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Impact of dentofacial development on early mandibular incisor crowding

Sérgio Estelita Barros,[a] Kelly Chiqueto,[b] and Guilherme Janson[c]
Porto Alegre, Rio Grande do Sul, and Campinas and Bauru, São Paulo, Brazil

Introduction: In this retrospective longitudinal study, we evaluated the influence of dentofacial development on mandibular incisor crowding from the early mixed dentition (T1) to the early permanent dentition (T2). **Methods:** The sample was selected from 1212 longitudinally followed untreated subjects. Cephalometric radiographs and dental casts of 42 subjects (mean age, 8.66 years) with mandibular incisor crowding were evaluated at T1 and T2. Dentoskeletal variables were compared, and their influence on crowding changes was estimated. The sample was divided regarding incisor crowding severity (≤2 mm and >2 mm) and behavior (improvement and worsening), and the variables with a significant influence on the crowding changes were compared between the groups ($P < 0.05$). **Results:** Incisor crowding decreased from T1 to T2. The crowding changes were influenced by the amount of initial crowding, leeway space, incisor protrusion, and maxillary width increase. Crowding of 2 mm or less was not a good predictor for self-correction, with similar chances for improvement or worsening. **Conclusions:** Incisor crowding reduction can be expected from the early mixed to the early permanent dentition. The potential for crowding reduction was associated with greater initial incisor crowding, leeway space, incisor protrusion, and maxillary width increase. A crowding threshold of 2 mm was not a valid borderline condition to define the self-correction prognosis. (Am J Orthod Dentofacial Orthop 2016;150:332-8)

Mandibular incisor crowding in the early mixed dentition is a common occlusal developmental trait, but it is a frequent source of discomfort and concern for the parents of patients with this condition. In an effort to determine the chances of reaching the permanent dentition without crowding, several mixed dentition analyses have been developed.[1-3] However, growing patients have significant variations in arch dimensional changes and dentoskeletal patterns, which can reduce the clinical value of the static prediction of mixed dentition analyses.[4-6] Furthermore, these analyses must be carefully interpreted because their reliability always depends on adequate radiographic images or high crown size correlations between different teeth.

Some authors have evaluated dental and skeletal factors associated with mandibular incisor crowding in the mixed dentition, but the cross-sectional characteristics of this information have limited value to predict crowding changes in the permanent dentition.[4,7-9] Based on the longitudinal studies of Moorrees and Chadha[10] and Moorrees et al,[11] several authors have considered mandibular incisor crowding of 1.6 to 2 mm as a normal and physiologic condition that is prone to self-correction, not requiring orthodontic care.[4,7,9,12-14] Thus, orthodontic treatment has been indicated when incisor crowding is greater than 2 mm and may include a passive lingual arch, a lip bumper, deciduous canine extraction, and interproximal stripping of the deciduous teeth.[12,13,15-18]

However, the studies of Moorrees and Chadha[10] and Moorrees et al[11] were based on a sample with normal incisor alignment at the end of the observation period. Furthermore, their alignment normality parameter allowed a large range of variations.[10,11,19] The authors of other longitudinal studies, in which the final occlusal status was not a selection criterion, concluded that mandibular incisor crowding behavior during the transitional period is unpredictable.[6,20] To shed some light on these uncertainties, the aim of this study was to evaluate the influence of dentoskeletal changes on the behavior of mandibular incisor crowding from the mixed dentition to the early permanent dentition.

[a]Professor, Department of Orthodontics, Faculty of Dentistry, Federal University of Rio Grande do Sul, Porto Alegre, Rio Grande do Sul, Brazil.
[b]Professor, Department of Orthodontics, São Leopoldo Mandic School of Dentistry, Campinas, São Paulo, Brazil.
[c]Professor, Department of Orthodontics, Bauru Dental School, University of São Paulo, Bauru, São Paulo, Brazil.
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Address correspondence to: Sérgio Estelita Barros, Department of Orthodontics, Faculty of Dentistry, Federal University of Rio Grande do Sul, Rua Ramiro Barcelos, 2492, Bairro Santana, Porto Alegre, RS 90036-003, Brazil; e-mail, sergioestelita@yahoo.com.br.
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MATERIAL AND METHODS

The original sample included 1212 untreated and longitudinally followed subjects from 2 growth study centers. All file records had to be evaluated to satisfy the selection criteria and the sample size delineated for this study. The sample size was based on α (type I error) and β (type II error) values of 5% and 20%, and the standard deviations of the measurements were obtained from a previous study.[6] Considering these statistical parameters, a sample size of at least 16 subjects was required.

Sample selection was based on the following inclusion criteria: mandibular incisor crowding, complete longitudinal records, quality of the orthodontic records, matched age of cephalograms, and dental casts at each time: early mixed dentition (T1), with all permanent incisors and first molars erupted and all deciduous molars and canines present; and earliest records of the permanent dentition (T2), with all permanent teeth up to the second molars, and all premolars fully erupted with no remaining leeway space. The exclusion criteria included early deciduous tooth loss, proximal caries with space loss, supernumerary teeth, notorious dental anomaly of size or shape, and impacted canines.

The selected sample consisted of 42 subjects (20 girls, 22 boys). Eleven subjects were from the University of São Paulo at Bauru, and 31 subjects were from the University of Michigan. The ages at T1, T2, and the observation period were of 8.66 (±0.83), 13.25 (±1.19), and 4.58 (±1.10) years, respectively. The sample division into group 1 (8.61 years; 12 girls, 11 boys) and group 2 (8.72 years; 8 girls, 11 boys) was based on the self-correction prognosis of initial mandibular incisor crowding (≤2 or >2 mm). The range and distribution of mandibular incisor crowding for each group are shown in Table I. A complementary sample division was performed to compare subjects with worsening (worsening group) and improvement (improvement group) of crowding.

All dental cast measurements were made with a dial caliper to the nearest 0.01 mm (Mitutoyo America, Aurora, Ill). Mandibular incisor crowding was the difference between all incisor widths and the available space between the mesial surfaces of the deciduous canines.[9] Arch depth was measured as the distance from a midpoint between the facial surfaces of the central incisors to a line tangent to the mesial surfaces of the first molars.[21] Molar relationship was measured as the horizontal distance between the mesiobuccal cusp tip of the maxillary permanent first molar to the mesiobuccal groove on the mandibular permanent first molar on each side. Maxillary dental arch widths were the distances between the cusp tips of the canines and between the mesiobuccal cusp tips of the permanent first molars, respectively. Overbite was measured as the greatest vertical distance between the incisal edge of the mandibular central incisor and the incisal edge of the maxillary central incisor, horizontally projected on the labial surface of the mandibular incisor. Overjet was measured as the greatest horizontal distance between the labial surfaces of the maxillary and mandibular central incisors at the level of the maxillary incisor edge. Leeway space was calculated as the differential size between the deciduous canine and first and second molars, and the permanent canine and first and second premolars.

Table I. Range and distribution of mandibular incisor crowding in each group

	n	%
Group 1 (n = 23)		
0 > Cr > −1 (mm)	15	65.2
−1 > Cr ≥ −2 (mm)	8	34.8
Group 2 (n = 19)		
−2 > Cr ≥ −3 (mm)	6	31.6
−3 > Cr ≥ −4 (mm)	8	42.1
−4 > Cr ≥ −5 (mm)	2	10.5
Cr < −5 (mm)	3	15.8

Cr, Crowding.

Lateral headfilms were obtained in centric occlusion. Most dental and skeletal cephalometric variables were taken from known analyses: those of Steiner[22] (SNA, SN to NA angle; SNB, SN to NB angle; ANB, NA to NB angle; SN.GoGn, SN to GoGn angle; Md1.NB, mandibular incisor long axis to NB angle; Md1-NB, distance between the most anterior point of the crown of the mandibular incisor and the NB line) and Tweed[23] (FH.MP, Frankfort mandibular plane angle; and IMPA, incisor mandibular plane angle), in addition to 2 complementary measurements (PP.MP, angle between the palatal and mandibular planes; and Md1-GoMe, perpendicular distance between the mandibular incisor edge and the mandibular plane). The cephalometric tracings were made by 1 investigator (K.C.) and checked for landmarks and outlines of the anatomic structures by a second examiner (S.E.B.). The cephalograms were digitized, and the data were analyzed with Radiocef Studio 2 software (version 2.0, release 12.82; Radiocef Studio 2, Belo Horizonte, Brazil). Lateral headfilms from the University of Michigan and the University of São Paulo at Bauru had different magnifications (12.9% and 6%) that were corrected with the cephalometric software.

For the error study, 12 pairs of dental casts were remeasured, and the lateral headfilms were retraced and redigitized by the same examiners (K.C. and S.E.B.). All variables were evaluated for random and systematic