Late Third Molar Genesis: Its Significance in Orthodontic Treatment

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Radiological evidence of third molar genesis has been reported to occur over a wide age range. Banks[2] and Trisovic et al.[13] quoted its earliest occurrence at five years.

The average age for third molar crypt formation was found to be seven years by Banks [2] and Garn et al.[6] Gravely[8] found the peak formation period at the age of nine years. He included cusp calcification in the first stage of formation in his cross-sectional study thus raising the age at which the largest numbers of third molars appeared to be in the first stage of development.

The upper age limit for third molar genesis is usually considered to be 13 years, i.e., the 14th year by Garn et al. and Gravely.

Banks noted two cases showing third molar crypt formation at 14 years, while Trisovic et al.[13] found the oldest subject showing third molar crypt formation in their material was aged 15 years. Barnett[3] reported a case where radiological evidence of third molar formation was first apparent at 15 years, and Adams' in a longitudinal growth study on 306 subjects found one subject with a lower third molar developing at age 15 years.

The earliest age for third molar genesis is of purely academic interest to the orthodontist. On the other hand the upper age limit for the onset of its development is of the utmost importance. The average patient is ready for orthodontic treatment at about 12 years, and this is usually considered to be the optimum age for the treatment of most malocclusions. It is important to know if third molars are developing before formulating a treatment plan.

Although there is still some doubt about the role of the third molar in the development of lower arch crowding, it is prudent to assume that, if a lower arch shows signs of crowding at age 12 years and third molars are developing, the crowding is likely to increase and the case should probably be treated by extraction. If on the other hand third molars are absent, the decision to extract has to be weighed between the severity of the crowding and the need for closure of excess space from the back of the arch for which purpose presence of third molars is desirable.

Another problem arises when lower first molars are carious. It is important to know whether they should be conserved at all costs in the absence of third molars or sacrificed at the optimum time in their presence.

The third molar is the tooth which is most commonly congenitally absent.[6] The percentage of individuals with one or more third molars congenitally missing ranges from 20 percent[2] to 9 percent.[10] Banks and Gravely found that it was most common for two third molars to be missing, then one, four or three in that order while Nanda[10] found congenitally absent third molars to occur in order of frequency one, two, three and four.

Banks noted that "There may be variations in the degree of calcification of third molars in the same mouth." Demisch and Wartmann[5] found chronological asymmetry in development of left and right third molars in 29 percent of 151 patients. The difference in timing of develop-

ment was one or two of their developmental stages.

Gravely found within mouth variation of up to four stages of development in a sample of 230 children aged 10-13 years. Trisovic et al. observed a high correlation in stage of development of contralateral third molars. Some cases showing asymmetric development between left and right sides were found in their material. Nanda observed diminution in size of some maxillary third molars which appeared to be associated with agenesis of one or more third molars.

An opportunity to examine subjects where third molars developed somewhat later than the average presented in the records of a longitudinal study set up to investigate various aspects of third molar development.[12]

Material and Methods

A group of 35 children, 14 males and 21 females, showing little or *no* radiographic evidence of third molar formation at the age of 10 years was enrolled as part of the third molar investigation. Since the peak age for third molar crypt formation was likely to be 7 years, it was considered that this group might be useful as a control with third molar agenesis. In subsequent years 89 percent of these children developed one or more third molars. They were therefore considered to be late in their development of these teeth and are hereafter referred to as the late group.

For comparison another group of 35 ten year olds with the same male/female ratio was selected at random from the remainder of the material and constituted an early group.

Among the records available for each subject were annual cephalometric radiographs taken in the 60° left and right lateral positions.[11]

Third molar development was classified using the system adapted by Björk et al. from that devised by Gleiser and Hunt[9] for first molars: Stage 1, crypt formation with no calcification; Stage 2, calcification of cusps; Stage 3, calcification of half crown; Stage 4, calcification of whole crown; and Stage 5, root formation commenced.

The size of the third molar was measured on the last radiograph of each series using a perspex scale and measuring at the widest mesiodistal diameter.

Results

The age at which third molar crypt formation was evident on radiographs was analysed for the late third molar group and the results are shown in Figure 1. Most of the third molars developed at 11 and 12 years but nine (five lowers and four uppers) developed at age 14 years, two uppers at age 15 years, and three lowers and one upper at 16 years.

Eighteen (51%) of the late group developed four third molars. Complete third molar agenesis occurred in four (11%). The pattern of third molar agenesis for the late group is shown in Table I.

In the early group, agenesis of one upper and one lower third molar was found in two different subjects.

Table II shows the intraindividual variation in stage of development in the late group. Of the eighteen subjects who developed four third molars, only two developed all four at the same stage. Up to four stages of difference in development were observed in this group. Of 28 sides showing difference in stage of development between maxillary and mandibular third molars in sixteen instances, the upper third molar appeared first and in twelve instances the lower appeared first.

Intraindividual variation in stage of development of third molars in the

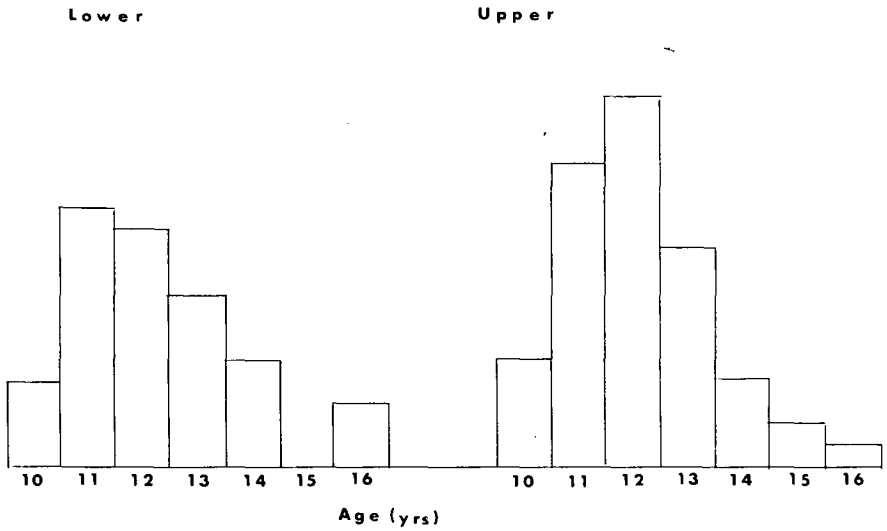

Fig. 1 Distribution of the age at which third molar crypt formation became apparent in the late group.

TABLE I

Pattern of third molar Agenesis in Late Group (35 subjects).

Missing Third Molars	None	1	2	3	4
Number of Cases	18 (51%)	7 (41%)	5 (29%)	1 (5.9%)	4 (24%)
	0/0	2/0	2/2	1/0	4/4
Distribution	0/0	4/1	3/3	1/1	4/4

TABLE II

Intraindividual Variation in Stage of Third Molar Development—Late Group

Comparison	*Concurrence in Development*	*Difference in Development*	*Stages of Difference*			
			1	*2*	*3*	*4*
Four Third Molars	2 (11%)	16 (89%)				
Upper/Lower third molars	8 (22%)	28 (77%)	16	6	2	4
Left/Right lower third molars	12 (55%)	10 (46%)	8	2	–	–
Left/Right upper third molars	8 (31%)	18 (69%)	12	3	2	1

TABLE III

Intraindividual Variation in Stage of Third Molar Development—Early Group

Comparison	*Concurrence in Development*	*Difference in Development*	*Stages of Difference*			
			1	*2*	*3*	*4*
Four Third Molars	20 (61%)	13 (39%)				
Upper/Lower third molars	51 (75%)	17 (25%)	13	4	–	–
Left/Right lower third molars	29 (85%)	5 (15%)	4	–	–	–
Left/Right upper third molars	25 (74%)	9 (26%)	7	1	–	–

TABLE IV

Difference in Size of Third Molars Between Early and Late Groups

Size of Third Molar	*Early Group Mean mm*	*Late Group Mean mm*	*Diff.*	*Degrees of Freedom* $(n_1 + n_2 - 2)$	*t*	*Probability*
Maxillary	9.48	9.77	−0.29	124	1.65	>0.05
Mandibular	11.81	11.44	0.37	116	1.47	>0.05

early group is shown in Table III. Concurrence in stage of development was more common in this group and the differences did not exceed two stages. Of the seventeen sides showing difference in stage of development between maxillary and mandibular third molars in four instances the upper appeared first and in thirteen the lower.

Differences in size of third molars between early and late groups were tested by Student's t tests (Table IV). There was no significant difference in size between early and late groups for upper or lower third molars (t = 1.65 upper, t = 1.47 lower).

Discussion

It is apparent from this material that third molar genesis can occur up to the age of sixteen years. It does so, however, only in a relatively small number of cases. The statement that third molars are unlikely to develop after the age of 14 years[6] (Garn et al.) probably holds true for the majority of the population.

Only 51 percent of the late group developed all four third molars. Thus it would appear that in this material when third molar genesis is delayed beyond the age of ten years the probability of four third molars developing is reduced by about 50 percent.

The pattern of third molar agenesis was slightly different from that found by Nanda, Banks or Gravely. Missing third molars occurred in order of frequency one, two, four and three. As in Nanda's material, lower third molars were missing more frequently than uppers in the ratio 13:7. Nanda found the ratio to be 17:12.

The method of selection of the present groups invalidates conclusions relating to the prevalence of third molar agenesis in the population as a whole or a comparison with figures quoted by other investigators.

There was a markedly greater degree of variability in stage of develop-

ment of third molars in the late group compared with the early group (89% late, 39% early). The late group also exhibited a wider range in stage of difference than the early group. It is apparent, therefore, that when third molar genesis is delayed beyond ten years of age there may be considerable variation in timing of development of third molars in an individual.

The pattern of variation in stage of development was similar for both groups. There was more frequent concurrence in development between contralateral mandibular third molars than between contralateral maxillary third molars or between upper and lower third molars.

It has been observed that third molar teeth are sometimes reduced in size. Nanda noted diminution in size of maxillary third molars in association with agenesis of one or more third molars. In view of the erratic development and the pattern of agenesis in the late group it seemed possible that they might be affected by size reduction. One peg-shaped maxillary third molar was found in each of the two groups, but on average there was no significant difference in size of upper or lower third molars between the early and late groups.

The clinical significance of these observations may be applied to the twelve year old patient presenting for orthodontic treatment. If four developing third molars of normal size are visible on radiographs, a treatment plan can be formulated in the knowledge of their presence.

If on the other hand there is no radiological evidence of third molar formation, or if one, two or even three third molars are advanced in their development up to calcification of the whole crown, we cannot predict with any degree of certainty what the final complement of third molars will be.

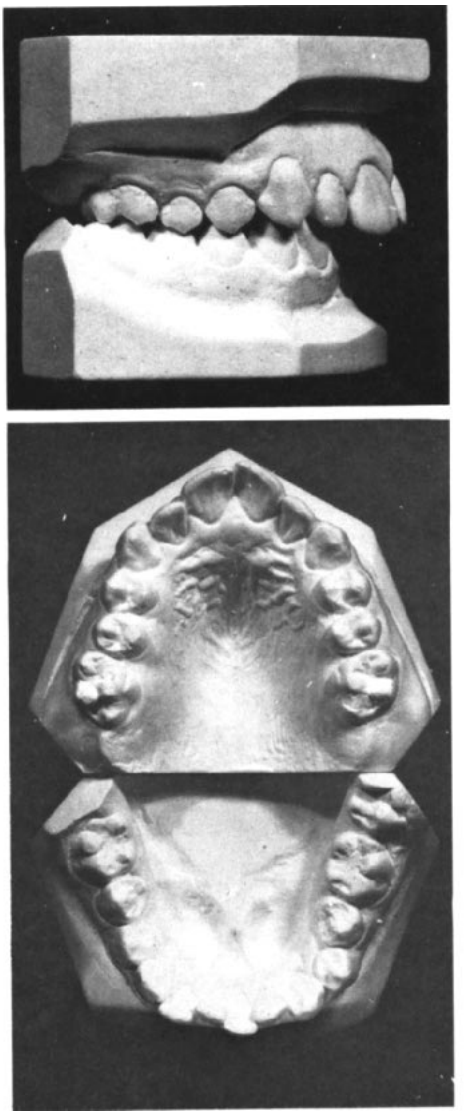

Fig. 2 Class II, Division 1 malocclusion with crowding in a patient aged fourteen years.

The orthodontist's dilemma is well-illustrated by the following case history. A female patient aged 14 years, 3 months presented with a mild Class II, Division 1 malocclusion on a mild skeletal Class II dental base relation-

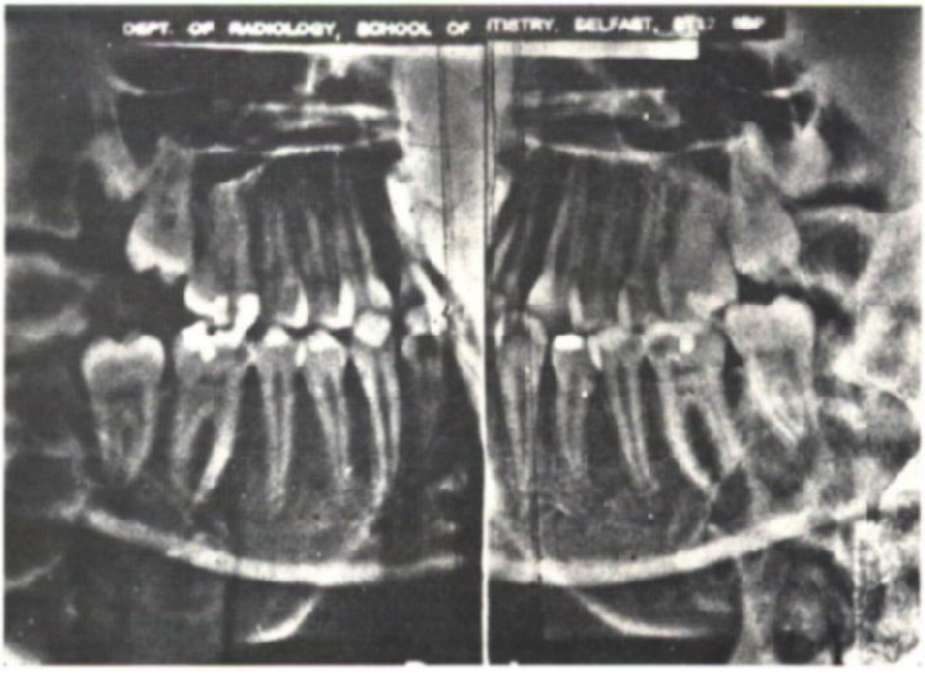

Fig. 3 Radiograph of patient shown in Figure 1.
Note absence of developing lower right third molar.

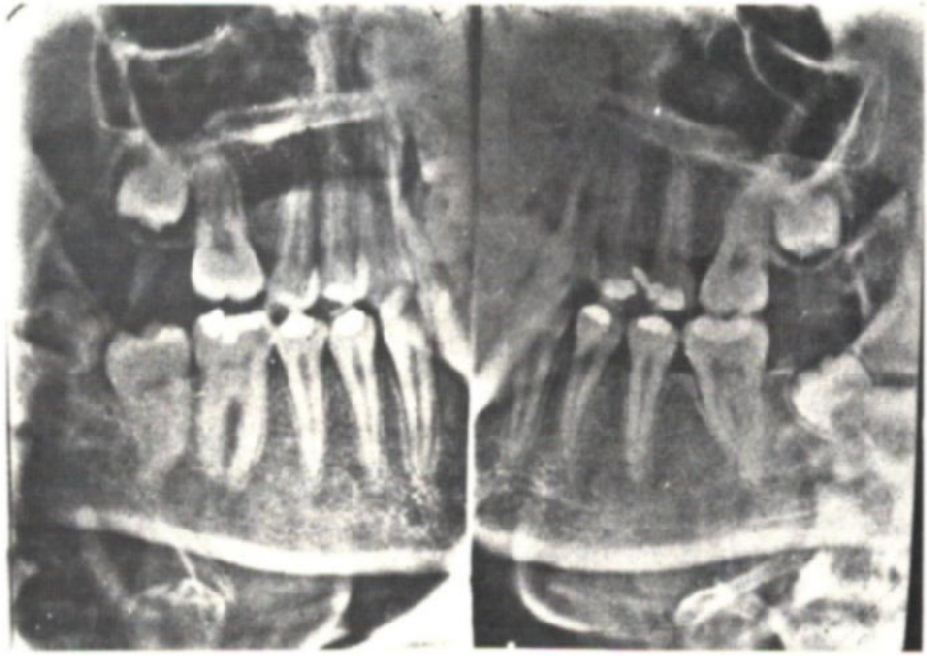

Fig. 4 Follow-up radiograph showing lower right third molar developing.

ship with crowding in upper and lower incisor regions (Fig. 2).

The treatment indicated was extraction of four teeth followed by mechanical alignment of both arches. Radiographic examination revealed the presence of normal-sized third molars, advanced in their development to the stage of calcification of half their crowns, on the lower left side and on both sides in the maxilla (Fig. 3). There was no sign of third molar formation in the lower right quadrant.

In the light of this finding the treatment plan was modified to include extraction of first molars in the three quadrants where third molars were present. The patient was treated with upper removable and lower fixed appliances.

Eruption of the lower right second molar was delayed and when treatment was well-advanced and it was still unerupted, another radiograph was taken. This revealed the presence of a developing lower right third molar which was now preventing eruption of the second molar (Fig. 4). The third molar was removed and the second molar erupted, but there was subsequently considerable relapse of lower incisor crowding which might not have occurred if the patient had been treated by the more conventional, four unit extraction (Fig. 5).

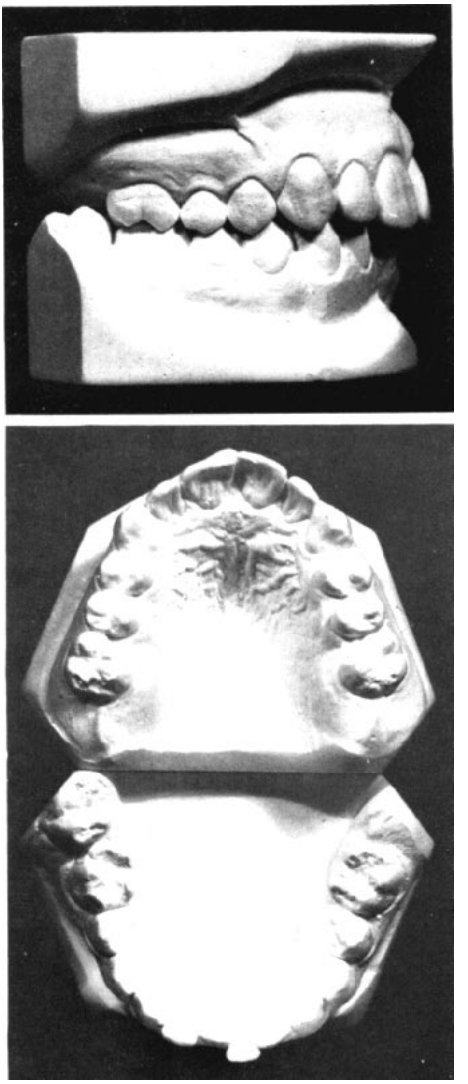

Fig. 5 Models showing final result of treatment. Relapse of lower incisor crowding has occurred.

Conclusions

(1) Third molar genesis may occur up to the age of sixteen years, although the possibility of their appearance after the age of twelve years is reduced.

(2) When third molar genesis is delayed beyond the age of ten years, the possibility of all four third molars developing is reduced by about fifty percent.

(3) The intraindividual variability in stage of development of third molars increases when genesis is delayed beyond ten years of age.

(4) There is no significant difference in size of early and late developing third molars.

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