitis was greater than the maxillary third molar, and mostly occurred in class IIA. The risk of caries was found in the maxillary third molars with class A, although it was not the eruption pattern commonly found in the maxillary third molars.

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CONFLICT OF INTEREST

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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