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Evaluation of the relationship of maxillary third molar teeth with pterygomaxillary fissure with cephalometric radygraph

Short Title: Relationship of impented third molar and pterygomaxillary fissure

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Abstract

Background: The aim of this study is to evaluate the relationship between the third molars which are determined to be closely related to pterygomaxillary fissure in cephalometric images.

Materials and methods: The material of this study was panoramic from 200 individuals (101 men, 99 women, mean age 19.02 ± 1.62) with three different skeletal malocclusion in the sagittal direction (Class I, 95; Class II, 85; Class III, 20). and lateral cephalometric radiographs. In the individuals included in the study, the maxillary third molar teeth are impacted unilaterally (n = 121) or bilaterally (n = 49). Angular and millimetric measurements (SNA°, SNB°, ANB°, Ptm [Height-x], Ptm [Width-y]) were made in accordance with the parameters determined on the lateral cephalometric radiographs of individuals. In this retrospective study, the relation of impaction with pterygomaxillary fissure evaluated on cephalometric radiographs, whether the impaction was unilateral or bilateral, was investigated in terms of skeletal anomaly. Mann-Whitney U analysis comparison tests were used to evaluate the groups.

Results: Of the 200 individuals with impacted maxillary third molar females, 110 were female and 90 were male. There is no statistical difference between them in terms of unilateral and bilateral impacted third molars (p> 0.05). Of the 200 patients, 95 patients were
Class I, 85 patients were Class II, and 20 patients were Class III. There is no statistical difference between unilateral and bilateral impacted cases in facial skeletal classification (p > 0.05). When the impacted teeth were evaluated as total in the study of 200 individuals, the number 2 sella variation was observed most in the individuals in this study (170/79) (46.5%). This is statistically significant (p < 0.001). According to Mann whitney U test results, the relationship between genders and pterygomaxillary fissure variable width and height (Ptm-x and Ptm-y) measurements were not statistically significant (p > 0.05).

**Conclusions:** The fact that the third molar teeth are impacted bilaterally or unilaterally is not affected by pterygomaxillary fissure change.

**Key words:** cephalometric radiography, maxillary third molar, pterygomaxillary fissure

**INTRODUCTION**

Maxillary complex is affected by not only face components but also skull base and neurocranium (1). The functional matrix hypothesis tries to explain the adaptation of skeletal tissues and organs during modification of craniofacial growth. According to this hypothesis, the two main units are skeletal structure and functional elements. Therefore, in the development of craniofacial skeletal structures, some adaptive responses can be influenced by functional components (2-4). Functional components refer to soft tissues surrounding skeletal units, organs, and operational volumes that perform a given function (1,5). The interaction between the skeletal unit and functional matrices may also have an effect on the spaces between skeletal units such as the pterygopalatine fossa (6). The pterygopalatine fossa is a space between the maxilla, palatine, and sphenoid bones (7,8). The pterygomaxillary fissure (PMF), on the other hand, forms the lateral boundary of the pterygopalatine fossa. In clinical terms, the PMF is in an important landmark for orthognathic surgical procedures such as Le Fort I osteotomy, and extraoral and intraoral maxillary nerve blockage (6,7). Furthermore, during surgically assisted rapid maxillary expansion, the PMF and the remaining posterior connection of the maxilla with the pterygoid process region can improve blood circulation and also provide symmetrical openings of the maxillary shelves (9).
With the influence of the development of the maxillary complex, differences in anatomical formations and structures can be observed in the maxillary complex. Especially with the maxillary deficiency, the progression of third molar teeth can also be affected.

The third molars are the teeth to become most frequently impacted. The most common reason for the third molar teeth to become impacted is the fact that they the last teeth to erupt, which leaves them with insufficient space for eruption. Periodontal diseases can cause pathologies such as tooth decay, root resorption, pericoronitis, pains of unknown origin, orthodontic and prosthetic problems, infections, odontogenic cysts and tumors (10,11). In cases of inadequate space on the dental arch, tooth eruption can be obstructed by the gingiva, bone or other adjacent teeth.

The relationship between the cranium and various anomalies has been previously studied (12,13,14). The PMF seems to have an effect on both growth and developmental stages of the face. In addition to this knowledge of the PMF morphology also seems to be essential during surgical procedures. Therefore, the aim of this study was to investigate the PMF lenght and possible correlation between maxillary third molars exisstance using cephalometric radiographs.

MATERIALS AND METHODS

The study conducted on the patients who were admitted to Usak University Faculty of Dentistry Departent of Orthodontic to undergo orthodontic treatment. Ethical approval was obtained from Usak University Faculty of Dentistry "Ethics Committee on Non-Interventional Clinical Research-Research Not Involving Pharmaceuticals and Medical Devices" (Number: B.30.2AYD.00.00-50.06.04/67). The present study included 200 patients, 101 males and 99 females between the ages of 19-39 (mean age 24.9), with the indications of impacted third molar dental surgery who were admitted to Usak University Faculty of Dentistry Department of Orthodontics and Usak University Dentistry Faculty, Department of Oral and Maxillofacial Surgery clinic between 2016 -2018. The sample size was calculated based on a power analysis and 90% strength using G * Power Software version 3.1.9.2 (Universität Düsseldorf, Germany) for the sella turcica classification with an alpha error probability of 0.05. Power analysis showed that 134 samples were absolutely necessary. During the acquisition of lateral cephalometric radiographs, the patient's head was fixed on the cephalosta, and the Frankfort horizontal plane was adjusted parallel to the ground. Radiographs were taken with the central...
beam perpendicular to the patient's mid oxal plane and the teeth in sentric occlusion. It was paid attention to see clearly the pterygomaxiller fissure. The individuals in the study were classified according to the ANB angle determined on the lateral cephalometric radiograph as Class I, Class II and Class III in the sagittal direction, with the unilateral or bilateral impacted of the maxillary third molar teeth (Table 1). Skeleton classification was done according to ANB angle as shown in Table 1. It was paid attention to see clearly the pterygomaxiller fissure in lateral cephalometric films (Figure 1). The width (W), depth (D) and interclenoid (I) determined by Taveras and Wood (24) with respect to the dimensions of sella turcican on each radiograph are shown in figure 2. Patients with unilaterally and bilaterally impacted teeth and complete bone retention, and with no local factors that would cause the maxillary third molar impaction, loss of third molar with incomplete root development or adjacent second molar due to any reason were admitted for the study. The data from the patients under 18 years of age who had suffered a trauma or accident in the head and neck region, undergone previous surgery on the sinus or skull base, and suffer from any syndromes or congenital anomalies (craniocytosis, hemi-facial microstomy) were excluded from the study (Figure 1). A clear visualization of the fissura pterygomaxillaris was ensured in lateral cephalometric images. All radiographs were taken using the same cephalometry device (Planmeca 2011-05 Proline Pan/Ceph X-Ray brand x-ray unit, Helsinki, Finland) with the Frankfurt plane parallel to the ground, teeth in centric occlusion, and lips in resting position. Cephalometric radiographs were evaluated by the same researcher using the NemoCeph NX 9.0 software program (Nemotech, Imaging and Management Solutions, Chatsworth, Madrid, Spain) (Figure 2). To evaluate the method error, 50 films were redrawn and measured again by the same researcher 2 weeks later. Paired t test was applied between the first and second measurements and no statistically significant difference was found between the two measurements. These results show that our drawings and measurements are repeatable.

**Statistical analysis**

The data were evaluated in SPSS 21.0 (Statistical Package for Social Sciences, Chicago, Illinois, USA) statistical package program. The analysis of the data was evaluated using the chi-square test. The significance level was considered statistically significant for p < 0.05.
RESULTS

This study was performed on 342 maxillary third molar teeth in a total of 200 patients, 99 women (49.5%) and 101 (50.5%) men. Of the 200 patients included in the study, 71 had bilateral and 129 were unilateral maxillary third molar teeth. According to the results of chi-square analysis, the relationship between gender and molar variable was not statistically significant (p > 0.05). 57% of women had unilateral (unilateral) molar, 44.9% of women had bilateral (bilateral) maxillary molars. 43% of men had unilateral molar and 55.1% of men had bilateral molar. In both gender categories, unilateral molar status was found higher than bilateral molar status, so gender has no relation with molar status (Table 1,2,3).

Since the variables are not normally distributed, the non-parametric test used in the comparison of two independent groups was used in the chi-square test. According to the chi-square test results, no variables were found statistically significant according to the molar status (Table 4). In the comparison of skeletal subgroups in facial skeletal classification, there was no statistically significant difference in the vertical and width distance (Ptm-x, Ptm-y) between the peak and the lower point of the pterygomaxillaris fissure (Table 5) (p > 0.05). According to this test result, PTM variables did not differ by gender (Table 6). Spearman correlation analysis was performed since the variables were not normally distributed. A significant negative correlation was found between age and PTM variable.

DISCUSSION

The third molars are the most frequently impacted teeth. The most common reason of impaction of the third molars is to be last teeth and not enough space to continue. The hard placement of these teeth on the back of the tooth depends on the fact that the conditions of dentition and eruption as well as the distance and direction traveled during riding differ from other teeth. With the increasing need for orthodontic treatment, especially the need for orthodontic surgery, consensus is needed for the relationship of third molar with anatomical structures. This study was performed on lateral cephalograms from untreated patients. Again, in order to minimize errors in anatomical point definition, anatomical points were checked again by the same researcher. Anatomical points used in McNamara analysis were marked on the lateral cephalograms obtained and related measurements were made. This analysis includes measurements that define dental and skeletal relationships that are important for orthodontists, and partially for oral and maxillofacial surgeons. The upper third molars are not
included in the scope of orthodontic theory and complete the process of riding with a completely opposite movement. Impacted teeth; It is a common problem with a prevalence of 18-32%, affecting a large population in the world. In order to determine the appropriate treatment method of impacted teeth, to prevent complications that may occur during or after treatment, the positions of the impacted teeth in the jaw should be evaluated in detail with their adjacent anatomical structures.

Radiological evaluation plays an important role on the treatment plan (15). Impacted teeth can cause pathologies such as perichoronitis, cystic lesions, tumors, periapical lesions and resorption in the adjacent tooth. For this reason, third molars must be removed when they are associated with pathological findings or for prophylactic reasons (16-18). For this reason, it is planned that the upper third molars will remain bilaterally or unilaterally, and the relationship between the base length of the maxilla and the anatomical structures will be examined. Therefore, the present study is a unique study that will bring a different perspective to the impaction pattern of the maxillary third molars. Since the known average impaction age of the wisdom teeth is 17 to 21, we set an age limit of 18 and found the mean age to be 24.9 for our study. There was no difference between the genders in our study. Tuğsel et al. (20) did not mention a difference in the distribution of impacted third molars between the genders in parallel with other information in the literature (21,22). In the study of Dural et al. (23), the incidence of impacted teeth was found to be higher in women than in men and it was statistically confirmed. According to the results of the non-parametric Mann whitney u test used in comparing the two independent groups, age and pterygomaxillary fissure (PTM) variables did not differ by gender. In the present study, it was observed that in the majority of the impacted maxillary third molars, the teeth were on the border of the PTM and no bone septa was observed between the PTF and third molars. According to this result, the vast majority of these teeth may be related to the development of the base length of the maxilla and it is likely that any complications occur during tooth extraction. As a result of cephalometric analysis in the present study, it is thought that the increase in anterior face height and PTM length measurement in women is characterized by an increase in the maxilla skeletal unit. In their three-dimensional KIKT studies, Costa et al. (24) recorded findings indicating no correlation between the anterior face height and maxillary posterior vertical alveoli, and thereby, PTM, which is in contradiction with our findings.

On the other hand, Rothstein and Tarlie (25) found a statistically positive relationship between the anterior facial heights and the maxilla posterior heights of individuals in the age
group of 10 and 12, similar to the results, in their longitudinal study. The reason for this is thought to be population differences. In the retrospective evaluation performed in our study, the relationship between the variables was determined by considering the differences in the lateral projection with anatomical structures in PTM, which was not previously evaluated in English or foreign literature. In the present study, no statistical difference was found in the evaluation of PTM variable according to gender, localization and the condition of the third molars (p> 0.05). Rothstein and Tarlie determined the length of the PTM by measuring the distance from the deepest point of the buccal sulcus to the peak of the fissure. To know the difference in measurements between PTM lengths; in anesthesia to be performed in the region, it is thought that paying attention to the penetration depth of the needle according to localization is important in terms of ophthalmic or intracranial complications that may occur due to providing sufficient anesthesia and advancing deeper than necessary. In the present study, a negative correlation was found between age and PTM variable. There was no statistically significant difference in terms of PTM variable in patients according to age groups (p> 0.05). Although the age progression causes changes in the fissure area, it suggests that the fissure does not cause macro changes in the overall morphology. Considering the results obtained by Albert et al. (26) in their studies, it was observed that the growth in both soft and hard tissues continued after adolescence. As a result of the reshaping of the alveolar bone in the craniofacial complex, PTM, which is located behind the tuberculosis region, is also thought to be affected by these changes. However, as mentioned earlier, it is thought that it will not be appropriate to use this point orthodontically as a fixed reference (27-29).

CONCLUSIONS

In groups formed according to unilaterally or bilaterally impacted maxillary third molars, anatomical structures were found not to affect the impacted teeth rather than the significant differences. Regarding pterygomaxillary fissure (PTM) in both genders, unilateral and bilateral impacted third molars were not found to differ significantly between groups. At the same time, it is thought that it should be supported by further studies that may trigger the formation of skeletal anomalies depending on PTM morphology.

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**Figure 1:** Class 3 and class C groups according to Archer (1975) classification.

In panoramic images, it is seen that 2 lines intersect at 90 degrees, parallel to the long axis and occlusal plane of the third molar tooth embedded in the maxillary.

**Figure 2:** Cephalometric Angular Measurements Used in the Research

1. SNA: the angle between the anterior skull base (S-N plane) and point A.

2. SNB: It is the angle between the front head base (S-N plane) and point B.

3. ANB: Angle between NA and NB lines. Determines the relation of the apical bases of the lower and upper jaw relative to each other. According to Steiner analysis, its normal value is between 0 and 4 degrees.

4. PTM-x (mm); Height of pterygomaxillary fissure

5. PTM-y (mm); Width of the pterygomaxillary fissure.
Table 1: Relationship of impacted molar with gender and facial skeletal classification

| Gender      | Unilateral Impacted | Bilateral Impacted | Total       |
|-------------|---------------------|--------------------|-------------|
|             | n       | %     | n       | %     | n       | %     |
| Female      | 69      | 57.0  | 30      | 44.9  | 99      | 53.5  |
| Male        | 60      | 43.0  | 41      | 55.1  | 101     | 46.5  |
| Facial Skel. |       |      |        |      |        |      |
| Class I     | 81      | 45.5  | 44      | 49.0  | 125     | 46.5  |
| Class II    | 50      | 40.5  | 22      | 44.9  | 72      | 41.8  |
| Class III   | 20      | 14.0  | 3       | 6.1   | 23      | 11.8  |
| Total       | 151     | 100.0 | 49      | 100.0 | 200     | 100.0 |

Chi square analysis: Gender (p = 0.151), Facial Skeletal Classification (p = 0.347)

Table 2: Relationship of unilateral impacted molar with gender and facial skeletal classification

| Facial Skel. | Unilateral Impacted |              |
|--------------|---------------------|--------------|
|              | Female  | %    | Male   | %    | Total  | %    |
| Class I      | 28      | 40.6 | 29     | 51.9 | 55     | 45.5 |
| Class II     | 33      | 47.8 | 22     | 30.8 | 49     | 40.5 |
| Class III    | 8       | 11.6 | 9      | 17.3 | 17     | 14.0 |
| Total        | 69      | 100.0| 60     | 100.0| 129    | 100.0|

Chi square analysis (p = 0.433)

Table 3: Relationship of bilateral impacted molar with gender and facial skeletal classification

| Facial Skel. | Bilateral Impacted |              |
|--------------|--------------------|--------------|
|              | Female  | %    | Male   | %    | Total  | %    |
| Class I      | 17      | 52.0 | 20     | 48.1 | 24     | 49.0 |
| Class II     | 13      | 48.0 | 18     | 47.7 | 22     | 44.9 |
| Class III    | 0       | 0.0  | 3      | 11.1 | 3      | 6.1  |
| Total        | 30      | 100.0| 41     | 100.0| 71     | 100.0|

Chi square analysis (p = 0.430)

n, number of individuals;
*, p < 0.001;
NS, not significant;
p, significance level according to chi square test
### Table 4: Relationship of impacted molar and Pterygomaxillary fissure

|                  | Unilateral Impacted Molar | Bilateral Impacted Molar | P   |
|------------------|---------------------------|--------------------------|-----|
| Ptm-X            | Mean±Sd                   | Mean±Sd                  | 0.420 NS |
| Ptm-y            | 25,18±3,24                | 25,2±3,2                 | 0.445 NS |
|                  | 5,22±1,2                  | 5,15±1,18                |     |

### Table 5: Relationship of Pterygomaxillary fissure and facial skeletal classification

| Ptm-x | Ptm-y | P   |
|-------|-------|-----|
|       | Mean±Sd | Mean±Sd |   |
| Class I | 25,64±3,24 | 5,18±1,14 | 0.420 NS |
| Class II | 25,55±3,2 | 5,1±1,1 | 0.330 NS |
| Class III | 25,42±3,04 | 5,22±1,02 | 0.433 NS |

### Table 6: Relationship of gender and Pterygomaxillary fissure

|       | Femal n=101 | Male N=99 | P   |
|-------|-------------|-----------|-----|
|       | Mean±Sd     | Mean±Sd   |     |
| Ptm-x | 25,68±3,16  | 25,79±3,09 | 0.576 NS |
| Ptm-y | 5,19±1,03   | 5,21±1,02  | 0.258 NS |
