Dental anomalies in orthodontic patients with and without skeletal discrepancies

Clarissa Christina Avelar Fernandez¹, Mônica Gentil Mattos¹, Christiane Vasconcellos Cruz Alves Pereira¹, Marcelo de Castro Costa¹

¹Department of Pediatric Dentistry and Orthodontics, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil

Abstract

Objective: To determine whether individuals with skeletal discrepancies of Class II or III display a higher frequency of dental anomalies in comparison with individuals with Class I malocclusion.

Design: A systematic search of the main electronic medical scientific literature databases was conducted. Observational studies were selected if mentioning dental anomalies in the different skeletal malocclusion patterns.

Results: A total of 4,768 studies were found and the duplicated studies (1,279) were removed, resulting in 3,489 papers to be analyzed. After screening by title, 138 were fit for screening by abstract. After that, a total of 13 papers were carefully read in full. Five studies included dental anomaly frequencies in orthodontic patients and included 7,679 participants. The frequency of dental anomalies ranged from 11.2% to 40.3%. It was observed that individuals with skeletal discrepancies of Class II and III had more dental anomalies when compared to individuals with Class I.

Conclusion: Individuals with skeletal malocclusion patterns have more dental anomalies and there is an association between dental anomalies and skeletal Class II or Class III malocclusion patterns.

Introduction

Dental anomalies are clinical alterations resulting from disturbances during the tooth formation process.¹ They represent disturbances of number, size, shape, position and structure of the teeth.¹,² The prevalence of dental anomalies can range from 5.46 to 74.7%,¹,³ due to different ethnicities and diagnostic criteria.¹,⁴,⁵ The etiology of dental anomalies includes genetic and environmental factors.²,⁵,⁶ Skeletal malocclusions are usually categorized and described by disturbances in the craniofacial and occlusal relationships⁷ and often appear together with the dental anomalies, asserting their relation and complicating therapy.⁸ It appears that dental anomalies may be more likely to occur if individuals have Class II or Class III relationships in comparison to Class I.⁹ This sophisticated clinical definition is a base for phenotype-genotype correlation, that may contribute to more accurate treatment predictions and to genetic studies.⁹ This systematic review aimed to confirm that evidence exists that individuals with Class I skeletal malocclusion are less likely to have dental anomalies.

Material and Methods

The present systematic review was registered at Prospective Register of Systematic Reviews (PROSPERO; Centre for Reviews and Dissemination, University of York; and the National Institute for Health Research) under the registry number.
CRD42016038916 and followed the Preferred Reporting Items for Systematic Review and Meta Analyses (PRISMA) checklist.10

**Search Strategy**

The following focused question was formulated: “Is there a difference in the frequency of dental anomalies in orthodontic patients with Class II or III versus Class I malocclusion?” To develop the focused question, a set of criteria for study eligibility was adopted, based on PECOS strategy (Population: orthodontic patients; Exposure: skeletal discrepancies; Comparator: standard of normality; and Outcome: dental anomalies), using MeSH, entry terms and key words (Table 1).

The main search was conducted in November 2016 and was updated on January 2019. Publications of potential relevance to this study were identified after searching the main electronic medical scientific literature databases, including PubMed, Scopus, Lilacs, Web of Science, the Cochrane Library, and Google Scholar. Additional articles of potential relevance were identified by manual searches. Textbooks, dissertations, case reports, case series, review articles, and abstracts were excluded. Studies in populations presenting specific systemic diseases, conditions (history of trauma, cleft lip and/or palate, syndromes), endocrine imbalances and/or metabolic disorders (being these sporadic or hereditary), and no descriptions of the three skeletal malocclusions were excluded.

Two examiners (C.C.A.F. and M.G.M.) independently screened each paper by examining the title, abstract, and keywords. No restriction was applied regarding language or date of publication.

The selected studies were described in relation to the type of study, total sample, sex distribution, how the diagnosis of skeletal malocclusion and dental anomalies were performed, and the frequency of dental anomalies in each malocclusion. Dental anomalies were also grouped in anomalies of number, shape and position (Table 2).

### Results and Discussion

Observational studies were included because they mentioned dental anomalies in the different skeletal malocclusion patterns, enabling comparison between groups (Claess I, II and III) and different populations. Figure 1 shows the flow diagram of the search results from the databases. After search, a total of 4,768 records were found: 750 from Cochrane Library, 1,616 from PubMed, 911 from Scopus, 323 from Scopus-Med, 1,158 from Web of Science, four from Lilacs and BBO, and six from Google Scholar.

---

**Table 1. PECOS strategy (Population; Exposure; Comparator; and Outcome), using MeSH, entry terms and key words**

| MeSH | Entry Terms | Key Words |
|------|-------------|-----------|
| **P:** | Maxilla (25648) + (15289) | Bone Maxillary (21502) Maxillae (1317) |
| **Mandible e Maxilla** | Jaw (92640) + (23972) Jaws (10315) |
| **E:** | **Skeletal Discrepancies** | Malocclusion, Angle Class II (12727) + (103) Angle Class II (408) Class II (69045) Skeletal Class II Malocclusion (140) |
| | Malocclusion, Angle Class III (2961) + (134) Prognathism, Mandibular (1604) Class III (17141) Skeletal Class III Malocclusion (377) |
| | Angle Class III (142) Underbite (14) |
| | Prognathism (3102) + (1845) Craniofacial Abnormalities (786) |
| **C:** Standard Pattern | Malocclusion, Angle Class I (1267) + (207) Angle Class I (260) Class I (51655) |
| **O:** Dental Anomalies | Malocclusion, Angle Class I (1267) + (207) Angle Class I (260) Class I (51655) |
**Table 2. Data extracted from the five selected studies.**

| Studies                        | Sample | Males N (%) | Females N (%) | Skeletal malocclusion diagnosis method | Dental anomalies diagnosis method | Prevalence of dental anomalies N (%) |
|-------------------------------|--------|-------------|---------------|---------------------------------------|----------------------------------|--------------------------------------|
| Chang et al., 2008            | 1793   | 611 (37.7)  | 1011 (62.3)   | cephalometric tracing                  | Panoramic radiographs, and dental models | 182 (11.2)                           |
| Uslu et al., 2009             | 900    | 352 (39.1)  | 548 (60.9)    | cephalometric tracing                  | Panoramic/periapical radiographs, photos, records and dental models | 363 (40.3)                           |
| Young, 2010                   | 3055   | 1205 (39.5) | 1850 (60.5)   | not reported                           | Panoramic and periapical radiographs, and dental models | 344 (11.3)                           |
| Celicoglu and Kamak, 2012     | 146    | 449 (42.9)  | 597 (57.1)    | cephalometric tracing                  | Panoramic radiographs and records | 237 (22.7)                           |
| Fernandez et al., 2018        | 1047   | 453 (43.3)  | 594 (56.7)    | cephalometric tracing                  | Panoramic and periapical radiographs, photos, records and dental models | 127 (15.7)                           |

| Studies                        | Class I – no dental anomalies (N) | Class II – no dental anomalies (N) | Class III – no dental anomalies (N) | Class I – with dental anomalies (N) | Class II – with dental anomalies (N) | Class III – with dental anomalies (N) |
|-------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| Chang et al., 2008            | 979                              | 256                              | 376                              | 103                              | 19                               | 60                               |
| Uslu et al., 2009             | 202                              | 221                              | 99                               | 156                              | 155                              | 67                               |
| Young, 2010                   | 862                              | 985                              | 864                              | 123                              | 117                              | 104                              |
| Celicoglu and Kamak, 2012     | 290                              | 290                              | 229                              | 74                               | 72                               | 91                               |
| Fernandez et al., 2018        | 158                              | 136                              | 28                               | 152                              | 113                              | 43                               |

| Studies                        | Class I – with dental anomalies of number (N) | Class II – with dental anomalies of number (N) | Class III – with dental anomalies of number (N) | Class I – with dental anomalies of shape (N) | Class II – with dental anomalies of shape (N) | Class III – with dental anomalies of shape (N) |
|-------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
| Chang et al., 2008            | 103                                           | 19                                            | 60                                            | -----                                         | -----                                         | -----                                         |
| Uslu et al., 2009             | 83                                            | 73                                            | 41                                            | 163                                           | 73                                            | 31                                            |
| Young, 2010                   | 123                                           | 117                                           | 104                                           | -----                                         | -----                                         | -----                                         |
| Celicoglu and Kamak, 2012     | 72                                            | 74                                            | 91                                            | -----                                         | -----                                         | -----                                         |
| Fernandez et al., 2018        | 58                                            | 38                                            | 13                                            | 21                                            | 15                                            | 12                                            |

| Studies                        | Class I – with dental anomalies of position (N) | Class II – with dental anomalies of position (N) | Class III – with dental anomalies of position (N) | Study conclusion                           |
|-------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
| Chang et al., 2008            | -----                                         | -----                                         | -----                                         | Hypodontia was associated with third molar agenesis and skeletal Class III malocclusion. |
| Uslu et al., 2009             | 17                                            | 6                                             | 8                                             | A remarkably high rate of dental anomalies was recorded in orthodontic patients.          |
| Young, 2010                   | -----                                         | -----                                         | -----                                         | The prevalence of hypodontia in Koreans is relatively high.                               |
| Celicoglu and Kamak, 2012     | -----                                         | -----                                         | -----                                         | Third molar agenesis depends on sagittal skeletal malocclusions.                          |
| Fernandez et al., 2018        | 73                                            | 60                                            | 18                                            | Microdontia was associated with the skeletal Class III malocclusion pattern, and tooth agenesis was associated with the hypodivergent growth pattern. |
The duplicated studies (1,279) were removed, resulting in 3,489 records to be analyzed. After screening by title, 138 were fit for screening by abstract. After that, a total of 13 records were carefully read in full and five studies containing 7,679 participants were selected. The eight studies were excluded because they did not have the classification of skeletal malocclusions patterns.

Table 2 shows the extraction of the data from the selected studies. The frequency of dental anomalies ranged from 11.2% to 40.3%. Celicoglu and Kamak (2012)\(^2\) reported a frequency of 22.7% of dental anomalies whereas Fernandez et al. (2018)\(^9\) reported a frequency of 15.7% of dental anomalies of number, shape and position. Uslu et al. (2009)\(^1\) had the highest frequency of dental anomalies among orthodontic patients of the five studies selected (40.3%), having tooth agenesis, evagination, and invagination as the most common dental anomalies. The studies that found the lowest frequency of dental anomalies in orthodontic patients were of Young (2010)\(^5\) and Chung et al. (2008),\(^11\) with a frequency of 11.3% and 11.2%, respectively. It is likely that these differences are due to the different populations studied (Turkish, Brazilian, and Korean) and different dental anomaly definitions.

**Conclusion**

In summary, individuals with skeletal Class II or Class III malocclusion patterns have more dental anomalies than individuals who are Class I. In addition, there is an association between dental anomalies and skeletal Class II or Class III malocclusion patterns.

**Acknowledgments**

This work was developed as part of a course on systematic reviews and meta-analysis taken by C.C.A.F. and M.G.M. We thank Lucianne Cople Maia, Marcela Baraúna Magno, and Danielle Masterson for this learning experience.

**References**

1. Prevalence of dental anomalies in various malocclusions. Uslu O, Akcam MO, Evirgen S, Cebeci I. Am J Orthod Dentofacial Orthop. 2009 Mar;135(3):328-35. doi: 10.1016/j.ajodo.2007.03.030.

2. The Class II Division 2 craniofacial type is associated with numerous congenital tooth anomalies. Basdra EK, Kiokpasoglou M, Stellzig A. Eur J Orthod. 2000 Oct;22(5):529-35.

3. [Agenesis in permanent dentition]. Diaz-Perez R, Echaverry-Navarrete RA.
4. Prevalence and distribution of dental anomalies in orthodontic patients. Altug-Atac AT, Erdem D. Am J Orthod Dentofacial Orthop. 2007 Apr;131(4):510-4.

5. Investigation of hypodontia as clinically relates dental anomaly: Prevalence and characteristics. Kim YH. ISRN Dentistry 2011; Article ID 246135, 6 pages.

6. Studies of dental anomalies in a large group of school children. Küchler EC, Risso PA, Costa Mde C, Modesto A, Vieira AR. Arch Oral Biol. 2008 Oct;53(10):941-6. doi: 10.1016/j.archoralbio.2008.04.00.

7. Congenital tooth anomalies and malocclusions: a genetic link? Basdra EK, Kiokpasoglou MN, Komposch G. Eur J Orthod. 2001 Apr;23(2):145-51.

8. Prevalence of Dental Anomalies among School Going Children in India. Kathariya MD, Nikam AP, Chopra K, Patil NN, Raheja H, Kathariya R. J Int Oral Health. 2013 Oct;5(5):10-4.

9. Dental anomalies in different growth and skeletal malocclusion patterns. Fernandez CCA, Pereira CVCA, Luiz RR, Vieira AR, De Castro Costa M. Angle Orthod. 2018 Mar;88(2):195-201. doi: 10.2319/071917-482.1.

10. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Int J Surg. 2010;8(5):336-41. doi: 10.1016/j.ijsu.2010.02.007.

11. The pattern and prevalence of hypodontia in Koreans. Chung CJ, Han JH, Kim KH. Oral Dis. 2008 Oct;14(7):620-5. doi: 10.1111/j.1601-0825.2007.01434.x.

12. Patterns of third molar agenesis in an orthodontic patient population with different skeletal malocclusions. Celikoglu M, Kamak H. Angle Orthod. 2012 Jan;82(1):165-9. doi: 10.2319/041911-274.1.