



## Mandibular intercanine width increase without intervention in children with slipped contacts

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### Abstract

**Purpose:** Imperfect spacing between the primary incisors and mal-alignment of the permanent incisors may suggest the need for orthodontic intervention. Without sufficient data, decisions to treat are based on individual judgment rather than evidence. The present study was undertaken to determine whether slipped contact arrangement (distal-lingual surface of mandibular permanent lateral incisors overlapping the facial surface of the primary canines at the end of incisor transition) merits intervention.

**Methods:** Seventeen children who presented with slipped contact arrangement between 1987 and 1991 were studied prospectively. Orthodontic records were gathered at enrollment and following eruption of full permanent dentition with the final record being obtained in 1995. Orthodontic characteristics were recorded and mandibular anterior teeth were measured for amount of slippage, available space and differences between primary and permanent intercanine width. Data were analyzed using student's paired t-test and other tests of statistical significance.

**Results:** Mean mandibular intercanine width increased significantly at the emergence of permanent canines (2.58 mm;  $p=0.001$ ). Average slipped contact was 3.21 mm; average space deficiency between primary canines for ideally aligned permanent incisors was 3.54 mm. No correlation was found between intercanine width measurements and molar relationships, skeletal relationship, facial type or other orthodontic characteristics.

**Conclusions:** Slipped contacts should be considered when children undergo early orthodontic treatment for crowding. An explanation of the transitional correction is provided. Continued research is needed in this area to establish evidence-based early treatment parameters. (*Pediatr Dent* 23:469-475, 2001)

While the dynamics of the average mandibular incisor eruption and its effects on mandibular intercanine width have been well studied,<sup>1-6</sup> there are few comparable descriptions in the literature of individual eruption patterns and their outcomes. Baume has described spaced and unspaced primary dentitions and the effect on future permanent incisor eruption.<sup>1</sup> A better understanding of individual eruptive patterns, as Baume has described, would aid development of scientifically based early treatment methods. Therefore, we undertook this prospective investigation to study the effects of "slipped contacts," in which the distal-lingual surface of the mandibular permanent lateral incisors overlaps the facial surface of the primary canines after incisor eruption (Figure 1).

This incisor arrangement has been considered to have an undesirable effect on future development.<sup>7</sup> This is because no relief of incisor crowding is expected after the mandibular lateral incisors erupt.<sup>3</sup> Furthermore, no intercanine width increase is expected at the exchange of the primary for permanent canines.<sup>3-6,8</sup> We observed the course of slipped contacts over time, evaluating intercanine width, and found slipped contacts to have a desirable effect on future development. Theoretical explanations for these findings are presented, as well as clinical implications.



Fig1. The slipped contact arrangement of the mandibular lateral incisors

Received January 18, 2001 Revision Accepted September 26, 2001

## Methods

Parents of all children from the primary author's practice who presented from 1987-1991 with the distal-lingual surface of the mandibular permanent lateral incisors overlapping the facial surface of the primary canines at the end of incisor transition were asked to consent to the child's participation in the study. All children were in excellent dental and general health, and none received orthodontic treatment during the observation period.

Twenty-one of the 22 children who presented with slipped contacts after incisor transition participated; seventeen completed the project (11 boys, 6 girls). A second group with ideal alignment of the mandibular incisors group was chosen to serve as a control. However, after five years of enrolling children for the study, only seven control subjects had been identified. This finding was consistent with the work of Moorrees, who found that very few children display average characteristics.<sup>8</sup> Because good data from several sources had found that intercanine width remains the same or may slightly decrease at the exchange of the permanent for primary canines,<sup>3,5,6,8</sup> the decision was made to compare the study group to groups presented in previous confirmed research. The ethnic background of the children in the previous research was that of Northern European ancestry living in the north central portion of North America, identical to the children from the present study. Additionally, the methods of measuring intercanine distances in the previous research were also identical to those in the present study. The study proceeded on the basis that intercanine width remains constant at the exchange of the permanent for primary canine.

A parent of each child who participated in the study gave consent for participation after the design and risks of the study were explained. At a subsequent appointment, a cephalometric radiograph and study models were obtained for each child. A second cephalometric radiograph and study models were obtained following the eruption of the full permanent dentition, with the final records being taken in 1995. From the study models, the following observations were made:

1. Mandibular intercanine width measurements.
2. Correlation of the mandibular intercanine width measurements to the orthodontic characteristics of the study group.
3. Comparison of the orthodontic characteristics of the study group to the orthodontic characteristics of the control group.
4. Distribution of facial types and molar relationships after incisor eruption and in full permanent dentition.

### Mandibular intercanine width measurements

The following measurements were taken of the mandibular anterior teeth:

1. The amount that the lateral incisors had slipped over the primary canines after incisor transition: width between the distal contact points of the permanent lateral incisors minus the distance between the mesial contact points of the primary canines.
2. Space available between the primary canines for ideally aligned permanent incisors after incisor transition. Using a brass wire centered over the child's basal arch form, the measure was made from the mesial contact of one primary canine, over the incisal edges of the anterior teeth, to the

mesial contact of the contralateral primary canine. The length of the brass wire was then subtracted from the combined mesial-distal widths of the four permanent incisors.

3. The difference between the primary intercanine width after incisor transition and the permanent intercanine width in full permanent dentition: permanent intercanine width minus the primary intercanine width. The intercanine distance was measured from cusp-tip to cusp-tip or from centroid to centroid in the case of worn primary canines using established methods.<sup>3-6,8</sup>

All mandibular intercanine width measurements were taken on two separate occasions by the same investigators using a non-calibrated, dial-type, needle-tipped calipers, except for the brass wire measurement. The measurements were transferred from the calipers to card stock and were interpreted by a technician. The distances were quantified using the Prescription Planner Cephalometric and Arch Analysis Program.<sup>9</sup> The measurements were taken to 0.1 mm. When two measures differed, an average of the two measures was used.

Student's paired t-test was performed to evaluate the intercanine width measurements.

### Correlation to orthodontic characteristics

The following observations were taken from the cephalometric radiograph and study models to determine if a correlation could be made between the intercanine width measurements and other orthodontic characteristics:

1. Molar relationship (mesial-buccal cusp of the maxillary first molar as it related to the buccal groove of the mandibular first molar)
  - A. Class I
  - B. Class II
  - C. Class III
  - D. End-to-end
2. Overbite (mm between the maxillary and mandibular central incisor's incisal edges)
3. Overjet (mm between the facial surface of the maxillary and mandibular central incisor)
4. Lower 1 to APg
5. Lower 1 to GoGn
6. Skeletal relationship as determined by
  - A. ANB
  - B. Convexity (A pt. to NPg)

When the value for this relationship was within one standard deviation from the average, the child was considered Class I. When the value was more than one standard deviation from the average, the child was considered either Class II or III depending on whether the deviation was in a Class II or III direction.

7. Facial type as determined by
  - A. Facial axis (NaBa to PtmGn)
  - B. Mandibular plane (FH to GoGn)
  - C. Lower facial height (Ans/Xi/Pg)

When two of the three values for these measures were within one standard deviation of the average, the child was considered mesofacial. When two of the three values were more than one standard deviation from the average, the child was considered either brachyfacial or dolichofacial, depending on whether the deviation was in a brachyfacial or dolichofacial direction.

8. Presence of primate space

ANOVA was performed to evaluate the correlation between mandibular intercanine width measurements and molar relationships, skeletal relationships and facial type.

The Pearson and Spearman correlation was performed to evaluate the correlation between intercanine width measurements and overbite, overjet, lower 1 to APg and lower 1 to GoGn.

**Comparison to average population**

To ascertain any unique characteristics that could distinguish them from the average population, recorded values of the study group for skeletal relationships, position of the mandibular anterior teeth, overbite and overjet were distributed across the average distribution for these same values as described by Moyers and Riolo.<sup>10,11</sup> The ethnic background of the children in the research of Moyers and Riolo was that of Northern European ancestry living in the north central portion of North America, identical to the children from the present study. Additionally, the methods of measurement in the previous research were identical to those in the present study. The average age of the study group was nine after incisor eruption and was fourteen in full permanent dentition. These ages were used to find the average values.

**Molar relationships and facial type**

A distribution of the molar relationships and facial type of the study group were made after incisor eruption and in full permanent dentition. Observations were made to determine if further development had an effect on molar relationships or facial type.

**Results**

The mandibular intercanine width for the study group increased significantly at the exchange of the permanent for primary canines. The average width increased 2.58 mm (p=0.001) from 23.19 mm to 25.77 mm with a range of -1.45 mm to +5.75 mm (Table 1). The average child also displayed 3.21 mm (p=0.001) of slipped contacts and 3.54 mm (p=0.001) space deficiency between the primary canines for ideally aligned permanent incisors (Table 2).

The ANOVA analysis found no correlation between the intercanine width measurements and molar relationships, skeletal relationships or facial type.

The Pearson and Spearman correlation found no correlation between intercanine width measurements and overbite, lower 1 to APg or lower 1 to GoGn. The Pearson and Spearman correlation did find

**Table 1. Mandibular Intercanine Width Increase at the Eruption of the Permanent Canines in the Study Group**

	Mean difference	SE	P value
Increase in intercanine width	+2.58 mm	0.40	0.001

**Table 2. The Amount of Slipped Contacts and the Lack of Space for Ideally Positioned Incisors of the Study Group**

	Mean difference	SE	P value
Amount the permanent lateral incisors had slipped over the primary canines	+3.21 mm	0.28	0.001
Lack of space for ideally positioned permanent incisors	+3.54 mm	0.28	0.001

that, after incisor eruption, as the space deficiency between the primary canines for ideally aligned permanent incisors increased, overjet decreased (-0.62 p=0.0032).

The distribution of skeletal relationships, overbite, overjet, lower 1 to APg and lower 1 to GoGn of the study group was made across the average values described by Moyers and Riolo.<sup>11,12</sup> (Tables 3, 4 and 5) The only deviation of the study group from the average population was that the skeletal relationships of the girls distributed more frequently into the second standard deviation. Tables 6 and 7 shows the distribution of molar relationships and facial type of the study group both after incisor eruption and in full permanent dentition.

No child in this study displayed primate spaces.

**Table 3. A Distribution of the Slipped Contact Group Across the Average Population<sup>11</sup> for Overjet and Overbite**

	Overjet		Overbite	
	Norm <sup>10</sup>	Slipped contacts	Norm <sup>10</sup>	Slipped contacts
<b>Male</b>				
After incisor eruption	Mean=4.08 mm	Number=11	Mean=2.87 mm	Number=11
	SD=2.05 mm	±1SD=10	SD=1.78 mm	±1SD=7
		±2SD=1		±2SD=4
Permanent dentition	Mean=3.48 mm	Number=11	Mean=3.45 mm	Number=11
	SD=1.49 mm	±1SD=8	SD=1.71 mm	±1SD=10
		±2SD=3		±2SD=1
<b>Female</b>				
After incisor eruption	Mean=3.70 mm	Number=6	Mean=2.46 mm	Number=6
	SD=2.46 mm	±1SD=6	SD=1.96 mm	±1SD=5
				±2SD=1
Permanent dentition	Mean=2.97 mm	Number=6	Mean=2.87 mm	Number=6
	SD=1.50 mm	±1SD=5	SD=1.48 mm	±1SD=5
		±2SD=1		±2SD=1

## Discussion

This is the first study in the literature to document the actual course of slipped contact arrangement of the permanent lateral incisors in a group of children. If children begin posterior transition with the slipped contact arrangement of the mandibular lateral incisors, then the permanent canines will develop an unexpected increase in intercanine width and thereby overcome the period of space deficiency.

Contrary to reports that the average mandibular intercanine width remains unchanged or may decrease at the exchange of the permanent for the primary canines,<sup>3-6,8</sup> the children in this

study developed an average increase of 2.58 mm ( $p=0.001$ ) intercanine width at the exchange of the mandibular canines. The increased width in the present group cannot be attributed to the canines drifting distally and laterally into the leeway space. Leeway space was not preserved in this study and is lost unless actively maintained.<sup>12</sup> As well, these changes cannot be attributed to the permanent canines using the primate spaces since no child in this study displayed primate spaces.

When the mandibular intercanine width measurements were compared to the characteristics of the orthodontic records, the only correlation that could be made was between a space

deficiency between the primary canines for ideally aligned permanent incisors and overjet. As the space for ideally positioned incisors decreased, overjet also decreased. It is difficult to draw a conclusion from this observation because a similar observation was not made between slipped contacts and overjet, a similar measure. No correlation was found between slipped contacts and overjet. The interrelationship of slipped contacts or space shortage for ideally positioned incisors to overjet deserves continued research.

Children with slipped contacts displayed no unique features that distinguished them from the general population, except the ability to develop mandibular intercanine width.

Record analysis to determine whether children with slipped contacts demonstrated any unique characteristics that could distinguish them from the average population generally showed normal distribution within the average population (Tables 3, 4 and 5).

Girls in the study group distributed more frequently into the second standard deviation in their skeletal patterns (Table 5). However, due to the small sample size, no conclusions can be drawn from this finding. We are also reluctant to draw conclusions about gender frequency of slipped contacts, as the preponderance of boys in this study may also be a function of small sample size.

**Table 4. A Distribution of the Slipped Contact Group Across the Average Population<sup>11</sup> for Position of Lower Incisor**

Male	Lower 1 to GoGn		Lower 1 to APg	
	Norm <sup>11</sup>	Slipped contacts	Norm <sup>11</sup>	Slipped contacts
After incisor eruption	Mean=94.7 degrees	Number=11	Mean=1.8mm	Number=11
	SD=5.7 degrees	±1SD=10	SD=12.4mm	±1SD=6
		±3SD=1		±2SD=5
Permanent dentition	Mean=94.9 degrees	Number=11	Mean=1.8mm	Number=11
	SD=7.2 degrees	±1SD=9	SD=2.5mm	±1SD=7
		±2SD=1		±2SD=3
		±4SD=1	±4SD=1	
<b>Female</b>				
After incisor eruption	Mean=93.9 degrees	Number=6	Mean=1.6mm	Number=6
	SD=7.2 degrees	±1SD=5	SD=2.5mm	±1SD=5
		±2SD=1		±2SD=1
Permanent dentition	Mean=94.5 degrees	Number=6	Mean=1.8mm	Number=6
	SD=6.9 degrees	±1SD=4	SD=2.4mm	±1SD=6
		±2SD=2		

**Table 5. A Distribution of the Slipped Contact Group Across the Average Population<sup>11</sup> for Skeletal Relations**

Male	A point to NPg		ANB	
	Norm <sup>11</sup>	Slipped contacts	Norm <sup>11</sup>	Slipped contacts
After incisor eruption	Mean=3.8mm	Number=11	Mean=4.2 degrees	Number=11
	SD=2.3mm	±1SD=8	SD=1.9 degrees	±1SD=7
		±2SD=3		±2SD=4
Permanent dentition	Mean=3.6mm	Number=11	Mean=3.4 degrees	Number=11
	SD=2.7mm	±1SD=8	SD=2.0 degrees	±1SD=8
		±2SD=2		±3SD=2
		±3SD=1	±4SD=1	
<b>Female</b>				
After incisor eruption	Mean=2.8mm	Number=6	Mean=4.0 degrees	Number=6
	SD=2.6mm	±1SD=2	SD=2.6 degrees	±1SD=5
		±2SD=4		±2SD=1
Permanent dentition	Mean=2.7mm	Number=6	Mean=3.4 degrees	Number=6
	SD=3.0mm	±1SD=2	SD=2.5 degrees	±1SD=2
		±2SD=4		±2SD=4

**Table 6. A Comparison of Facial Type after Incisor Eruption and in Permanent Dentition for the Slipped Contact Group**

Facial type	Dolicofacial	Mesofacial	Brachyfacial
After incisor eruption	3	10	4
Permanent dentition	3	11	3

**Table 7. A Comparison of Molar Relationships after Incisor Eruption and in Permanent Dentition for the Slipped Contact Group**

Molar relationship	I	II	III	End to end	Mixed
After incisor eruption	7	0	0	8	2
Permanent dentition	11	0	0	2	4

Table 7, which compared the molar relationships after incisor eruption to full permanent dentition, showed that only 50 percent of the children who displayed an end-to-end molar relationship after incisor eruption shifted to a Class I molar relationship in the permanent dentition. This finding is consistent with the previous work of Bishara,<sup>13</sup> who also found that only about half of the children with a flush terminal plane molar relationship shift to Class I in full permanent dentition.

**Developmental theory implications**

Others have reported that children develop intercanine width between the primary canines during the eruption of the permanent incisors.<sup>1-4,6</sup> Both Baume<sup>1</sup> and van der Linden<sup>14</sup> have proposed a theoretic mechanism for this increase in intercanine width, suggesting that during permanent incisor eruption, a lateral force is exerted on the roots of the primary neighbors. As the permanent central incisors erupt, the force drives the primary lateral incisors into the primary canines, increasing intercanine width (Figure 2a,b). Then, as the permanent lateral incisors erupt, the primary canines are further propelled laterally, again increasing intercanine width (Figure 2c,d).

The findings from this study add to this developmental theory. When children have the slipped contact arrangement of their mandibular lateral incisors at the beginning of posterior transition, it appears that the crowns of the erupting permanent canines will use the roots of the permanent lateral incisors as guides to a more lateral position during eruption, increasing intercanine width (Figure 3a,b,c).

Baume and van der Linden's developmental theory also explains another phenomenon that occurs during mandibular incisor transition. During incisor transition, children frequently experience a period when insufficient space is available to accommodate all of the permanent mandibular incisors.<sup>3</sup> This period occurs after the permanent central incisors have erupted and while the primary lateral incisors are still in place. In this situation, the small primary lateral incisors still need to be replaced by the larger permanent lateral incisors (Figure 2c).

Children without enough available space at this stage frequently will overcome the space deficiency as the permanent lateral incisors erupt. While the permanent lateral incisors erupt, a force drives the primary canines laterally, increasing intercanine width and providing sufficient room for proper incisor alignment (Figure 2c,d). This developmental mechanism explains why children develop the largest amount of mandibular intercanine width at the eruption of the lateral incisors.<sup>1</sup> It also explains why 57 percent of children who begin mandibular incisor transition without spacing between the primary incisors develop enough space for well-aligned permanent incisors.<sup>1</sup>

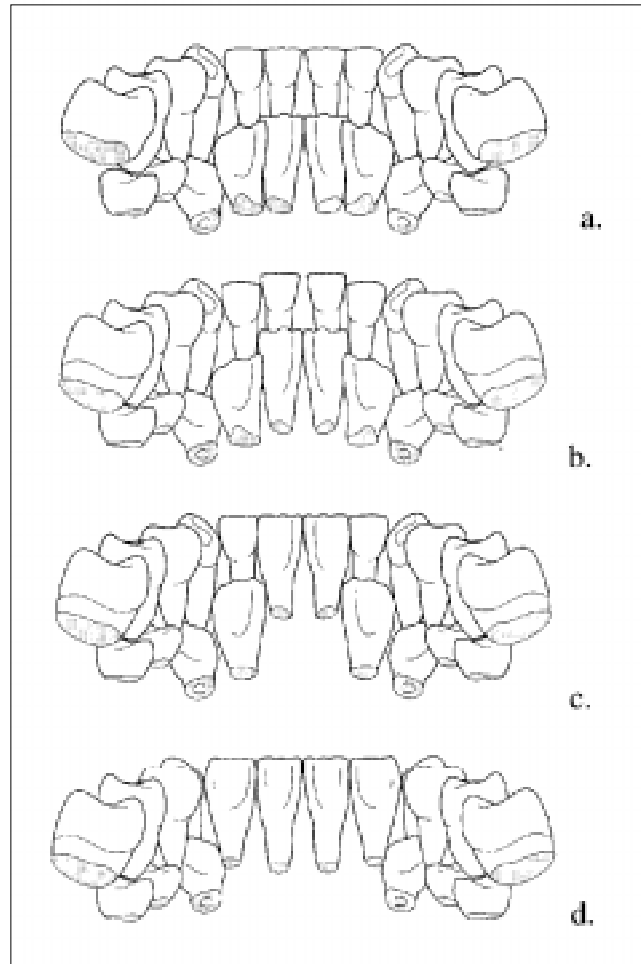


Fig 2. The development of mandibular intercanine width during incisor eruption. As the permanent central incisors begin eruption (a, b), a lateral force is exerted through the primary lateral incisors to the primary canines, increasing intercanine width. With the eruption of the lateral incisors (c, d), an additional force propels the primary canines laterally, developing more intercanine width. (Adapted from van der Linden FGM. *Development of the Dentition*. Quintessence Books, Chicago: 1983.)

The present study identifies an additional stage when insufficient space for the proper alignment of the permanent teeth is overcome. Children with slipped contacts experience a period when they do not have enough available space to accommodate the permanent canines. This period occurs after the permanent lateral incisors have erupted and before the permanent canines erupt (Figure 3a). But during canine eruption, the permanent canines will use the roots of the lateral incisors as guides to direct their eruption into a more lateral position. The intercanine width will increase and the period of insufficient space will be overcome (Figure 3b,c).

## Clinical implications

Children with slipped contacts tend to develop an increase in mandibular intercanine width at the exchange of the canines. The slipped contact arrangement of the permanent lateral incisors must be considered when a child is to begin early orthodontic treatment, have extraction of primary canines or disking of the primary canines. The results of this study indicate that an appropriate course of action is to merely observe the eruption process. Based on these results, the permanent canines should erupt an average of 2.58 millimeters wider than the position of the primary canines. There have been no reports of a more desirable eruptive pattern of the mandibular permanent canines.

Many practitioners attempt non-extraction orthodontic treatment. When crowding is eliminated without extraction of teeth, expansion of the teeth must occur in some direction. The mandibular permanent canines, if expanded during orthodontic treatment, usually return to their original width or even narrower.<sup>15-19</sup> Therefore, use of orthodontic appliances to expand mandibular permanent canines is generally considered unstable. Not violating the pretreatment width of the mandibular canines has been considered a significant factor in achieving post treatment stability.

With this in mind, if the mandibular permanent canines could be encouraged to erupt into a wider position, there would be more potential space available for elimination of crowding in the mandibular arch in non-extraction orthodontic treatment. Untreated children from the present study who exhibited slipped contacts had the permanent canines erupt an average of 2.58 millimeters wider than expected. Additional research is needed to determine if effects similar to those of slipped contacts can be achieved by aligning malpositioned incisors before canine eruption.

A study that touched on this area was conducted by Dugoni.<sup>20</sup> He aligned the mandibular incisors before posterior transition and held the result with a lingual arch. He measured an increased intercanine width of 2.24 millimeters after eruption of the permanent canines. However, he extracted the primary canines and primary first molars. The permanent canines were encouraged to erupt and drift distally into a wider portion of the arch. In our study of children with slipped contacts, the canines erupted wider in a more lateral direction.

Additional studies in this area are needed in order to shape an evidence-based consensus of how children should be treated during the mixed dentition.

## Conclusions

1. Based on this study, slipped contacts should be considered when children undergo early orthodontic treatment for crowding.
2. The American Association of Orthodontists recommends that an orthodontist examine children at seven years of age.<sup>21</sup> However, there is no common consensus as to what types of patients should receive early treatment or for which situations treatment should be delayed. The present study adds to the evidence base for making early treatment decisions.
3. Research is needed to investigate the effects on mandibular permanent canine eruption after the alignment of malpositioned mandibular permanent incisors. Additionally, work needs to be done to evaluate the long-term stability of this early incisor alignment.

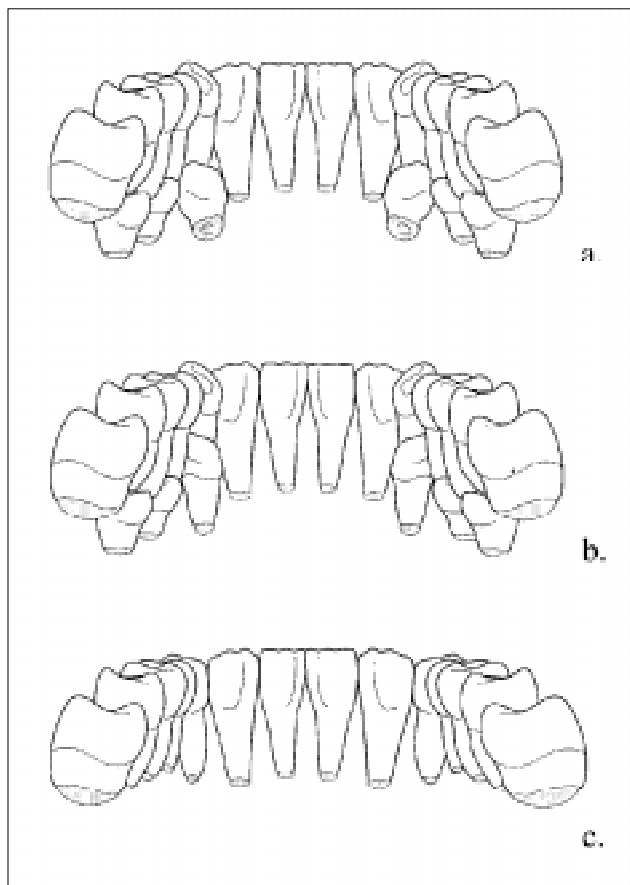


Fig. 3. The development of mandibular intercanine width for the slipped contact incisor arrangement. As the permanent canines begin eruption (a, b), they use the roots of the permanent lateral incisors as their guide to erupt in a more lateral position than the preceding primary canines (c).

## Acknowledgement

The authors would like to thank Christine McLaughlin for her insightful contributions to this manuscript.

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## ABSTRACT OF THE SCIENTIFIC LITERATURE



### THE ORAL CAVITY IN CROHN'S DISEASE (CLINICAL AND LABORATORY OBSERVATIONS)

Crohn's disease (CD) is an inflammatory bowel disease characterized by granulomatous inflammation, which may affect any site along the gastrointestinal tract. Oral manifestations of CD may include lip swelling with or without fissures, buccal mucosal swelling/cobblestoning, deep linear ulceration, mucosal tags, and localized mucogingivitis. These manifestations are considered disease-specific in patients with CD. The utility of expert oral examination as a part of the diagnostic evaluation of patients with suspected Crohn's disease was investigated. Of 45 patients with newly diagnosed CD, 25 (mean age 11.85) had been examined by a dentist. Twelve (48%) of these (mean age 12.4) had oral CD lesions. Mucosal tags constituted the most frequent form of oral lesion (8/12). Of 8 oral biopsy specimens, 6 (75%) contained non-caseating granulomas. The result of this study indicates that oral manifestations of CD may occur more commonly than previously recognized. When oral lesions are present, they may be helpful in establishing the diagnosis of CD because granulomatous inflammation will frequently be detected. Since the oral cavity is directly visible and can harbor lesions accessible for diagnostic biopsy, a systematic oral examination may be valuable in the initial diagnostic evaluation of children with suspected CD.

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