

# TOOTH TRANSPOSITION: TWO CASE-REPORTS AND LITERATURE REVIEW

TRANSPOSIÇÃO DENTÁRIA: DOIS RELATOS DE CASOS E REVISÃO DE LITERATURA

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## ABSTRACT

Tooth transposition is a rare developmental disorder in which a normal tooth erupts in an inappropriate position. The change in position occurs between two adjacent teeth within the same quadrant. In this article, two cases of tooth transposition involving mandibular molars are described. To our knowledge, this is the first article describing bilateral TT between first and second mandibular molars. Patient 1 presented with bilateral transposition between first and second mandibular molars. In addition, giroversion of the first molars was observed. Patient 2 presented with unilateral transposition between the mandibular left molars. Because this tooth disorder does not affect quality of life, both patients declined to seek dental treatment. Out of the 153 cases of tooth transposition found in the literature, 141 occurred in the maxilla and 73 were on the left side, 94 of these cases involved the canine and first premolar; 44 involved the canine and lateral incisor; 6 involved the canine and central incisor; and only 1 involved the first and second molar. The majority of tooth transposition cases occurred in women (102 cases). In literature, tooth transposition is a poorly-documented condition. Consequently, this report seeks to contribute to the existing information in the literature on this disorder, since this is the first article describing a case of bilateral TT affecting mandibular molars. Moreover, we also suggest a new categorization for dental transposition.

**Keywords:** Dental transposition. Tooth abnormalitie. Tooth transposition.

## INTRODUCTION

Tooth transposition (TT) has been described as an interchange in the position of two permanent teeth within the same quadrant of the dental arch<sup>1</sup>. It is a unique form of ectopic eruption wherein a permanent tooth develops and erupts in a position normally occupied by another permanent tooth<sup>2</sup>. TT is considered a rare anomaly with uncertain etiology that often represents a challenge for the clinician<sup>1</sup>. A literature search was conducted on PubMed, Scielo, and Bireme databases using the term “tooth transposition,” and 176 studies published in the last 15 years were found. However, only 62 reports in the English language, that described clinical cases of TT in humans, met the inclusion criteria (these articles are listed in Table 1).

TT can occur at any age and is usually diagnosed during clinical and radiographic examination, prior to orthodontic treatment. The distribution of TT cases by sex varies according to the geographical location<sup>1,65,66</sup>. It can affect the maxillary or mandibular dentition, unilaterally or bilaterally<sup>66</sup>. However, unilateral transpositions are reported more frequently than bilateral transpositions, and the left side is more frequently involved than the right side<sup>67</sup>. In addition, it is more common in the maxilla<sup>6</sup> (between the canine and first premolar) than the mandible where fewer teeth groups are affected (between the canine and lateral incisor)<sup>17,69</sup>. To our knowledge, this is the first article describing bilateral TT between first and second mandibular molars.

Five different variations of maxillary TT have been described<sup>69</sup>. They are classified as Canine-first premolar (Mx.C.P1), Canine-lateral incisor (Mx.C.I2), Canine to first molar site (Mx.C to M1), Lateral incisor-central incisor (Mx.I2.I1), and Canine to central incisor site (Mx.C to I1). In the mandible, only two classifications are described which are Lateral incisor-canine (Mn.I2.C) and Canine transmigrated/erupted (Mn.C.transerupted)<sup>70</sup>. Another classification was suggested for maxillary transposition, between the third molar and second molar (Mx.M3M2)<sup>71</sup>.

In the identification of this condition, a distinction should be made between a complete and an incomplete transposition. A complete transposition occurs where both crowns and the entire root structures of the involved teeth are found in their transposed positions. Incomplete transposition is also called “pseudo” or “partial” transposition because the crowns may be transposed while the root apices remain in their normal positions or the crowns may be in the correct order while the root apices are transposed. The involved teeth overlap and their long axes cross each other<sup>72</sup>.

Many developmental dental anomalies may be caused by genetic and environmental factors, especially during the morpho-differentiation or histo-differentiation stages of development<sup>70</sup>. The etiology of TT is multifactorial; both genetic and environmental factors can play important roles in its development. The nature of recommended treatment for TT is orthodontic, since many cases are diagnosed during orthodontic assessment<sup>1</sup>.

The aim of this study was to report two cases of TT and review the literature of cases published in English language on this condition.

## CASE REPORT

During a routine clinical examination, bilateral TT was observed between the first and second mandibular molars in a 26-year old male patient (patient 1). Giroversion of the mandibular first molars was also observed (figure 1A and B). Moreover, clinical and radiographic examinations demonstrated missing third mandibular molar of the right side (figure 1E and H), though the patient denied any previous dental extraction, which led to the hypothesis of agenesis.

From these observations, we diagnosed TT. Based on the knowledge of genetic factors associated

with TT, we conducted clinical evaluations on the direct relatives of the patient; TT was observed in his mother.

The second patient (patient 2), a 56-year-old-woman, presented with unilateral transposition between the left mandibular molars, without giroversion (figure 2B). The transposition was characterized by the presence of three vestibular cusps in the tooth located as the second left mandibular molar. However, three vestibular cusps are characteristic of the first molar. On clinical examination, the absence of right maxillary canine, first left maxillary premolar, and first right mandibular molar, was observed. The patient reported a history of few tooth extractions when she was younger, but she could not recall which teeth. Retained maxillary left canine was observed on the panoramic radiograph. The patient was informed about her diagnosis and referred to the oral and maxillofacial surgery department.

Both patients did not have previous knowledge of the TTs. Hence, they declined any treatment, since this anomaly did not influence their quality of life.

## DISCUSSION

TT is considered a rare dental anomaly<sup>73</sup> and has been described as an interchange in the position of two permanent teeth within the same quadrant of the dental arch<sup>1</sup>. The prevalence of this anomaly varies according to the sample studied, but it remains low in most literature reports<sup>69</sup>. Clinical relevance of TT are possible disorders in dental occlusion, level of dental crowding, aesthetics and position of the roots. Besides that, this anomaly can be associated with other dental



Figure 1 - (Patient 1): A) Tooth transposition between first and second right mandibular molars. In addition, giroversion of first molar can be observed. B) Tooth transposition between first and second left mandibular molars. In addition, giroversion of first molar can be observed. C) Occlusal view of the left maxillary molars. D) Occlusal view of the right maxillary molars. E) Mandibular arch view. F) Maxillary arch view. G) Occlusion of the upper and lower arches showing aesthetic and functional harmony. H) Panoramic Radiography showing the absence of third mandibular right molar.

anomalies teeth<sup>71,12,19</sup>.

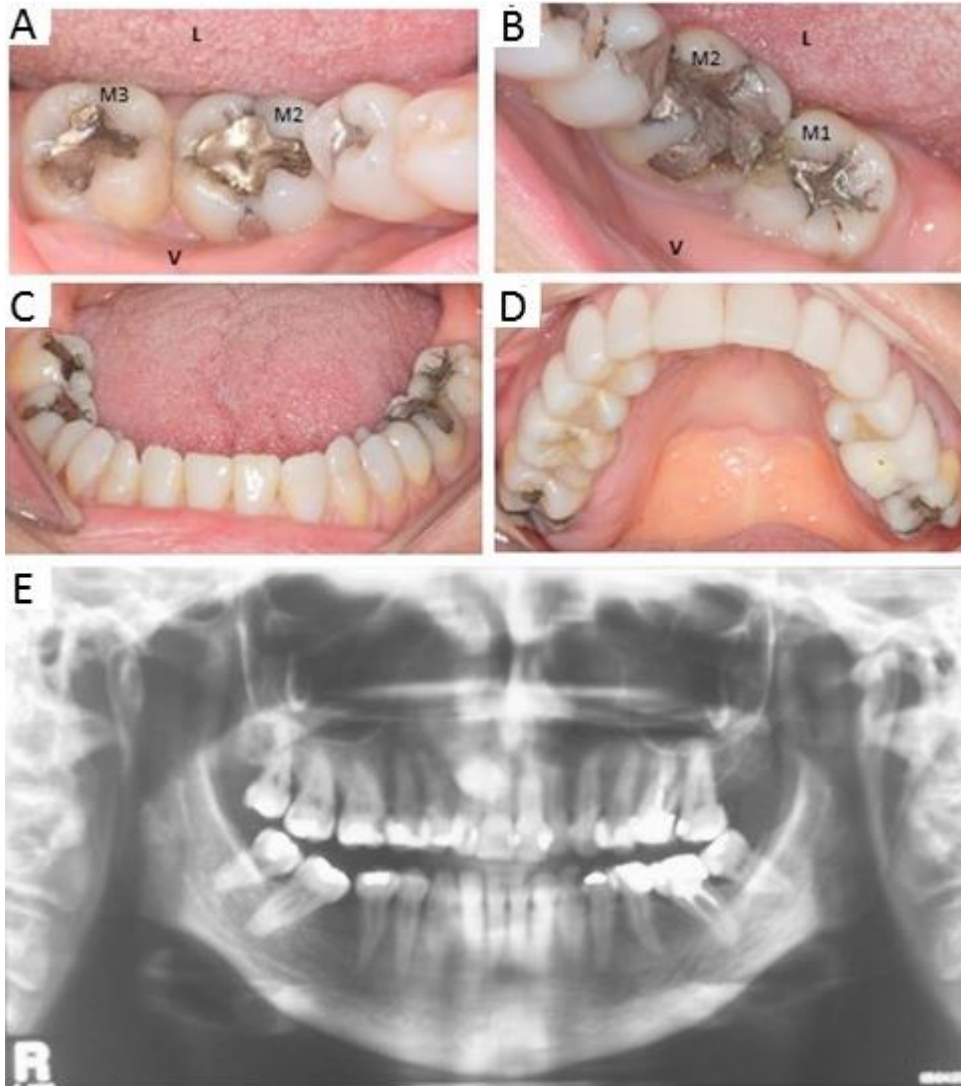


Figure 2 - (Patient 2): a) Occlusal view of the right mandibular molars and showing the absence of first mandibular right molar. b) Tooth transposition between first and second left mandibular molars. c) Mandibular arch view. d) Maxillary arch view. e) Panoramic Radiography.

It can be complete or incomplete. When it affects both the roots and crowns of the teeth, it is described as complete and when it affects only the crowns, it is said to be incomplete transposition<sup>16,60</sup>. Three database reviews in English literature revealed 62 articles published over the last 15 years, in which 153 clinical cases were described (table 1). Among these, only 12 described cases in mandible<sup>6,12-14,21-23,40,54,60</sup> and only 1 case involved the first and second molars<sup>13</sup>. With this research it was possible to show the rarity of cases in the mandibular molars, which led to the elaboration of this report. Furthermore, an earlier case survey identified 60 cases of mandibular TT; however, none of these cases involved molars<sup>70</sup>.

In the literature, most of the reported TT cases have occurred in the maxilla, between the canine and first premolar, representing 94 cases (table 1 – figure 3). In both arches, unilateral TT is most prevalent and the occurrence of more than one TT in the same patient is rare<sup>66</sup>. Besides, TT can be associated with other dental anomalies, the most common being impacted canine, hypodontia and supernumerary teeth<sup>71,12,19</sup>. In our case report, patient 1 presented with mandibular bilateral TT, in addition to giroversion of the transposed molars and mandibular right third molar agenesis. Patient 2 presented with retained maxillary left canine.

In the literature survey performed during this study, 12 articles reported an association between TT and agenesis<sup>3,4,9,11,13,14,17,20,54,55,62,64</sup> but none described the occurrence of tooth giroversion. The reported frequency of the association between TT and agenesis in previous studies was around 37-40%<sup>16,65</sup>. In addition, retained canine was one of the most common dental anomalies found in combination with TT (Table 1), and this may suggest a common etiological origin for these conditions.

In the review of literature, we analyzed the most common anomalies associated with TT. We found 56 cases associated with retained canine, 24 associated with impaction, 12 associated with

hypodontia, 14 associated with microdontia, 1 associated with macrodontia, 11 associated with ectopic eruption; 13 associated with agenesis; 5 associated with dilacerations, 3 associated with supernumerary teeth, 1 associated with dens in dente, 1 associated with radiculomegaly and 16 with no associated anomaly, may have more than one associated (table 1).

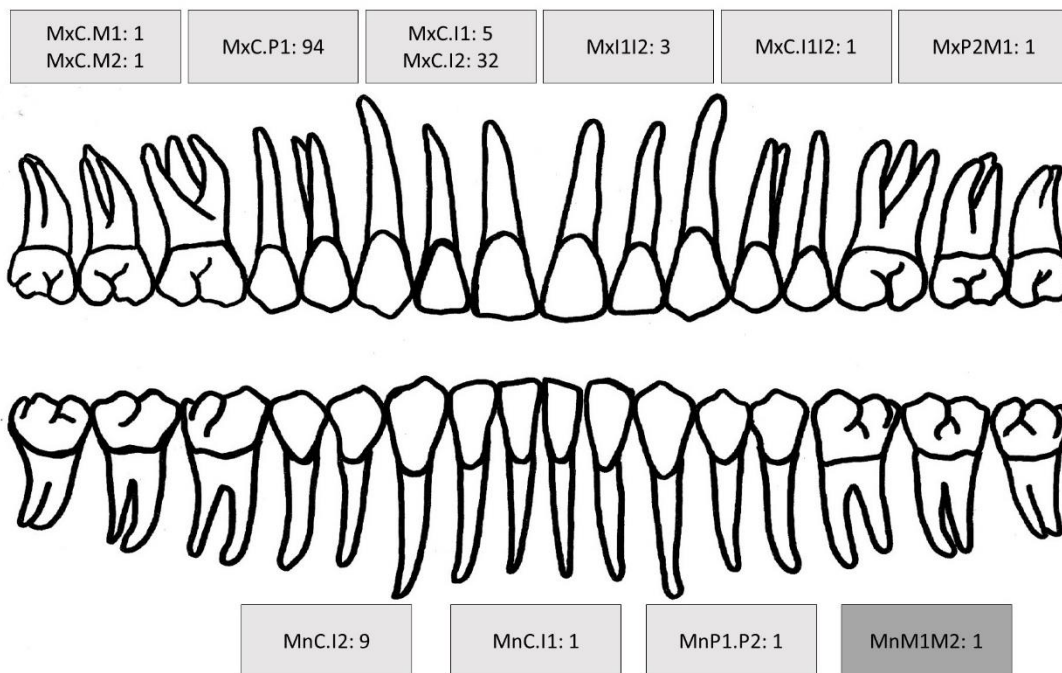


Figure 3 - Number of tooth transposition cases found in literature review. MnC.I2: Mandibular canine-lateral incisor; MnC.I1: Mandibular canine-central incisor; MnP1.P2: mandibular first-second premolars; MnM1.M2: mandibular first-second molars; MxC.M1: maxillary : maxillary canine-first molar; MxC.M2: maxillary canine-second molar; MxC.P1: Maxillary canine-first premolar; MxC.I1: maxillary canine-central incisor; MxC.I2: Maxillary canine-lateral incisor; MxI1.I2: maxillary central incisor-lateral incisor; MxC.I1.I2: Maxillary canine-central incisor-lateral incisor; MxP2.M1: maxillary second premolar-first molar.

The etiology of TT is uncertain and multifactorial. Both genetic and environmental factors have been cited as probable causes. Many theories have been propounded on the etiology of transposition. Accordingly, retained teeth, trauma, genetic predisposition, and ectopic eruption have all been suggested as the possible causes of transposition. The best argument for the genetic etiology of transposition would be a perturbation of the order of developing tooth follicles, since genes play an important role in patterning the dentition<sup>66</sup>. It is known that the development of the tooth depends on reciprocal interactions between the oral epithelium (derived from the ectoderm) and ectomesenchyme, which are mediated by the expression of several genes. The interchange of dental anlage during the developmental stages has been proposed as a cause of transposition<sup>13</sup>. Trauma, which presumably causes an "exchange" imposed by an external force, is another factor that been proposed as a cause of transposition<sup>13</sup>.

Another hypothesis for the genetic origin of dental transposition, would be that that the anomaly would initiate with cell migration after the induction of cell groups at the onset of odontogenesis<sup>75</sup>. The epithelial cells would continue to migrate until they decoded the genetic information about the position in which they should develop. A mutation could cause abnormal dental position, and once these cells are fixed in position, they would begin to develop. Were found the frequency of transposition of canines and first pre-molars to be 8.5% in prehistoric populations; this further suggests a genetic origin of this dental anomaly<sup>76</sup>. In addition, another studie showed transposition between the canines and first premolars in multiple members of the same family, further suggesting hereditary origins<sup>77</sup>.

Based on the data collected, orthodontic treatment and extraction followed by prosthetic rehabilitation are the most common treatment procedures for TT. In our review, 55 of the articles analyzed, reported the use of orthodontic treatment for TT (Table 1). Moreover, in many of the cases reviewed, TT was identified during orthodontic treatment planning and examination. The goal of orthodontic treatment is to reestablish the normal position of dental elements in order to restore appropriate occlusion<sup>1</sup>. In clinical cases where TT affects the anterior teeth, orthodontic treatment can recreate the aesthetic harmony of the dentition<sup>1</sup>. However, when TT does not interfere with aesthetics or occlusion, treatment may not be required. In this case, the decision to opt for treatment should be determined by the patient, taking into account the benefits and consequences of available interventions, surgical or orthodontic<sup>1</sup>. The choice of the most appropriate treatment will be determined by factors such as occlusion, level of dental crowding, aesthetics, position of the roots, and patient specific needs.

Often, the extraction of some dental element is necessary for orthodontic treatment in order to make room for adequate repositioning of the teeth. Patient 1 reported having undergone orthodontic treatment for 7 years for a rather "wrong" dentition. Few years later, maxillary and mandibular dental containments were placed. Previous radiographs and the orthodontic records of the patient were not available in order to better analyze the dental condition prior to the orthodontic treatments.

## **CONCLUSIONS**

TT is a dental condition that rarely involves mandibular molars. It is extremely rare and poorly documented in the literature. We hope that this report will help to improve the clinical knowledge about this anomaly.

In this report, we suggest a new categorization for dental transposition, Mn.M1.M2, represented by the transposition between the first and second mandibular molars. Our report documents two cases of this anomaly and we found another case during the literature review<sup>13</sup>.

AUTHOR	CASES	GENDER	AGE	LOCALIZATION	TEETH	SIDE	OTHER ANOMALY	TREATMENT
Al-Mutawa, 2003 <sup>3</sup>	1	F	17	Mx	C.P1	B	Ag.	No
Saldarriaga, 2003 <sup>4</sup>	1	F	13	Mx	C.I1	R	Ag. EE	Orthod
Takada, 2005 <sup>5</sup>	1	M	11	Mx	I1.I2	L	No	Orthod.
Kensu, 2005 <sup>6</sup>	1	F	29	Mn	C.I2	L	No	No
Kuroda, 2005 <sup>7</sup>	1	F	21	Mx	C.P1	L	No	Orthod.
Lewis, 2005 <sup>8</sup>	2	F	9	Mx	C.I2	L	Dilacer	Orthod / Rest
		F	8	Mx	C.I2	L	Dilacer	Orthod / Rest
Maia, 2005 <sup>9</sup>	1	F	9	Mx	C.P1	B	Ag.	Orthod
Oredugba, 2005 <sup>10</sup>	1	F	15	Mx	C.I2	R	Hypodontia	Orthod.
Türkkahraman, 2005 <sup>11</sup>	2	F	10	Mx	C.I1	L	Ag / ,Impac,	Orthod.
		M	44	Mx	C.I1	L		Orthod.
Doruk, 2006 <sup>12</sup>	1	M	8	Mn	C.I2	R	No	Orthod
Grant, 2006 <sup>13</sup>	1	M	12	Mn	M1M2	R	Ag.	No
Suprabha, 2006 <sup>14</sup>	1	F	14	Mn	P1.P2	L	Ankylosis / Ag	Orthod.
Borrie, 2007 <sup>15</sup>	1	M	7	Mx	I1.I2	R	Macrodont / Supernumerary	Rest / Extraction
Capelozza Filho, 2007 <sup>16</sup>	1	F	9	Mx	C.P1	R	No	Orthod
Ciarlantini, 2007 <sup>17</sup>	12	6 F	11-52	Mx	8 C.P1	6 R	Retained canine / Ag	Orthod /
		6M			4 C.I2	5 L 1B		Extraction
Hägg, 2007 <sup>18</sup>	1	F	13	Mx	C.P1	R	EE	Orthod.
Babacan, 2008 <sup>19</sup>	1	F	12	Mx	C.P1	B	No	Orthod
Bruno, 2008 <sup>20</sup>	1	F	15	Mx	C.P1	R	Ag	Orthod / Extraction
Sabri, 2008 <sup>21</sup>	9	7 F	10-13	3 Mn	6 C.I2	6 L	Impac / EE / Retained canine	Orthod /
		2 M		6 Mx	3 C.P1	3 B		Extraction / Rest
Almeida, 2009 <sup>22</sup>	1	F	10	Mn	C.I2	B	Impac	Orthod
Canoglu, 2009 <sup>23</sup>	1	F	12	Mn	C.I2	R	No	Orthod
Giacomet, 2009 <sup>24</sup>	1	F	10	Mx	C.P1	R	EE	Orthod
Halazonetis, 2009 <sup>25</sup>	1	M	12	Mx	C.P1	B	EE, / Impac	Orthod
Ruellas, 2009 <sup>26</sup>	1	F	10	Mx	C.I2	L	Impac / Dilacer	Orthod

Vitale, 2009 <sup>27</sup>	1	F	8	Mx	C.P1	L	No	Orthod
Asensi, 2010 <sup>28</sup>	1	F	7	Mx	C.I1.I2	R	Impac	Orthod
Deepti, 2010 <sup>29</sup>	1	F	12	Mx	C.I2	R	Impac	Orthod
Kapoor, 2010 <sup>30</sup>	1	F	16	Mx	C.P1	B	EE	Orthod
Ozan, 2010 <sup>31</sup>	1	F	22	Mx	C.P1	L	No	Orthod
Synodinos, 2010 <sup>32</sup>	1	F	9	Mx	C.P1	L	No	Orthod
Cho, 2011 <sup>33</sup>	1	M	14	Mx	C.P1	L	Retained canine	No
Pair, 2011 <sup>34</sup>	1	F	12	Mx	C.I2	L	No	Orthod
Uribe, 2011 <sup>35</sup>	1	F	25	Mx	C.P1	R	Radiculomegaly	Orthod
Cho, 2012 <sup>36</sup>	69	26 M 43 F	11-15	Mx	55 C.P1 12 C.I2 1 C.I1 1 C.M1	B (8 in C.P1) 29 R 32 L	Hypodontia (11 cases) Microdontia lateral incisor (10) Impac (11) Supernumerary (2) Retained canine (52)	No described
Farret, 2012 <sup>37</sup>	1	F	14	Mx	C.P1	R	Impac	Orthod
Kuril, 2012 <sup>38</sup>	1	M	23	Mx	C.P1	L	No	Orthod / Rest
Nishimura, 2012 <sup>39</sup>	1	F	16	Mx	C.P1	R	Retained canine / EE	Orthod
Sabuncuoglu, 2012 <sup>40</sup>	1	F	10	Mn	C.I2	L	EE	Orthod
Yadav, 2012 <sup>41</sup>	1	F	35	Mx	C.I2	L	Microdontia	Protetic / Rest
Cannavale, 2013 <sup>42</sup>	1	F	10	Mx	P2M1	L	EE	Orthod
Fu, 2013 <sup>43</sup>	1	F	17	Mx	C.I2	L	Impac	Orthod
Lin, 2013 <sup>44</sup>	1	F	8	Mx	C.I2	L	Dilacer / Impac	Orthod./ Extraction
Sachan, 2013 <sup>45</sup>	1	M	19	Mx	C.P1	L	No	Orthod
Selvaraj, 2013 <sup>46</sup>	1	F	36	Mx	C.P1	B	No	Orthod
Ali, 2014 <sup>47</sup>	1	F	9	Mx	C.I1	L	Dilacer	Orthod
Campbell, 2014 <sup>48</sup>	1	M	7	Mx	C.I2	L	EE / Hypodontia / Microdontia / Impac	Orthod / Extraction / Rrest
Cardoso, 2014 <sup>49</sup>	1	M	8	Mx	C.P1	B	No	Orthod / Extraction
Gebert, 2014 <sup>50</sup>	1	F	12	Mx	C.I2	L	Impac	Orthod
Memon, 2014 <sup>51</sup>	1	F	13	Mx	C.P1	B	No	Orthod
Sholapurkar, 2014 <sup>52</sup>	1	M	56	Mx	I1.I2	R	Dens in dente	No
Tripathi, 2014 <sup>53</sup>	1	F	19	Mx	C.I2	L	No	Protetic



<b>Venkataraghavan, 2014<sup>54</sup></b>	1	M	11	Mn	C.I2	L	Ag	Orthod
<b>Di Palma, 2015<sup>55</sup></b>	1	F	7	Mx	C.P1	B	Ag	Orthod
<b>Dinoi, 2015<sup>56</sup></b>	1	M	12	Mx	C.P1	R	Microdontia	Orthod
<b>Hsu, 2016<sup>57</sup></b>	1	F	12	Mx	C.I2	L	EE	Orthod
<b>Lorente, 2016<sup>58</sup></b>	2	M	12	Mx	C.I2	B	No	Orthod
		F	15	Mx	C.I2	L	No	
<b>Potrubacz, 2016<sup>59</sup></b>	1	F	7	Mx	C.P1	B	No	Orthod
<b>Di Venere, 2017<sup>60</sup></b>	1	M	9	Mn	C.I1	R	No	Orthod
<b>Hekmatfar, 2017<sup>61</sup></b>	1	F	22	Mx	C.M2	L	Impac	No
<b>Nabbout, 2017<sup>62</sup></b>	2	F	13	Mx	C.P1	L	Ag	Orthod
		F	11	Mx	C.P1	R	No	Orthod
<b>Hwang, 2018<sup>63</sup></b>	1	M	12	Mx	C.P1	R	Microdontia	Orthod
<b>Matsumoto, 2018<sup>64</sup></b>	1	F	17	Mx	C.I2	R	Ag Retained canine	Extraction / Orthod
<b>TOTAL</b>	153	F	M	Mn 12 Mx 141				
		102	51	153				

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