

## The Relationship between Agenesis of Third Molar and Craniofacial Morphology in Orthodontic Patients

Mahdjoube Goldani Moghadam<sup>1</sup>, Farzane Etemadi<sup>1</sup>, Narjes Akbari<sup>2</sup>

Departments of <sup>1</sup>Orthodontics and <sup>2</sup>Oral Medicine, Faculty of Dentistry, School of Dentistry, Birjand University of Medical Sciences, Birjand, Iran

Received: 09-03-18.  
Accepted: 15-05-18.  
Published: 18-07-18.

ABSTRACT

**Aims and Objectives:** The aim of this study was to evaluate the association between third molar agenesis and craniofacial morphology in a group of Iranian orthodontic patients.

**Materials and Methods:** A total of 164 high-quality lateral cephalograms and panoramic radiographs were included in the study. Eighty-two radiographs with the absence of at least one-third molar were assigned to agenesis group and other 82 radiographic records were served as control group. Cephalometric analysis was performed, and the results were compared between the two groups using Independent Samples Student's *t*-test.

**Results:** Significant differences were found in SNA, ANB, sum of posterior angles, and lower gonial angle between the study groups. All of them were smaller in the agenesis group.

**Conclusion:** Third molar agenesis in this group of Iranian subjects is associated with deficient maxillary development and brachyfacial and hypodivergent skeletal pattern.

**KEYWORDS:** *Agenesis, craniofacial morphology, third molar*

### INTRODUCTION

Congenital absence of teeth is a fairly common phenomenon.<sup>[1]</sup> It has been found to be the most frequently occurring anomaly of dentition.<sup>[2]</sup> Dental agenesis (hypodontia) is defined as the case that at least one of the individual's teeth is congenitally not formed.<sup>[3]</sup> Hypodontia can occur in any tooth, but it is more prevalent in some than other teeth. Agenesis in white race involves the most distal teeth, including the third molars, the second mandibular premolar, and maxillary lateral teeth.<sup>[4-6]</sup>

The worldwide prevalence of the absence of third molars has been reported to be 22.63%. It is 14% more likely to be found in women and maxillary agenesis is 36% more probable than mandibular agenesis.<sup>[7]</sup> Crown and root morphology, time of formation, and presence or absence of the third molar tooth are all subjected to wide variations. The agenesis of third molars is frequently occurred, but the reported prevalence is different among different populations.<sup>[7]</sup> The wide range of the prevalence of this type of anomaly is caused by differences in sample

selection, assessment methods, samples' examination, and the gender, age, and race distribution of studied cases.<sup>[8,9]</sup> A few studies addressed the rising prevalence of agenesis in the 20<sup>th</sup> century.<sup>[10]</sup> Agenesis has been associated with the development of some other dental anomalies such as delay in teeth formation, delay in exfoliation, over retention of the primary teeth, and deficient growth of alveolar bone.<sup>[5]</sup>

Agenesis can affect dentofacial and craniofacial structures. Few studies have evaluated this relation and yielded contradictory results. Some studies have suggested no relationship between the craniofacial structure and teeth agenesis; whereas a number of researchers have suggested a possible link between the size of the jawbone and agenesis.<sup>[3]</sup> Some reports suggest that the same genes are involved in regulating

**Address for correspondence:** Dr. Narjes Akbari, Faculty of Dentistry, Birjand University of Medical Sciences, Birjand, Iran.  
E-mail: narges\_akbare4021@yahoo.com

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

**How to cite this article:** Moghadam MG, Etemadi F, Akbari N. The relationship between agenesis of third molar and craniofacial morphology in orthodontic patients. *J Int Soc Prevent Communit Dent* 2018;8:304-8.

| Access this article online  |  |
|---|--|
| Quick Response Code:<br> | Website: <a href="http://www.jispcd.org">www.jispcd.org</a>                                  |
|   | DOI: <a href="https://doi.org/10.4103/jispcd.JISPCD_110_18">10.4103/jispcd.JISPCD_110_18</a> |

both the craniofacial structure development and teeth morphogenesis. Some other studies have reported that agenesis does not affect the craniofacial structures and there is no evidence that the third molars are essential for jawbone growth.<sup>[3,11]</sup> One study states that measurement of mandibular length in patients with third molars, compared to patients with congenital absence of mandibular third molar, showed no different growth patterns.<sup>[8,11]</sup> In another study conducted in the Turkish population, the absence of third molars had a minor impact on dentofacial structures,<sup>[12]</sup> and in a study on Japanese population, the absence of third molars was not associated with mandibular length but was associated with the anteroposterior dimension of maxilla.<sup>[13]</sup> On the other hand, it has been found that the absence of third molars increases the likelihood of agenesis of other teeth 13 folds.<sup>[14]</sup> It has been suggested that the functional compensation in subjects with advanced hypodontia may be responsible for the altered craniofacial structure and it may be irrelevant to agenesis in itself.<sup>[15,16]</sup> Some studies have suggested a link between the absence of teeth and unusual morphology of the remaining teeth;<sup>[17,18]</sup> other studies have shown an association between agenesis of third molar and anomalies of other teeth. Some studies revealed evidence regarding that the presence of third molars is required for the development of the maxilla and mandibular bones.<sup>[19]</sup>

To the best of our knowledge, the association of third molar agenesis and craniofacial structures has not been yet evaluated in the Iranian population. Therefore, regarding conflicting results of previous studies on this topic, the aim of this study was to evaluate the association between agenesis of third molars and craniofacial morphology in orthodontic patients, admitted to Dental School of Birjand University of Medical Sciences.

## MATERIALS AND METHODS

In this cross-sectional study, radiographic records of patients who referred to Orthodontic Clinic of Dental school of Birjand University of Medical Sciences in 2016 were reviewed, of which 164 records were selected. The study protocol was approved by the Ethics Committee (no: 139547) of Birjand University of Medical Sciences, Birjand, Iran. The sample size was calculated based on a previous study<sup>[9]</sup> and sample size calculation formula. Lateral cephalograms and panoramic radiographs of high quality of 82 patients who had at least one-third molar agenesis were selected as the agenesis group, and 82 others which had all four third molars were assigned to the control group.

The mean age of subjects was  $24.9 \pm 5.4$  years in the agenesis group and  $24.9 \pm 5.2$  years in the control group.

The group with agenesis ( $n = 82$ ) consisted of 49 women and 33 men and in the control group ( $n = 82$ ), 58 were women and 24 were men.

Inclusion criteria for the agenesis group included the absence of at least one-third molar and high-quality radiographs. Agenesis of the third molar was diagnosed, when radiographic sign of crown mineralization of third molar could not be observed, whereas the second mandibular molar was in the seventh or G stage or higher according to the method of Demirjain (mineralization of bifurcation was initiated).<sup>[20]</sup> Subjects with congenital disorders and deformities such as cleft palate or any other syndrome or absence of any teeth, other than third molars, and subjects with a history of previous orthodontic treatment were excluded from the study.

Pretreatment cephalometric radiographs were analyzed. Cephalometric analysis was done using measurements from Wits, Steiner (SNA, SNB, and ANB),<sup>[21]</sup> Ricketts (lower face height, corpus Length, mandibular plane, facial axis, and palatal plan),<sup>[22]</sup> and Jarabak (lower gonial angle, face height ratio, mandibular body length, saddle angle, articular angle, gonial angle, and upper gonial angle) analysis.<sup>[23]</sup> Lateral cephalograms of all subjects were hand traced by one investigator on acetate paper overview box and the tracing was further reviewed by other authors for accuracy. The reference points and planes used in this study are shown in Figure 1. The following skeletal and the following measurements were made and compared between the groups:

1. SNA (Steiner analysis): Anteroposterior position of maxilla in relation to the anterior cranial base
2. SNB (Steiner analysis): Anteroposterior position of mandible in relation to the anterior cranial base
3. ANB (Steiner analysis): The difference between the SNA and SNB

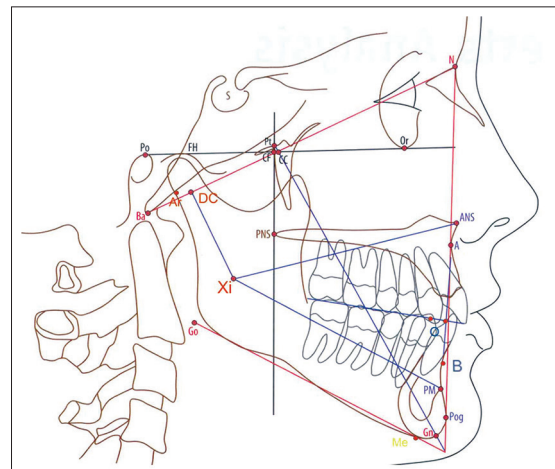


Figure 1: Cephalometric reference points used in this study

4. Wits (mm): the distance between AO and BO on occlusal plane
5. Facial axis (Ricketts analysis): Inferior angle made by the intersection of Ba-N and Pt-Gn
6. Mandibular plane angle (Ricketts Analysis): The angle formed by the intersection of mandibular plane (Me-Go) and Frankfort plane (FH)
7. Lower face height (Ricketts Analysis): The angle established by the intersection of two planes: ANS-Xi and Xi-Pog
8. Corpus length (Ricketts analysis): The angle between DC-Xi and corpus axis
9. Saddle angle (Bjork-Jarabak): angle between S-N and S-Ar
10. Articular angle (Bjork-Jarabak): angle between S-Ar and Go-Ar
11. Gonial angle (Bjork-Jarabak): angle between Ar-Go and Go-Me
12. Sum of S + A + Go angles (Bjork-Jarabak): The sum of posterior angles: saddle angle, articular angle, and gonial angle
13. Upper gonial angle (Bjork-Jarabak): The upper angle made by Go-N plane which bisected gonial angle (the angle between Ar-Go-N)
14. Lower gonial angle (Bjork-Jarabak): The lower angle made by Go-N plane which bisected gonial angle (the angle between N-Go-Me)
15. Face height ratio (%): The ratio of the posterior (S-Go) and anterior (N-Me) face height
16. Palatal plane length (ANS-PNS) (mm) (Ricketts Analysis): The distance between ANS and PNS
17. Mandibular body length (Go-pog) (mm) (Bjork-jarabak): the distance between Go-Pog.

One month after the first measurement, 20 cephalograms were analyzed again in each group by the same person to assess the reproducibility which showed intraclass correlation coefficient of 0.95 indicating good reproducibility.

For each of the cephalometric parameters, mean and standard deviation were calculated using the Statistical Package for the Social Sciences (SPSS) version 18 for Windows (SPSS, Inc., Chicago, Illinois, USA). Independent samples Student's *t*-test was used to make a comparison between agenesia and control groups. Statistical significance was considered to be  $P \leq 0.05$ .

## RESULTS

A total of 164 patients were examined in this study, 82 of whom had agenesia of third molar (the agenesia group) and 82 others had four third molars present (the control group). The mean age of patients was  $24.9 \pm 5.4$  years in the agenesia group and  $24.9 \pm 5.2$  years in the control

group ( $P = 0.98$ ,  $t = 0.02$ ). The results of *t*-test showed insignificant differences in mean age between the study groups. Based on the data of this study, there was no significant difference in sex frequency between the two groups ( $P = 0.14$ ).

As can be seen from Table 1, mean value of SNA and ANB angles in the control group was significantly higher than the agenesia group ( $P = 0.02$ ). As Table 1 shows, there is a significant difference in sum of posterior angles and lower gonial angle between the agenesia and the control groups. Comparison of other measurements revealed insignificant difference between the two groups.

## DISCUSSION

The agenesia and control groups were adequately matched in this study which is confirmed by insignificant differences in age and sex frequencies of subjects in the two groups. The mean age of the subjects was  $24.9 \pm 5.4$  years in the agenesia group and  $24.9 \pm 5.2$  years in the control group. To evaluate the agenesia of the third molar in this study, dental age was used. It has been said that the third molar crypt can be radiographically observed at 5 years and 10 months of age.<sup>[24]</sup> Early and late formation of third molar was stated to be at 9 and 14–16 years of age, respectively.<sup>[25,26]</sup> According to Massler *et al.*, the third molar cavity is formed at the ages of 3–4 years. Between the ages of 7–10 years, third molars start to calcify; between the

**Table 1: Descriptive statistics including means and standard deviations as well as comparison of cephalometric measurements in the agenesia and control groups**

| Variables              | X±SD                  |                      | P         |
|------------------------|-----------------------|----------------------|-----------|
|                        | Agenesia group (n=82) | Control group (n=82) |           |
| SNA                    | 79.7±3.1              | 83.7±3.2             | 0.02*     |
| SNB                    | 77.6±2.4              | 78.6±3.2             | 0.53 (NS) |
| ANB                    | 2.63±3.1              | 5.12±2.4             | 0.02*     |
| Facial axis            | 90.6±4.8              | 92.7±4.1             | 0.07 (NS) |
| Mandibular plane angle | 28.3±4.8              | 29.7±4.9             | 0.08 (NS) |
| Lower face height      | 52.4±2.8              | 53.4±2.5             | 0.37 (NS) |
| Corpus length          | 34.51±3.9             | 33.92±3.2            | 0.59 (NS) |
| Palatal plane          | 54.09±3.2             | 55.22±3.31           | 0.81 (NS) |
| Saddle                 | 121.1±2.2             | 122.5±2.4            | 0.13 (NS) |
| Articular angle        | 141.9±3.5             | 144.8±3.4            | 0.61 (NS) |
| Gonial angle           | 126.5±5.7             | 127.9±5.6            | 0.59 (NS) |
| Sum                    | 388.3±70.9            | 394.9±6.4            | <0.001*   |
| Upper gonial angle     | 52.8±2.5              | 49.7±2.9             | 0.53 (NS) |
| Lower gonial angle     | 74.6±2.8              | 78.4±2.8             | 0.001*    |
| Face height ratio      | 66.9±2.8              | 66.7±2.2             | 0.85 (NS) |
| Mandibular body length | 76.6±0.96             | 77±0.51              | 0.94 (NS) |
| Wits                   | -0.59±2.46            | -0.43±3.7            | 0.76 (NS) |

\* $P < 0.05$ . NS=Not significant, SD=Standard deviation



ages of 12 and 16, the teeth crowns become completely calcified; and between ages of 17 and 21 years, third molars start to erupt.<sup>[27]</sup> All the subjects in this study had passed these time limits; therefore, the diagnosis of third molar agenesis could be made easily.

The main question which was planned to be answered by this study was whether there is a relationship between third molar agenesis and craniofacial morphologies in sagittal and vertical planes or not. We hypothesized that sagittal and vertical dimension changes are associated with third molar agenesis. As previously described, to evaluate the main hypothesis of this study, we designed a cross-sectional study which was conducted on a group of orthodontic patients who had high quality panoramic and cephalometric radiographs and met the inclusion criteria of the study. The intraexaminer reproducibility was assessed, and the data were analyzed using appropriate statistical tests as mentioned earlier.

To summarize the main findings revealed by this study, we found that, in subjects with agenesis of one or more third molar teeth, the SNA, sum of posterior angles, and lower gonial angle were significantly lower compared to the control group.

As mentioned above, in this study, we found significantly lower SNA and therefore ANB angles in the agenesis group. This finding is further supported by previous studies. A study conducted in a group of Japanese showed lesser sagittal dimensions of the basal bone of the maxilla in subjects with bilateral maxillary third molar agenesis.<sup>[13]</sup> However, they failed to show any association between third molar agenesis and anteroposterior dimensions of the mandible, which further supports our observation in this respect.<sup>[13]</sup> Kömerik *et al.* in their study to evaluate the relationship between third molar agenesis and skeletal jaw morphologies in sagittal and vertical planes showed that agenesis of third molars was more prevalent in subjects with smaller sagittal maxillary and mandibular dimensions. They also found that subjects with hypodivergent and short face pattern had a higher frequency of third molar agenesis in both jaws.<sup>[28]</sup> In a recent study done by Huang *et al.*, it was found that subjects with agenesis had smaller SNA and Wits values which are in line with our observations. They also found that hypodivergent subjects had a higher incidence of third molar agenesis.<sup>[29]</sup> Altan *et al.* also found that anteroposterior dimensions of both jaws were significantly smaller in agenesis groups. However, they failed to find any difference in vertical dimensions among the groups.<sup>[30]</sup> The association between tooth agenesis and significant decreases in maxillary jaw size has also been stated by Tavajohi-Kermani *et al.*,<sup>[5]</sup> while they observed insignificant changes in mandibular size associated with

tooth agenesis. However, this result differs from those of Sánchez *et al.*<sup>[3]</sup> and Ramiro-Verdugo *et al.*<sup>[9]</sup> since they did not find a significant association between maxillary anteroposterior dimension and third molar agenesis. Racial differences can be a possible explanation for these differences.<sup>[13]</sup> Some studies support a link between certain malocclusions and third molar agenesis. For example, a significantly higher prevalence of third molar agenesis was found in the Class II Division 2 group in Japan.<sup>[31]</sup>

We found a significant association between agenesis of the third molar and smaller lower gonial angle in this study. A reduced gonial angle is representative of more horizontally directed mandibular growth and counter clockwise rotation of mandibular plane which are indicative of a brachycephalic head form. The lower sum of posterior angles in this study seems to be influenced by the lower gonial angle. This observation is consistent with that of Sánchez *et al.* who found that maxillary third molar agenesis was associated with reduced mandibular plane angle.<sup>[3]</sup> They found decreased lower facial height and brachyfacial pattern in subjects with mandibular third molar agenesis.<sup>[3]</sup> This also accords with findings of Ramiro-Verdugo *et al.*, who found an association between third molar agenesis and reduction in Jarabak's gonial angle and upper gonial angle and brachyfacial skeletal pattern.<sup>[9]</sup> Nevertheless, this observation is in contrast to findings of Celikoglu and Kamak, who reported the similar prevalence of third molar agenesis among the hyperdivergent, normal, and hypodivergent groups.<sup>[8]</sup> Cocos and Halazonetis have also evaluated the shape of the craniofacial complex in patients with tooth agenesis and found that patients with agenesis of teeth other than third molars had Class III tendency and hypodivergent skeletal pattern, but this was not true for third molar agenesis group.<sup>[32]</sup>

It has been recently claimed that the third molar agenesis could be a potential marker for craniofacial deformities and may be associated with the disturbances related to cleft lip and palate. Fernandez *et al.* in a study to evaluate the relationship between third molar agenesis and other craniofacial structure alterations found that there was high frequency of third molar agenesis among individuals with cleft lip and their relatives. However, they did not find an association with skeletal malocclusion or growth pattern.<sup>[33]</sup>

Due to lacking systematic search protocols and similar criteria for appraising evidence on the relationship of third molar agenesis and craniofacial morphology, the literature lacks systematic reviews on the topic. However, there are systematic reviews about morphologic and demographic predictors of third molar agenesis and

predictors of third molar impaction<sup>[7,34]</sup> which were irrelevant to the topic of this paper.

Within the limitation of this study, it can finally be implied that third molar agenesis is associated with sagittal and vertical jaw dimensions. However, further studies with larger samples are needed for presenting definitive conclusions.

## CONCLUSION

Third molar agenesis in this group of Iranian subjects was associated with reduced SNA angle and decreased lower gonial angle which is suggestive of deficient maxillary development and brachyfacial and hypodivergent skeletal pattern in subjects with third molar agenesis.

## FINANCIAL SUPPORT AND SPONSORSHIP

Nil.

## CONFLICTS OF INTEREST

There are no conflicts of interest.

## REFERENCES

- Bergendal B, Olgart K. Congenitally missing teeth. In Consensus conference on oral implants in young patients. Jönköping: The Institute for Postgraduate Dental Education 1996. p. 16-27.
- Sujon MK, Alam MK, Rahman SA. Prevalence of third molar agenesis: Associated dental anomalies in non-syndromic 5923 patients. *PLoS One* 2016;11:e0162070.
- Sánchez MJ, Vicente A, Bravo LA. Third molar agenesis and craniofacial morphology. *Angle Orthod* 2009;79:473-8.
- Endo T, Ozoe R, Yoshino S, Shimooka S. Hypodontia patterns and variations in craniofacial morphology in Japanese orthodontic patients. *Angle Orthod* 2006;76:996-1003.
- Tavajohi-Kermani H, Kapur R, Sciote JJ. Tooth agenesis and craniofacial morphology in an orthodontic population. *Am J Orthod Dentofacial Orthop* 2002;122:39-47.
- Yüksel S, Uçem T. The effect of tooth agenesis on dentofacial structures. *Eur J Orthod* 1997;19:71-8.
- Carter K, Worthington S. Morphologic and demographic predictors of third molar agenesis: A systematic review and meta-analysis. *J Dent Res* 2015;94:886-94.
- Celikoglu M, Kamak H. Patterns of third-molar agenesis in an orthodontic patient population with different skeletal malocclusions. *Angle Orthod* 2012;82:165-9.
- Ramiro-Verdugo J, De Vicente-Corominas E, Montiel-Company JM, Gandia-Franco JL, Bellot-Arcis C. Association between third molar agenesis and craniofacial structure development. *Am J Orthod Dentofacial Orthop* 2015;148:799-804.
- Flores-Mir C. Increased hypodontia through the twentieth century. *Evid Based Dent* 2006;7:15.
- Bishara SE. Third molars: A dilemma! Or is it? *Am J Orthod Dentofacial Orthop* 1999;115:628-33.
- Yüksel S, Uçem T. The effect of tooth agenesis on dentofacial structures. *Eur J Orthod* 1997;19:133-43.
- Kajii TS, Sato Y, Kajii S, Sugawara Y, Iida J. Agenesis of third molar germs depends on sagittal maxillary jaw dimensions in orthodontic patients in Japan. *Angle Orthod* 2004;74:337-42.
- Bailit HL. Dental variation among populations. An anthropologic view. *Dent Clin North Am* 1975;19:125-39.
- Ogaard B, Krogstad O. Craniofacial structure and soft tissue profile in patients with severe hypodontia. *Am J Orthod Dentofacial Orthop* 1995;108:472-7.
- Garn SM, Lewis AB. The gradient and the pattern of crown-size reduction in simple hypodontia. *Angle Orthod* 1970;40:51-8.
- Vastardis H. The genetics of human tooth agenesis: New discoveries for understanding dental anomalies. *Am J Orthod Dentofacial Orthop* 2000;117:650-6.
- Kokich VG, Kokich VO. Congenitally missing mandibular second premolars: Clinical options. *Am J Orthod Dentofacial Orthop* 2006;130:437-44.
- Jorgenson RJ. Clinician's view of hypodontia. *J Am Dent Assoc* 1980;101:283-6.
- Demirjian A, Goldstein H, Tanner JM. A new system of dental age assessment. *Hum Biol* 1973;45:211-27.
- Steiner CC. Cephalometrics for you and me. *Am J Orthod* 1953;39:729-55.
- Ricketts RM. Cephalometric analysis and synthesis. *Angle Orthod* 1961;31:141-56.
- Jacobson A, Jacobson R. Radiographic Cephalometry, From Basics to 3D Imaging. 2<sup>nd</sup> ed. New Malden, Surrey, UK: Quintessence Publishing Co.; 2006.
- Bolaños MV, Moussa H, Manrique MC, Bolaños MJ. Radiographic evaluation of third molar development in Spanish children and young people. *Forensic Sci Int* 2003;133:212-9.
- Gravely JF. A radiographic survey of third molar development. *Br Dent J* 1965;119:397-401.
- Richardson M. Late third molar genesis: Its significance in orthodontic treatment. *Angle Orthod* 1980;50:121-8.
- Massler M, Schour I, Poncher H. Developmental pattern of the child as reflected in the calcification pattern of the teeth. *Am J Dis Child* 1941;62:33-67.
- Kömerik N, Topal O, Esenlik E, Bolat E. Skeletal facial morphology and third molar agenesis. *J Res Pract Dent* 2014.
- Huang Y, Yan Y, Cao J, Xie B, Xiao X, Luo M, *et al.* Observations on association between third molar agenesis and craniofacial morphology. *J Orofac Orthop* 2017;78:504-10.
- Altan AB, Sinanoglu EA, Ucdemir E. Dentofacial morphology in third molar agenesis. *Turk J Orthod* 2015;28:7-12.
- Ota K, Arai K. Prevalence and patterns of tooth agenesis in angle class II division 2 malocclusion in Japan. *Am J Orthod Dentofacial Orthop* 2015;148:123-9.
- Cocos A, Halazonetis DJ. Craniofacial shape differs in patients with tooth agenesis: Geometric morphometric analysis. *Eur J Orthod* 2017;39:345-51.
- Fernandez CC, Pereira CV, Luiz RR, Faraco IM Jr., Marazita ML, Arnaudo M, *et al.* Third molar agenesis as a potential marker for craniofacial deformities. *Arch Oral Biol* 2018;88:19-23.
- Carter K, Worthington S. Predictors of third molar impaction: A systematic review and meta-analysis. *J Dent Res* 2016;95:267-76.