Relationship between molar deciduous teeth infraocclusion and mandibular growth: A case-control study

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Abstract

Aim As the effects of infraocclusion on mandibular growth could have a significant impact on the treatment planning made by the orthodontist, the aim of this study is to evaluate the correlation between infraocclusion and mandibular growth.

Materials and methods Study design: A total of 42 healthy Caucasian patients with no history of dental trauma or orthodontic treatment were selected for this study from the same paediatric dentistry department. These patients were divided in two groups based on the presence or absence of infraocclusion: Group A, 22 patients (12 males and 10 females) suffering from infraocclusion of at least one inferior deciduous molar, and Group B, 20 patients (9 males and 11 females) who did not suffer from infraocclusion but had to be treated for dental overcrowding. Each patient was examined through an orthopantomography scan and lateral cephalogram. All measurements were made before the start of the treatment, and they were analysed in order to show cephalometric correlation between the skeletal class, the vertical dimension and cranio-maxillo-mandibular divergence.

Results According to Student's t-test, the only measurements which had a statistically significant difference between Group A and Group B were the SNB angle (p-value <0.01), the ANB angle (p-value <0.05) and the PC-GO-GN angle (p-value <0.05).

Conclusion From the data collected in this study, it is possible to conclude that patients suffering from infraocclusion of the mandibular deciduous molars show mandibular post-rotation and an increased total Gonial angle, compared to patients who do not suffer from infraocclusion. Despite the absence of a longer-term evaluation of these patients, thanks to this data it is possible to state that early diagnosis of infraocclusion is fundamental in order to apply a well-planned and thought-out orthodontic treatment.

KEYWORDS Ankylosis; Infraocclusion; Mandibular growth; Orthodontics; Vertical dimension.

Introduction

Infraocclusion is an anomalous position of a tooth, in which the occlusal surface is below the occlusal plane. The condition is often described also as submerged tooth, impacted tooth or secondary retention [Kurol, 1984]. An infraoccluded tooth is completely erupted but is somehow unable to maintain a correct position in relation with the neighbouring teeth during development [Kurol, 1984]. The majority of infraoccluded teeth suffer from ankylosis, which is caused by the fusion of radicular cement with the alveolar bone [Wise and King, 2008] and is the main comorbidity for infraocclusion [Silvestrini Biavati et al., 2011]. According to Biederman [1962], ankylosis is caused by an alteration of the remodelling processes preceding root resorption. This condition can be identified by clinical examination [Kurol, 1984] or cephalometric analysis [Koyoumdjisky-Kaye and Steigman, 1982] and can be divided in two subcategories [Wise and King, 2008]: Primary Eruption Failure (PEF), in which the natural eruption is interrupted causing infraocclusion without ankylosis of the tooth; Mechanical Eruption Failure (MEF), in which the infraoccluded tooth is also suffering from ankylosis.

Infraocclusion has also been classified into three degrees of severity [Brearley, 1973]: mild, the occlusal surface of the infraoccluded tooth is ≃ 1 mm, below the occlusal plane; moderate, the occlusal surface of the infraoccluded tooth is at the same level as the adjacent teeth's contact points; severe, the occlusal surface of the infraoccluded tooth is at the same level as the adjacent teeth's interproximal gingiva.

The prevalence of infraoccluded deciduous molars is between 1.3% and 38.5% depending on age, sex and ethnicity, with a peak between 6- and 11-year-old children [Koyoumdjisky-Kaye and Steigman, 1982; Steigman et al., 1973].

Kurol analysed, through clinical observation, 1059 male and female subjects between 3 and 12 years of age; he observed that females between 3 and 6 years old showed more infraoccluded teeth, while males suffered this condition more between 7 and 12 years of age [Kurol 1984]. The biggest peak for incidence regarding infraocclusion is 14.3% and is registered between 8 and 9 years of age, with no difference between the right or left side; infraocclusion, however, is more common in the mandibular arch, particularly deciduous molars [Altay

and Cengiz, 2002]. Silvestrini Biavati et al. [2011] found 88 ankylosed teeth in a group of 512 patients in a 1:1 proportion between male and female, observing that mandibular deciduous molars are more often ankylosed when compared to the maxillary arch; in addition, an incidence peak for ankylosis was registered at 9 years of age in males and between 9 and 10 years of age in females.

Cephalometric and occlusal studies [Kula et al., 2017] displayed a high incidence of crossbites and dental aplasia. Most crossbites involved the buccal segments and/or anterior segments. A premature ankylosis of superior deciduous molars can interfere with maxillary growth, causing asymmetries and crossbite (either bilateral or monolateral). In such cases, early diagnosis and extraction of the affected teeth is suggested. The crossbite should be solved using the most suitable orthodontic or orthopaedic treatment [Farronato, 2011; Gianolio, 2014; Lanteri, 2016; Lanteri, 2018] (Fig. 1). A genetic predisposition for infraocclusion has been assumed: Baccetti [2000] observed a higher incidence in patients with genetic anomalies such as agenesis of permanent teeth, and other authors observed that one of the first clinical sign of agenesis is infraocclusion [Steigman et al., 1973; Atrizadeh et al., 1971; Farronato, 2011]. Infraocclusion has also been associated with other syndromes such as Cleidocranial Dysplasia (CCD), Osteopetrosis, Ectodermal Dysplasia (ED) and Down Syndrome (DS) [Atrizadeh et al., 1971; Murtaugh, 2013]. According to Baccetti and other authors, ectopic canines and superior lateral incisor microdontia are the most common anomalies associated to infraocclusion [Baccetti, 2000; Suri et al., 2004; Shalish et al., 2010]. Many other authors suggested that ankylosis may be consequential to conditions such as loss of eruptive force in permanent teeth, infections, alveolar bone deficit or trauma [Farronato, 2013; Halterman, 2013; Peretz et al., 2013; Arhakis et al. 2016; Shalish et al., 2013]. In particular, Decker et al. [2008] and Frazier-Bowers et al. [2010] explained how a mutation in the PTH1R gene is correlated to ankylosis: it has been observed that a peptide called PTHrP, a ligand for the PTH1R receptor, is needed for tooth eruption; the absence of PTHrP usually produced by the dental follicle stops the eruption process, causing the tooth to be surrounded by bone tissue. This hypothesis was confirmed by Ouyang et al. [2000] who observed that cementoblasts are the target cell for the PTHrP peptide (related to parathyroid hormone, PTH): these cells have a PTH/PTHrP receptor which acts as a regulator for cementogenesis; if PTHrP increases, cyclic Adenosine Monophosphate (cAMP) and Protein Kinase A (PKA) are activated allowing tooth growth and normal eruption. If this process is interrupted, cementogenesis is not regulated and the excessive mineralisation by cementoblasts causes tooth ankylosis. According to Frazier-Bowers et al. [2010] a PTH1R mutation is strongly correlated to failure of orthodontic treatment, and clinicians should be aware of this possibility when treating Primary Eruption Failures (PEF) and ankylosed teeth: a PTH1R genetic test may be necessary in order to avoid ankylosis following treatments such as orthodontic extrusion.

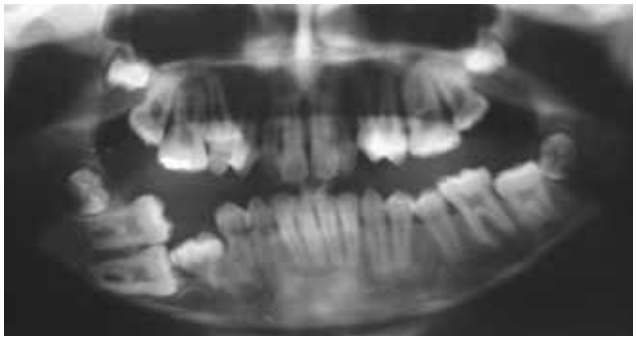

FIG. 1 An example of an orthopantomography showing infraocclusion of tooth 8.5. Tooth 4.5 is also missing due to tooth agenesis. The infraocclusion of the ankylosed tooth is inversely proportional to the onset age of the ankylosis: the sooner the tooth becomes ankylosed, the more severe its infraocclusion will be.

Indication to therapy for infraoccluded molars depends on [Cozza et al., 2004; Maspero, 2019]: patient's age; degree of root resorption; degree of tipping of the adjacent teeth; presence/absence of the respective permanent tooth.

As the potential of orthodontic treatments such as slow maxillary expansion is nowadays clear [Gianolio, 2014; Lanteri, 2018], knowing the effects of infraocclusion on mandibular growth could have a significant impact on treatment planning. Therefore, the aim of this study is to evaluate the correlation between infraocclusion and mandibular growth.

Materials and methods

A total of 42 Caucasian patients from the same paediatric dentistry department at the University of Milan, Italy were selected for this study. These patients were divided in two groups based on the presence or absence of infraocclusion.

- Group A: 22 patients (12 males and 10 females) suffering from infraocclusion of at least one inferior deciduous molar.
- Group B: 20 patients (9 males and 11 females) who did not suffer from infraocclusion but had to be treated for dental overcrowding.

The inclusion criteria were: healthy patients between 7 and 14 years old, either suffering from infraocclusion of at least one inferior deciduous molar or dental overcrowding without infraocclusion; no severe skeletal dysmorphism or malformation; no systemic diseases; no previous cytostatic therapies; no previous dental trauma of any kind; no previous orthodontic treatment.

In order to determine the severity of the ankylosis, if present, the occlusal plane considered went from the most mesial point of the first permanent inferior molar to the cuspid of the deciduous canine in the same quadrant, as indicated by Baccetti et al. [2004].

Each patient was examined through an orthopantomography and lateral cephalogram (Fig. 2, 3). Cephalometric evaluation was performed according to the preferred method of the department in which this study was made: two of the authors, trained to use a dedicated software (Deltadent), took all the measurements twice for each patient. If differences in measurements were present between the "twin" evaluations, a discussion between the two authors was made in order to solve them and verify the accuracy of each other's work. All measurements were made before treatment, and they were analysed in order to show cephalometric correlation between the skeletal class, the vertical dimension and cranio-maxillo-mandibular divergence.

The following parameters were analysed.

- SNA angle: measures the position of the maxillary bone (normal range 82°±2°).
- SNB angle: measures the sagittal position of the mandibular bone compared to the cranial base (normal range 80°±2°). Results lower than the normal range suggest a mandibular retrusion on the sagittal plane

FIG. 2 A 7-year old patient at T1 showing agenesis of multiple teeth (1.5 and 2.5). Teeth 6.5 and 7.5 are showing signs of infraocclusion.

FIG. 3 The same patient at T2 (9-year old) showing ankylosis of deciduous molars that caused first molars mesialisation. The severity of the clinical situation of untreated cases calls for a better monitoring and preventive therapy.

compared to the cranial base.

- ANB angle: measures the difference between the maxillary bone and the mandibular bone, and is correlated to the SNA and SNB angle (normal range 2°±2°).
- Intermaxillary angle (SNA-SNP^GO-GN): measures the inclination (either anterior or posterior), on the sagittal plane, between the maxillary and mandibular bones (normal range 20°±5°).
- Cranio-spinal angle (SN^SNA-SNP): measures the inclination, on the sagittal plane, of the maxillary bone compared to the cranial base (normal range 10°±3°). Any variation from this range indicates a different type of growth of the cranial base.
- Cranio-mandibular angle (SN^GO-GN): measures the tilt of the mandibular bone compared to the cranial base (normal range 32°±5°).

Vertical skeletal Class evaluation was based on the following.

- SOR-ANS distance: measured from the Supra-Orbitary Point (SOR) to the Anterior Nasal Spine (ANS). It indicates the antero-superior vertical skeletal height.
- ANS-ME distance: measured from the Anterior Nasal Spine (ANS) to the Menton point (ME). It indicates the total vertical skeletal height. It is correlated with the SOR-ANS distance through a proportion, which is different depending on the patient's sex and age.
- Jarabak and Fizzel analysis: growth prediction made using the Superior Gonial Angle (PC-GO-N; normal range 50°±2°), the Inferior Gonial Angle (N-GO-GN; normal range 70°±3°) and the Total Gonial Angle (PC-GO-GN; normal range 120°±5°): these angles measure the position of the Temporomandibular Joint (TMJ), and the shape and dimensions of the mandibular bone.

The results obtained in group A and group B were compared using Student's t-test.

All the procedures followed in this study were in accordance with the ethical standards of the Helsinki Declaration of 1975, as revised in 2000.

Results

All of the specific results and raw data can be found in Table 1 and Table 2 for Group A, Table 3 and Table 4 for Group B. Statistically significant differences are indicated in Table 5. The results are divided in sub-sections, as follows.

- Infraocclusion.

Group A: Only one patient showed monolateral infraocclusion of an inferior deciduous molar, while the other 21 patients showed bilateral infraocclusion (from moderate to severe) affecting teeth 75 and 85.
Group B: No patients showed infraocclusion of deciduous molars.

- SNA angle (82°±2°).
Group A: Values between 75.00° and 88,80° (mean value: 79.63°). No anomalies were reported.
Group B: Values between 73.02° and 84,54° (mean value: 80.75°). No anomalies were reported.
- SNB angle (80°±2°).
Group A: Values between 68.00° and 82,00° (mean value: 76.65°). There are cases of mandibular retrusion compared to the cranial base.
Group B: Values between 71.92° and 84,95° (mean value: 81.10°).
- ANB angle (2°±2°).
Group A: Values between 0.56° and 10,00° (mean value: 4.22°). 8 Patients were assigned a skeletal Class I, while the remaining 14 were assigned a skeletal Class II.
Group B: Values between 0.4° and 5,67° (mean value: 2.97°). 5 patients were assigned a skeletal Class II, only one was assigned a skeletal Class III and the remaining 14 were assigned a skeletal Class I.
- Inter-maxillary angle (SNA-SNP^GO-GN, 20°±5°).
Group A: mean value of 27.1°. 8 patients were registered as normo-divergent, only one as hypodivergent and the remaining 13 as hyperdivergent.
Group B: mean value of 25.8°. 10 patients were registered as normo-divergent, 4 as hypodivergent and the remaining 6 as hyperdivergent.
- Cranio-spinal angle (SN^SNA-SNP, 10°±3°).
Group A: mean value of 9.75°. This indicates a slight tendency to an upwards and forwards growth of the "A point" for this group.
Group B: mean value of 8.62°.
- Cranio-mandibular angle (SN^GO-GN, 32°±5°)
Group A: mean value of 35.32. This indicates a slight tendency for a growth causing a posterior inclination of the mandibular plane.
Group B: mean value of 34.56.
- Vertical Skeletal class (Normal bite, Open bite, Deep bite): SOR-ANS and ANS-ME linear distances evaluation.

Group A: among this group, 10 patients had a skeletal open bite, 6 had a skeletal deep bite and 6 had a skeletal normal bite. A higher prevalence of a Class II skeletal class.
Group B: among this group, 5 patients had a skeletal open bite, 9 had a skeletal deep bite and 5 had a skeletal normal bite.

- Jarabak and Fizzel analyses (growth pattern prediction): Total Gonial Angle (PC-GO-GN, 120°±5°).
Group A: mean value of 125.93°. A slight tendency for values higher than 125° (maximum limit for the normal range) was registered. This suggests a mandibular growth with a downwards and backwards direction. Specifically, 9 patients had a post-rotational mandibular growth tendency, only one patient had an ante-rotational mandibular growth tendency and the remaining 12 patients had an horizontal mandibular growth tendency.
Group B: mean value of 123.6°, slightly lower than group A.

Statistics

According to Student's t-test, the only measurements which had a statistically significant difference between Group A and Group B were: SNB angle (p-value <0.01); ANB angle (p-value <0.05); PC-GO-GN angle (p-value <0.05.

Discussion

The average age for the two groups is similar: 10.7 in Group A and 10.65 in Group B.

The SNA angle shows the sagittal position of the superior maxilla: Group A had a mean value of 79.63°, slightly lower than the normal value range of 82°±2° (which indicates a normal position of the maxilla), showing a slight tendency to maxillary retrusion.

Group B had a mean value of 80.75°, which is included in the normal value range.

The SNB angle shows the sagittal position of the inferior maxilla (mandible): Group A had a mean value of 75.65°, significantly lower than the normal value range of 80°±2°; Group B instead had a mean value of 81.10°, perfectly in line with the normal value range. The difference between these two mean values is statistically significant (p<0.01), indicating that patients with infraocclusion (Group A) show a higher rate of mandibular retrusion.

Another statistically significant difference between the two groups was registered for the ANB angle, which shows the sagittal position of the maxilla compared to the mandible. Group A had a mean value of 4.22°, higher than the normal

Patient	Infraoccl. Teeth	Age	Sex	SNA	SNB	ANB	Maxill. Diverg.	Cranio-spinal	Cranio-mand.	SOR-ANS	ANS-ME
1	7.5 8.5	11.75	F	75.00	70.00	5.00	37.00	8.00	44.00	49.00	53.00
2	7.5 8.5	9.00	M	84.00	79.00	5.00	27.00	10.00	38.00	52.00	55.00
3	7.5 8.5	10.10	M	78.00	68.00	10.00	27.00	24.00	31.00	49.00	46.00
4	7.5 8.5	12.20	F	87.00	82.00	5.00	31.00	4.00	33.00	54.00	61.00
5	7.5 8.5	9.30	F	75.00	70.00	5.00	33.00	15.00	41.00	38.00	42.00
6	7.5 8.5	10.50	M	76.00	71.00	5.00	24.00	14.00	37.00	51.00	54.00
7	7.5 8.5	11.00	M	88.00	79.00	9.00	35.00	7.00	40.00	60.00	68.00
8	7.5 8.5	14.00	M	83.00	79.00	4.00	12.00	6.00	18.00	55.00	56.00
9	7.5 8.5	8.00	F	75.00	70.00	5.00	30.00	9.00	44.00	50.00	55.00
10	7.5 8.5	10.20	F	76.49	72.48	4.01	27.30	13.58	41.00	56.57	57.30
11	7.5 8.5	8.10	M	80.30	71.10	9.40	32.80	8.40	41.20	70.70	84.80
12	7.5 8.5	8.70	M	82.50	76.50	6.00	22.10	8.10	30.20	78.30	80.70
13	7.5 8.5	12.30	M	80.00	76.00	4.00	25.00	12.00	37.00	52.00	53.00
14	7.5 8.5	10.00	F	80.00	78.00	2.00	25.00	9.00	34.00	42.00	46.00
15	7.5 8.5	14.00	M	80.00	78.00	2.00	22.00	7.00	30.00	58.00	60.00
16	7.5 8.5	12.90	F	78.00	76.00	2.00	29.00	6.00	35.00	58.00	63.00
17	7.5 8.5	12.00	F	78.00	76.00	2.00	24.00	9.00	31.00	66.00	68.00
18	7.5 8.5	10.40	M	76.00	74.00	2.00	31.00	10.00	42.00	52.00	61.00
19	7.5 8.5	7.00	M	82.00	81.00	2.00	19.00	6.00	25.00	52.00	52.00
20	7.5 8.5	9.00	F	81.00	80.00	1.00	25.00	10.00	34.00	41.00	38.00
21	7.5	12.60	F	79.04	78.62	0.56	26.90	7.64	34.27	53.20	58.20
22	7.5 8.5	13.00	M	75.11	72.24	2.87	30.13	10.50	37.63	52.80	60.14

TABLE 1 Cephalometry measurements for Group A.

value range of 2°±2°; Group B instead had a mean value of 2.9°, perfectly in line with the normal value range. The difference between these two mean values indicates that Group A patients show a skeletal Class II caused by mandibular retrognathia, while group B patients show a skeletal Class I with a normal position and a normal relation between maxilla and mandible. In order to analyse the maxillary-mandibular growth vector, it is necessary to observe the vertical dimension which is usually split into a superior (SOR-ANS) and inferior (ANS-ME) component. In order to determine a normal skeletal overbite growth, the ANS-ME component of the vertical dimension needs to grow more than the SOR-ANS component, and do so in a constant manner (0.7 mm each year) between 4 and 12 years of age. According to this kind of evaluation, at 12 years of age the inferior segment (ANS-ME) should be 5.6 mm longer than the superior segment (SOR-ANS). Statistically speaking, considering the mean age of the two groups (10.7 years for Group A and 10.65 years for group B) an increase of 4.2 mm for ANS-ME compared to SOR-ANS is expected. In group A, the mean length for the superior component of the vertical dimension (SOR-SNA) is 53.72 mm, with a mean difference between the two components of 3.94 mm: this suggests that group A shows a normal skeletal overbite growth. In group B, the mean length for the superior component of the vertical dimension (SOR-SNA) is 53.19 mm with a mean difference between the two components of 4.31 mm: this suggest that group B also shows a normal skeletal overbite growth.

When observing data related to each single patient in the two groups, the following was observed.

Group A: 10 patients with skeletal open bite, 6 patients with normal skeletal overbite, 6 patients with skeletal deep bite.

Group B: 6 patients with skeletal open bite, 5 patients with

Patient	PC-GO-N	N-GO-GN	PC-GO-GN
1	52	77	129
2	57	77	134
3	56	78	134
4	50	78	127
5	48	76	134
6	49	75	124
7	45	85	130
8	44	84	128
9	44	74	118
10	54	74	128
11	50	76	126
12	56.5	64.9	121.4
13	52	72	124
14	51	70	121
15	54	71	125
16	51	75	126
17	52	72	124
18	47	75	122
19	55	70	125
20	56	70	126
21	48	73	121
22	48	75	123

TABLE 2 Measurements for Superior Gonial Angle (Pc-Go-N). Inferior Gonial Angle (N-Go-Gn) and Total Gonial Angle (Pc-Go-Gn) for Group A.

Patient	Age	Sex	SNA	SNB	ANB	Maxill. Diverg.	Cranio-spinal	Cranio-mandib.	SOR-ANS	ANS-ME
1	10	F	79.92	77.26	2.67	25.12	8.86	33.99	50.73	54.46
2	10.5	F	81.26	80.19	1.07	26.21	8.8	35.02	50.98	53.33
3	10	F	84.21	80.33	3.88	24.56	11.23	35.79	56.02	54.49
4	11	F	76.57	73.37	3.2	24.36	11.42	35.79	55.71	58
5	11	F	80.48	77.49	2.99	24.47	10.18	34.65	50.98	57.45
6	8	M	83.1	81.28	1.82	26.7	4.29	30.99	50.19	59.45
7	13	M	80.74	76.87	3.87	23.33	9.37	32.69	57.43	59.97
8	10	F	78.39	75.34	3.05	22.95	10.13	41.08	54.67	58.08
9	11	F	81.33	78.18	3.15	25.91	8.63	34.54	54.7	60.73
10	14	M	86.04	84.71	1.34	20.76	5.27	26.03	56.14	65.9
11	10	F	82.22	80.04	2.19	26.03	9.82	35.85	51.67	51.87
12	13	M	79.02	76.75	2.27	24.35	9.25	33.61	57.3	56.01
13	9	M	78.49	75.27	3.22	24.18	9.39	33.57	53.49	57.93
14	11	F	73.02	71.92	1.1	26.43	10.27	36.7	56.04	56.95
15	10.5	F	82.61	77.68	4.97	30.89	6.93	42.82	49.67	59.03
16	14	F	79.09	73.85	5.17	28.5	12.03	40.39	59.98	63.17
17	10	F	83.07	77.4	5.67	30.12	8.75	38.86	51.12	50.56
18	10	F	83.25	78.09	5.16	27.7	10.71	38.41	53.05	54.34
19	10	M	78.48	76.25	2.37	24.55	8.37	32.92	53.19	55.98
20	7	F	84.54	84.95	0.4	30	8.38	35.14	55.65	58.26

TABLE 3 Cephalometry measurements for Group B.

Patient	PC-GO-N	N-GO-GN	PC-GO-GN
1	50.11	70.15	120.26
2	50.22	73.5	123.72
3	48.96	76.25	125.21
4	47.34	72.19	119.53
5	52.4	72.41	124.81
6	44.86	75.25	120.11
7	48.94	70.99	119.93
8	47.97	74.09	122.06
9	40.97	71.11	112.08
10	53.94	75.66	129.59
11	49.32	75.6	124.92
12	45.39	72.01	117.4
13	48.91	72.94	121.86
14	51.33	73.71	125.03
15	48	70	118.00
16	47.66	70.35	118.01
17	46.7	72.12	118.82
18	54.06	70.42	124.49
19	47.7	79.25	126.95
20	41.97	72.13	113.04

TABLE 4 Measurements for Superior Gonial Angle (Pc-Go-N), Inferior Gonial Angle (N-Go-Gn) and Total Gonial Angle (Pc-Go-Gn) for Group B.

normal skeletal overbite, 9 patients with skeletal deep bite.

Overall, the difference between the two groups is not statistically significant.

When comparing the mandibular growth pattern predictions, Group A indicates a tendency to a post-rotational mandibular growth (Inferior Gonial angle and Total Gonial angle with values higher than average, respectively 74.68° and 125.70°). Group B, instead, showed a tendency to horizontal mandibular growth (Total Gonial angle with a mean value of 123° included in the normal range of 120°±5°). When observing data related to each single patient in the two groups, it was observed that 12 patients in Group A showed an increase in the Total Gonial angle, while only 4 in group B did. The difference between the mean values of the Total Gonial angle in Group A and Group B is statistically significant ($p<0.05$).

Angle	p-value
SNB	<0.01
ANB	<0.05
PC-GO-GN	<0.05

TABLE 5 Statistically significant differences between Group A and Group B according to Student's t-test.

Lastly, the analysis of data regarding the cranio-maxillary-mandibular divergency shows no statistically significant differences between the two groups. All measurements are included in the normal range of values, except for the values referring to the inter-maxillary divergence: for both Group A and group B values higher than the normal range were registered (respectively 26.5° and 25.85°). This suggests a tendency to inter-maxillary hyper-divergency, particularly in group A, in which there is a post-rotational mandibular growth which increases the inter-maxillary divergency and produces a skeletal Class II.

Mandibular retrognathia appears to be a consequence of mandibular post-rotation rather than a primary growth deficiency [Teague et al., 1999]. According to Kurol [2002] mandibular post-rotation seems to be caused by an anomalous position of mandibular first molars: an early occlusal contact caused by teeth malposition, which causes a mandibular post-rotation, probably influences mandibular growth (Fig. 4, 5, 6). This hypothesis, however, is refuted by Baccetti [1998] who observed that, in patients with deciduous molars infraocclusion, mandibular growth seems to tend towards an anterior rotation. In this study, it appears that the mandibular post-rotation theory is supported by the data obtained, but a comparison between groups after a long-term evaluation is needed in order to draw a stronger conclusion.

Conclusion

The analysis of cephalometric data collected in this study shows a tendency for mandibular post-rotation in patients

FIG. 4 Clinical and radiographic example of ankylosis of tooth 7.5 associated to tooth 3.5 agenesis. The infraocclusion of tooth 7.5 creates a space which allows mesialization and rotation towards the lingual side of the first mandibular molar (tooth 3.6). This causes the disto-vestibular cuspid to be higher than the occlusal plane, causing a precontact.

FIG. 5 Typical occlusion anomaly caused by tooth 7.5 ankylosis. The first mandibular molar becomes more and more mesialized because of the contact point's apicalization between it and the ankylosed 7.5. The antagonist tooth, without a physiological occlusal stop, becomes hyper-erupted. Because of this, posterior pre-contacts appear.

FIG. 6 Posterior pre-contacts caused by the molars' mesio-inclination favour the onset of mandibular post-rotation and a consequent vertical dimension increase. The Cranio-Mandibular Angle (SN^GO-GN) measures the inclination of the mandible relative to the cranial base: its normal value is 32°±5°. In this paper, its average value is 35,32°: this suggests a tendency to mandibular post-rotation.

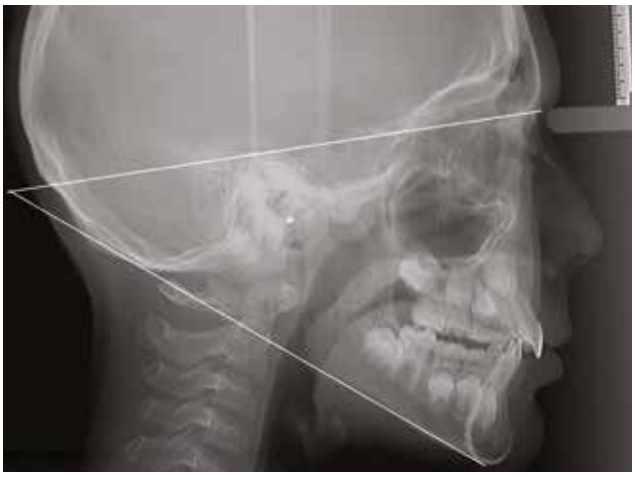

FIG.7 Posterior pre-contacts caused by the molars' mesio-inclination favour the onset of mandibular post-rotation and a consequent vertical dimension increase. The Cranio-Mandibular Angle (SN^GO-GN) measures the inclination of the mandible relative to the cranial base: its normal value is 32°±5°. In this paper, its average value is 35,32°: this suggests a tendency to mandibular post-rotation.

affected by infraocclusion of deciduous mandibular molars. The hypothesis for which mandibular post-rotation is promoted by infraocclusion and mesial tilt of deciduous mandibular molars [Maspero, 2019] seems to be supported by the results of this study, although a longer period of observation is needed to draw stronger conclusions.

The incidence of infraocclusion of deciduous second molars is more or less the same between males and females, as described by Silvestrini Biavati et al. [2011].

From the data collected in this study, it can be concluded that patients suffering from infraocclusion of the mandibular deciduous molars show mandibular post-rotation and an increased Total Gonial angle, compared to patients who do not suffer from infraocclusion. Additionally, despite the absence of a long-term evaluation of these patients, it is possible to state that early diagnosis of infraocclusion is fundamental in order to apply a well-planned and thought-out orthodontic therapy.

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