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ORIGINAL ARTICLE

The predictivity of mandibular third molar position as a risk indicator for pericoronitis

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Abstract The aim of this study was to describe the characteristics of the mandibular third molar at highest risk for acute pericoronitis using clinical and radiographic analysis. A total of 102 volunteers, including 40 (39%) male and 62 (60%) female patients presenting with acute pericoronitis, participated in the study. The mean age of the participants was 23.4 years (range 17–30 years). The variables tested included the percentage of soft tissue coverage, availability of impinging maxillary dentition, and the angulation and eruption level of the mandibular third molar. While vertical impaction was the most frequent angulation (51%), horizontal impaction was quite rare (3%). Mesioangular impaction (25%) was slightly higher than distoangular impaction (21%). Difference between type of angulation was statistically significant for all groups ($p<0.05$). The frequency of partial soft tissue coverage, particularly 75% coverage, was far more observed than the full soft tissue coverage (47%). The difference for the amount of soft tissue coverage was statistically significant ($p<0.05$). In 57% of the cases, pericoronitis was associated with the third molars that erupted at the same level of the adjacent tooth occlusal plane. The difference among the three levels of eruption was significant ($p<0.000$). Impinging maxillary dentition did not have a significant impact on development of pericoronitis (41%). Evidence of impinging maxillary dentition did not have a statistically significant impact on presence of pericoronitis ($p=0.075$). Mandibular third molars at or near to the same level of the occlusal plane of the arch and exhibiting vertical inclination were considered at highest risk for developing pericoronitis. Such third molars can be given high priority for prophylactic care due to the possibility of severe consequences of acute pericoronitis.

Keywords Third molars · Pericoronitis · Panoramic radiograph · Impaction · Prediction of pericoronitis

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Introduction

Dental practitioners are generally concerned with the development and eruption patterns of third molars and their impact on dental arch [6]. Although third molars with a proper positioning normally emerge between the ages of 18 and 24 years, approximately 40% fail to erupt and thus become partially or completely impacted in the bone [11]. Dental caries, root resorption, cystic processes, periodontitis, periapical infection, benign or malignant tumors of odontogenic origin, and inflammatory processes (pericoronitis) are among the various pathologic conditions that are frequently associated with unerupted or partially erupted third molars [3, 4, 6, 10, 11]. Third molars may also lead to arch crowding and interfere with the stability of orthodontic treatment [6, 10]. Thus, prophylactic extraction may be considered before occurrence of such consequences [3, 5, 10, 11].

After maxillary third molar, mandibular third molar is by far the most frequently impacted tooth. The incidence of mandibular third-molar impaction varies considerably among different populations, ranging from 9.5 to 39% [4, 6]. Lack of space, limited skeletal growth, distal eruption of the dentition, vertical direction of condylar growth, increased crown size of impacted teeth, and the late maturation of third molar are listed among the major causes of third-molar impaction [6].

Pericoronitis, a soft tissue infection located around the crown of partially impacted tooth [9, 12] is the most commonly experienced pathologic condition of the mandibular third molar [2, 10, 14]. Acute pericoronitis accounts for approximately 10% of the third molars extracted [8]. Due to the associated spectrum of symptoms that range from a mild, low-grade pain to severe infection with trismus, pharyngeal involvement, and systemic toxemia [5], prophylactic extraction of third molars at high risk has been recommended [5, 8]. Although there seems to be no universally acceptable predictive criteria for third-molar eruption involving subsequent impaction or pericoronitis, the relation of incidence of pericoronitis to the position of the third molar is of particular concern [4–7, 13, 14, 16]. Most studies highlight the impact of positional characteristics of the third molar tooth on development of acute pericoronitis and particularly focus on angulation of the third molar [7, 13] and the eruption level of the tooth [16] as important determinants.

The aim of the present study was to describe the positional characteristics of the mandibular third molars that were associated with acute pericoronitis by use of clinical and radiographic analysis.

Materials and methods

This study was carried out at the University of Gazi, Faculty of Dentistry, Department of Oral and Maxillofacial Surgery. One hundred and two volunteers, including 40 (39%) male and 62 (60%) female patients with the chief complaint diagnosed as mandibular third-molar pericoronitis participated. The mean age of the participants was 23.4 years (range 17–30 years). Women had a mean age of 23.2 years (range 17–30 years), while men had a mean age of 23.8 years (range 19–30 years).

All subjects were examined with a mouth mirror, a No. 3 explorer, and a World Health Organization (WHO) periodontal probe. The WHO probe was not used to detect visually hidden third molars from those with a connection into the mouth through distal pocket of second molar. The clinical criteria for a diagnosis of acute pericoronitis was defined as sharp or throbbing pain, redness, swelling, and/or purulence associated with the third molar. The presence of limitations of mouth opening, discomfort on swallowing, fever, lymphadenopathy, and halitosis were also recorded. No attempt was made to classify the degree of inflammation. A history of symptoms of the affected third molar was then recorded, and a thorough clinical examination was made. Standardized panoramic radiographs (OP100 Orthoceph OC100, Japan) were also analyzed. The magnification of the machine was 25% for all the subjects. All radiographs were scanned to desktop computer with a scanner, and the measurements illustrated in Fig. 1 were calculated using NetCAD 5.05 software. All pericoronitis cases were examined during the acute episode.

The following observable criteria (clinical or radiographic) were assessed as possible predictive factor(s) for developing acute pericoronitis: percentage occlusal coverage by operculum, tissue impingement by an opposing maxillary tooth, mandibular third-molar angulations, eruption level of mandibular third molar, the mesiodistal crown width of mandibular third molar, and retromolar space.

For each mandibular third molar, determination of the amount of the occlusal surface covered by the pericoronal soft tissues was recorded as a visual estimate in 25, 50, 75, and 100%.

The assessment of impinging maxillary structures was made by direct visual inspection of the affected site and was not limited to an opposing maxillary third molar. Impingement by malpositioned maxillary second molars on the mandibular third-molar region was also noted.

Angulation of third molar was measured using the method of Ventä et al. [15]. The angulations were classified as follows:

1. Vertical, ±10 degrees
2. Mesioangular, +(11–70) degrees
3. Distoangular, −(11–70) degrees
4. Horizontal, greater than ±71 degrees

The height of vertical, mesioangular, and distoangular impacted third molars was determined by establishing a point along the line describing occlusal table of the third molar at the midpoint of the mesiodistal dimension and comparing this to the adjacent second molar. In the case of horizontal third molars, the radiographic superior portion of the crown was selected as the comparison point. The

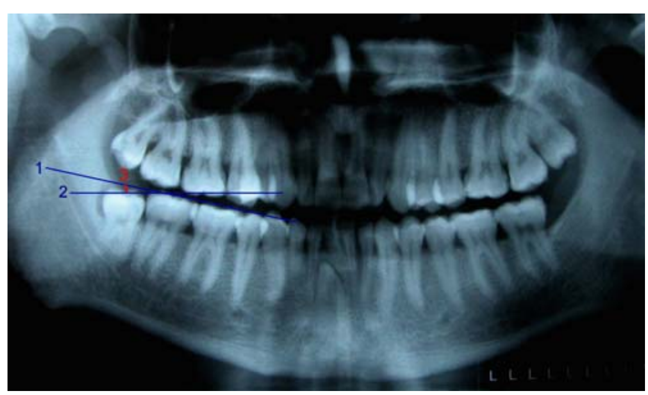


Fig. 1 Radiographic measurements performed: *1* occlusal plane, *2* third-molar occlusal plane, *3* third-molar angulation

Table 1 Comparative analysis of the type of angulation and the extent of soft tissue coverage (arithmetic mean±SD and the actual p values)

	p Value for Kolmogorov–Smirnov test	Mean±SD	ANOVA p value	Post hoc test Scheffe	
Angulation type					
Vertical	0.606	−2.05±5.39	0.000*	For all groups	p=0.000
Distoangular	0.491	−15.69±5.76			
Mesioangular	0.985	37.33±15.36			
Horizontal	0.921	79.61±0.75			
Extent of soft tissue coverage					
Vertical		0.64±21	0.107	All bilateral comparisons	p>0.05
Distoangular		0.68±21			
Mesioangular		0.78±26			
Horizontal		0.66±14			

One-sample Kolmogorov–Smirnov test was used for the analysis of the distribution of the population.
Among-group differences were analyzed by use of ANOVA, and bilateral comparisons were made by different angulations.
*$p<0.05$ significant

classification used was the same as those described in a previous study [5]. Three height-of-eruption groups were defined in this study. Height of eruption was classified relative to the adjacent mandibular second molar and was as follows:

1. Above occlusal plane (AOP), the crown of the third molar was above the occlusal plane.
2. Occlusal plane (OP), the crown of third molar was at the occlusal plane.
3. Below occlusal plane (BOP), the crown of third molar was below the occlusal plane.

Statistical analysis

Data were analyzed with the use of the computer program, Microsoft SPSS 11.0 for Windows. After the measurements corresponding to the sum of third molar teeth were obtained, their distribution was evaluated with the one-sample Kolmogorov–Smirnov test to see whether the sample came from a normally distributed population. Therefore, parametric tests were used. The differences between angulations' types (vertical, distoangular, mesioangular, and horizontal angulations) were analyzed with a one-way analysis of variance (ANOVA) and with the Scheffé test. The chi-square test was used to calculate case frequencies. The mean values of the men and women were analyzed using the t test for independent groups. The level of significance was set at $p<0.05$.

Results

While vertical impaction was the most frequent angulation (more than half of the cases), horizontal impaction was the least (only in three cases). Difference between type of angulation was statistically significant for all groups ($p<0.05$). Table 1 demonstrates the actual p values arising from Kolmogorov–Smirnov test which demonstrated that the sum of the third molar teeth for all groups regarding tooth angulation came from a normally distributed population. Distributions and percentages of different modes of angulations of mandibular third molars are shown in Fig. 2.

The frequency of partial soft tissue coverage was far more than the full soft tissue coverage (Fig. 3). Among the

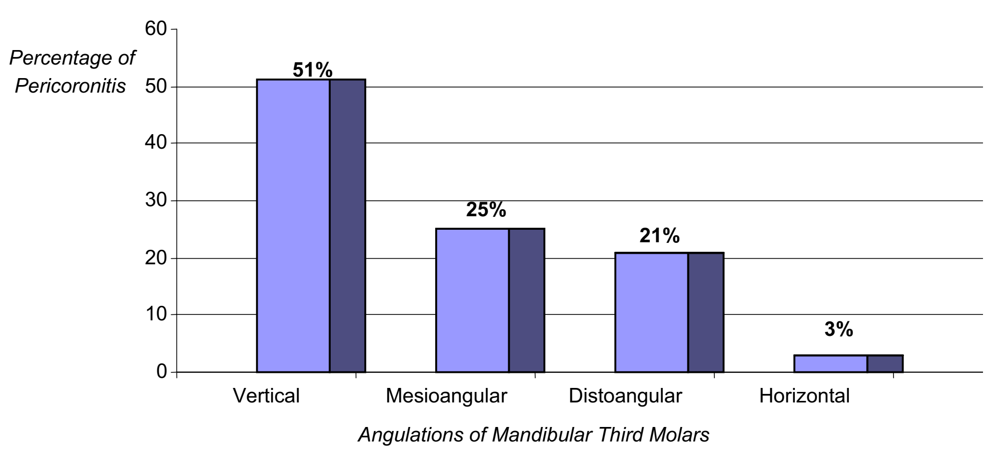


Fig. 2 Angulations of mandibular third molars with pericoronitis

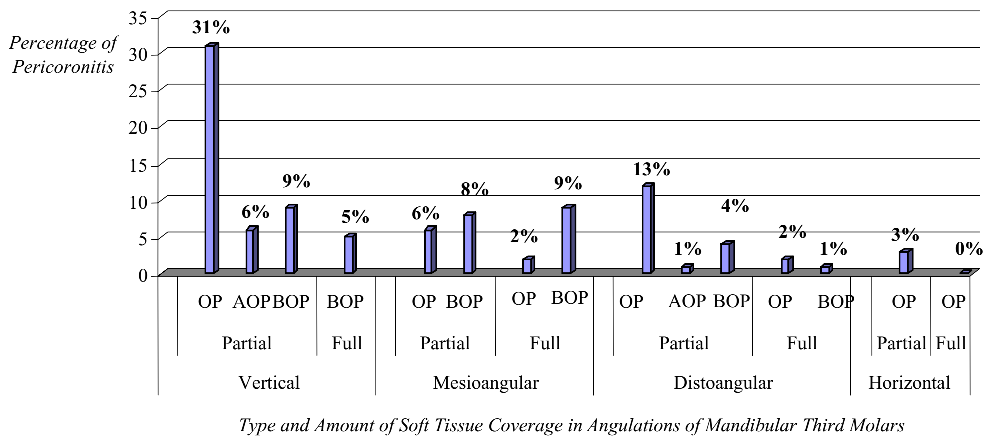


Fig. 3 Type and amount of soft tissue coverage in angulations of mandibular third molars

partial soft tissue coverage, the most frequent case was the 75% soft tissue coverage, while the least was 25% (Fig. 4). The difference for the amount of soft tissue coverage was statistically significant ($p<0.05$), as tooth with 75% soft tissue coverage presented with the highest frequency of pericoronitis ($n=49$; Table 2). Partial soft tissue coverage was the most seen in vertical impactions (approximately half of the cases), while it was the least seen in horizontal impactions (only in 3% cases; Fig. 3). When all teeth, regardless of the angulation, were concerned, the majority of cases presented with partial soft tissue coverage (81%), while full soft tissue coverage was observed only in a few cases (19%). When the extent of soft tissue coverage was considered, statistical analysis revealed no difference among the various types of angulations ($p=0.107$; Table 1).

Availability of impinging maxillary dentition in acute pericoronitis is shown in Fig. 5. Evidence of impinging maxillary dentition did not have a statistically significant impact on presence of pericoronitis ($p=0.075$). Impinging maxillary dentition was the most associated in the vertical impactions (approximately half of the cases in vertical angulations), while it was the least associated in the involved distoangular impactions. Despite the low number of cases, it was not associated in the involved horizontal impactions (Table 2).

Eruption level of the third molars in pericoronitis cases is shown in Fig. 3. Overall, the majority of pericoronitis cases were associated with eruption at the same level of the adjacent tooth OP (57%). When a tooth could erupt above the occlusal plane of the adjacent tooth, frequency of pericoronitis was observed to be less. The difference among the three levels of eruption was significant ($p<0.000$; Table 2).

Pericoronitis was more associated with female patients rather than male patients ($p<0.05$; Table 2). However, gender did not have any significant impact on the type of third-molar angulation, mode of soft tissue coverage, and the extent of the eruption level ($p>0.05$; Table 3).

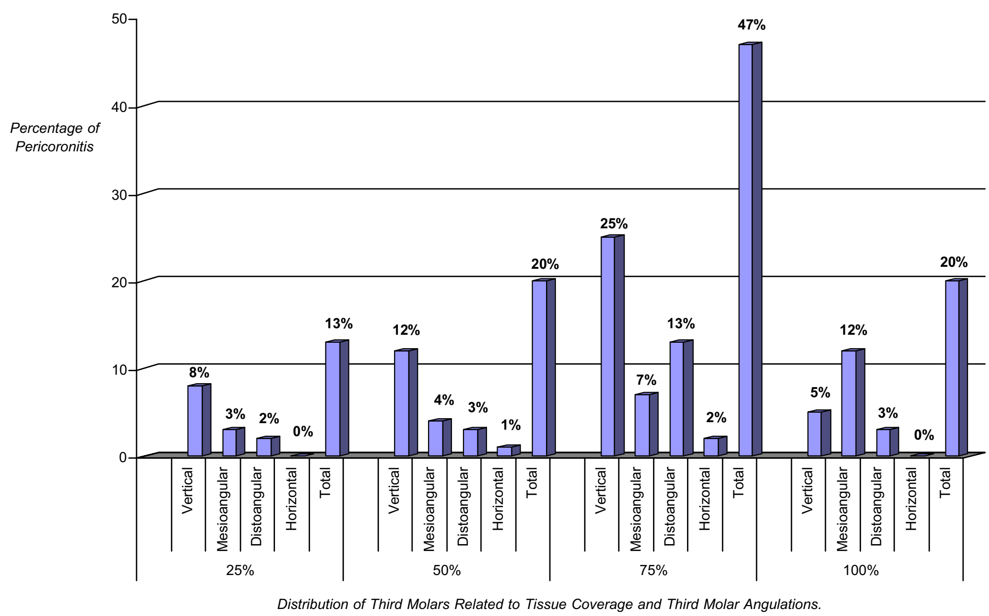


Fig. 4 Distribution of third molars related to tissue coverage and third-molar angulations

Table 2 Frequency of pericoronitis, soft tissue coverage, level of eruption, and impinging maxillary dentition (the actual p values)

	N	p Value
Sex		
Women	62	0.029*
Men	40	
Extent of soft tissue coverage		
25%	13	0.000*
50%	20	
75%	49	
100%	20	
Eruption level		
AOP	8	0.000*
OP	58	
BOP	36	
Impinging maxillary dentition		
Yes	42	0.075
No	60	

Chi-square test
*$p<0.05$ significant

Table 3 Comparative analysis of the impact of gender on the type of angulation, the extent of soft tissue coverage, and eruption level (arithmetic mean±SD and the actual p values)

	Mean ± SD	p-Value
Third-molar angulation		
Women	9.71±25.70	0.161
Men	2.60±23.30	
Soft tissue coverage		
Women	0.69±0.24	0.693
Men	0.67±0.20	
Level of eruption		
Women	0.69±0.78	0.452
Men	0.77±0.57	

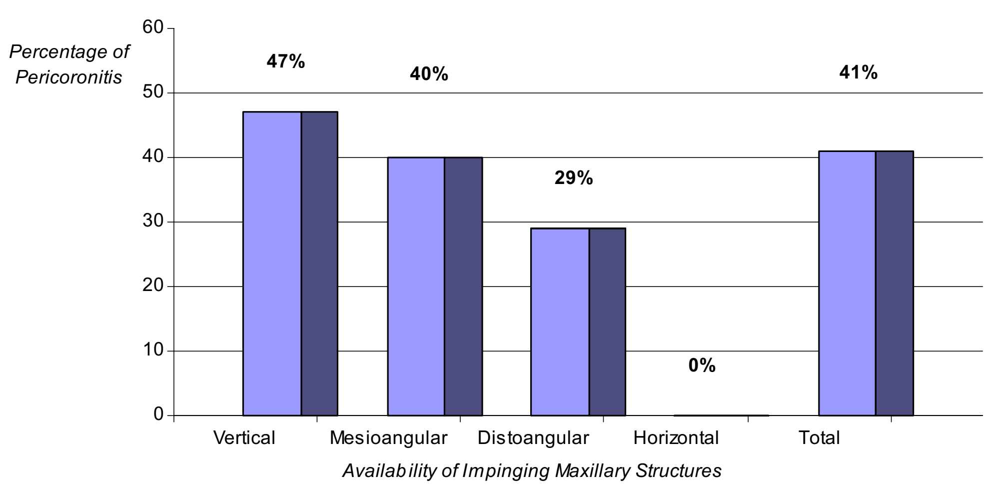
t Test for independent groups
*$p<0.05$ significant

Discussion

The correlation between pericoronitis and angulation of the mandibular third molar has previously been reported [5, 7, 8, 16]. The majority of pericoronitis cases were demonstrated to be associated with the vertically oriented mandibular third molars (81%); of the 20. 9% were at or below the height of the occlusal plane of the arch [5]. Leone et al. [8] described the tooth at highest risk as the mandibular third molar that is fully erupted, vertically positioned, in contact with the second molar at or above the occlusal plane, and partially encapsulated by soft and hard tissues. Evidence indicates that third molars partially covered by soft tissue proceeded many more pathologic problems than molars covered by tissue or are erupted [6, 9]. In the present study, angulation was observed to have a statistically significant impact on the development of pericoronitis, as such cases were mostly associated with vertical inclination (51%). Thus, the findings of the present study confirm vertical angulation as an important factor for the development of pericoronitis. Further, it was observed that 32% of such molars had erupted to the same level of the adjacent second molar occlusal plane; followed by the state of eruption below the occlusal plane. This finding is in full agreement with Halverson and Anderson [5], who reported an association of pericoronitis with the third molar tooth at or below the height of the occlusal plane of the arch, and in partial agreement with Leone et al. [8], who suggested a similar association with third molar tooth at or above the occlusal plane. Thus, it can be concluded that pericoronitis cases are most likely to occur when a mandibular third molar has a vertical angulation and is at or near to the same level of the occlusal plane of the arch and exhibits vertical inclination.

On the other hand, mesioangular positioned third molars were suggested to be the most frequently involved among

Fig. 5 Availability of impinging maxillary structures in pericoronitis cases



the molars in all positions [4, 6]. Güngörmüs [4] reported the predominance of mesioangular positioning (83%) of the mandibular third molars and in 40% of which pericoronitis occurred. Kay [7] reported that the majority of pericoronitis cases were involved with mesioangular impactions (greater than one third of the total); followed by distoangular displacement. Although mesioangular impaction was not associated with the majority of the pericoronitis cases, still, in the present study, mesioangular positioning was relatively more involved than distoangular position. This, in part, we can support the previous studies that report the relatively higher frequency of mesioangular positioning [4, 6, 7]. The findings of the present study are also in accordance with the study of Halverson and Anderson [5], where horizontally angulated third molars were reported to be less associated with pericoronitis when compared to other angulations. However, when the extent of soft tissue coverage is concerned, the findings of the present study do not support these authors because 75% coverage was the predominant mode of coverage which is higher than 50% reported [5]. The amount of soft tissue coverage may however differ in different studies depending on the age of the patients.

In general, evidence of impinging maxillary structures did not seem to have any statistical impact on the development of pericoronitis. Halverson and Anderson [5] reported that it was in 39.7% of the vertical impactions, 56.2% of the mesioangular impactions, 14% of the horizontal impactions, and 40% of the distoangular impactions. In the present study, the incidence of the presence of impinging maxillary dentition associated with acute pericoronitis was found to be relatively higher in vertical impactions, while lower in mesioangular and distoangular impactions when compared with previous study [5].

The impact of gender on development and frequency of pericoronitis has been reported. In a total of 2,151 pericoronitis patients, Bataineh [1] reported that pericoronitis cases were much seen in female patients (56.7%) than male patients (43.3%). A similar trend was also observed in the present study (women, 61%; men, 39%), supporting the findings of Bataineh [1] regarding the impact of gender on development of pericoronitis, as there was statistically significant difference between the two sexes.

Development of pericoronitis is a complicated process, and a wide array of variables are available that affect development of pericoronitis [8]. Based on the analysis of the particular variables tested in the present study, it can be concluded that vertical angulations, partial encapsulation, and eruption at or below near to the same level of the occlusal plane are likely to be among the important determinants of the development of pericoronitis.

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