Pre-eruptive Movements of the Mandibular Third Molar

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The mandibular third molar begins its development in the ramus of the mandible with its occlusal surface at an angle to the mandibular plane.

To assume a normal occlusal relationship it must undergo an uprighting movement of greater or lesser degree depending on its original angulation to the mandibular plane.

Broadbent[2] believed that ". . . important changes in the axial inclination of the mandibular third molar take place between the ages of 16 to 18 years when the roots of these teeth move abruptly forward in the bone. . . ."

Salzmann[4] described a forward shift and tilt of third molar roots to correct the anterior crown tilt and permit normal eruption. He did not specify the timing of these movements.

Silling claimed that no uprighting movement of the third molar occurred until it came into contact with the second molar.[7]

Investigating the development of third molar impaction, Richardson observed that there were three ways in which impactions could arise.[3] Firstly, the third molar could upright in the usual way, but insufficiently to permit eruption. Secondly, the angular relationship of the developing third molar to the mandibular plane may remain unchanged. Thirdly, the third molar may undergo a reverse angular change and become prostrate. That is to say there is an increase in the angle of the third molar to the mandibular plane. Deviations from the normal pattern of development evidenced by the two latter atypical types of behaviour impose limitations on suggested methods of prediction of impaction. Such predictions, based on measurements of space available and forecasts of growth rate and direction,[5] necessarily assume that the mandibular third molar will upright and erupt if space is available. This is not always the case.[3]

It was decided, therefore, to examine when and, if possible, how these angular changes are brought about.

MATERIAL

From the records of a longitudinal study of third molar development[3] three groups of third molars were selected for examination. Since small changes in angulation are difficult to detect on annual radiographs, only those third molars which underwent either marked angular changes, or no changes, were chosen. This necessarily imposed limitations on the numbers in each group.

Group I consisted of eleven third molars which had uprighted and erupted from an angle of 45° or more to the mandibular plane.

Group II had eight third molars which had remained in their original angular position (+ 2.5° which was the S.E. of measurement), and had become impacted.

Group III was composed of ten third molars which had undergone reverse angular changes (ranging from 10° to 36°) and become prostrate. These were all either severe mesioangular or horizontal impactions.

Annual 60° lateral cephalometric radiographs for periods ranging from 7-10 years were available for each third molar.

METHOD

Two methods of examination were used, one acting as a check on the other.

1. The first film of each series was

traced. The structures marked were the lower border of the mandible, the inner outline of the mandibular symphysis, inferior dental canal, and first, second and third molars. This tracing was superimposed on subsequent annual radiographs with the maximum number of marked structures in register, and the angular changes and stages of development of the third molar noted. No attempt was made to quantify the annual changes.

2. The second method utilized the Adams Blink Comparator,[1] superimposing each annual film on its immediate precursor, and registering on the same structures as in the tracing method. Apparent movements of the third molar were noted.

Findings

GROUP I Angular changes of an uprighting nature were found to occur at various stages of development, quite frequently in the early stages when the third molar germ was well-spaced from the second molar, as well as later when contact with the second molar was established. These uprighting movements seemed to be associated with growth at the mesial crown surface, or mesial root, proceeding in advance of growth at the distal. (Radiological evidence of root growth was manifest as progressive root calcification.)

In the later stages all the third molars in this group displayed a typical root configuration with a mesial root which curved distally and was often a little longer than the distal root. Figure 1 shows the development of a third molar typical of this group.

GROUP II Third molars were allocated to this group because their angulation to the mandibular plane had remained virtually unchanged throughout the observation period. Examination of annual radiographs revealed that the same angular relationship with the

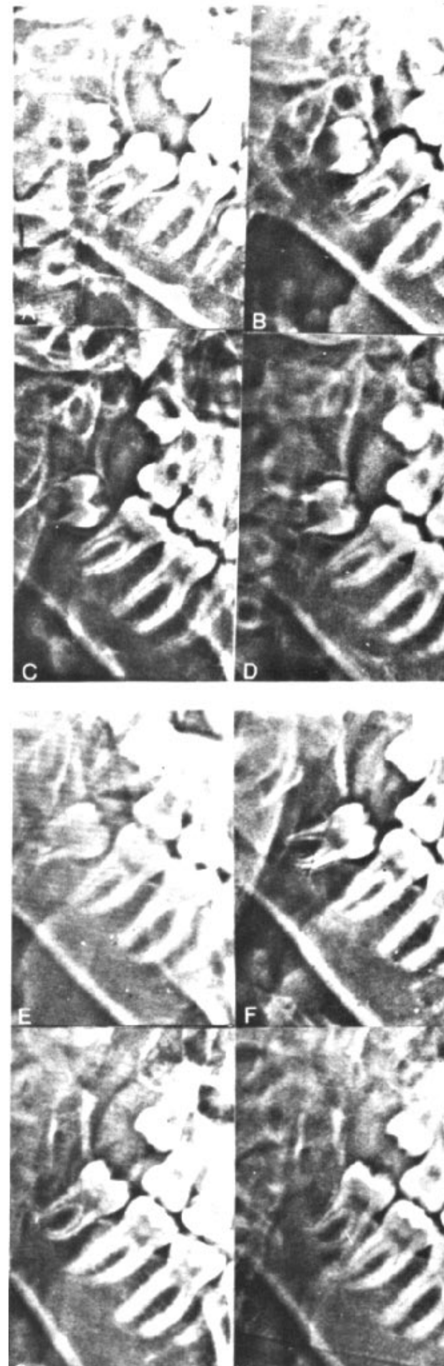

Fig. 1 From annual 60° lateral cephalometric radiographs showing the development of a mandibular third molar which erupted.

mandibular plane was not, in fact, maintained throughout the course of development. Uprighting changes were followed by reverse angular changes resulting in a final angulation similar to the original.

In some cases the magnitude of angular change was small and difficult to demonstrate, while in others, where more marked changes occurred, it was possible to detect differential growth at the roots. As in group I, uprighting movements were associated with advanced growth at the mesial crown surface or root. Reverse angular changes seemed to be associated with more advanced growth at the distal root. Figure 2 shows such a case.

GROUP III Of the ten third molars in this group eight underwent initial uprighting movements associated with growth at the mesial crown surface or root proceeding in advance of the distal. In the remaining two cases no uprighting movements occurred.

In all cases later reverse angular changes were found to be associated with growth at the distal crown surface or root catching-up-with, and exceeding the mesial.

Both types of angular change were observed before contact with the second molar was established and after the space between second and third molars was closed.

The typical root configuration of a third molar in this group showed a distal root which curved mesially and was slightly longer than the mesial root. This was particularly apparent in those third molars which underwent gross

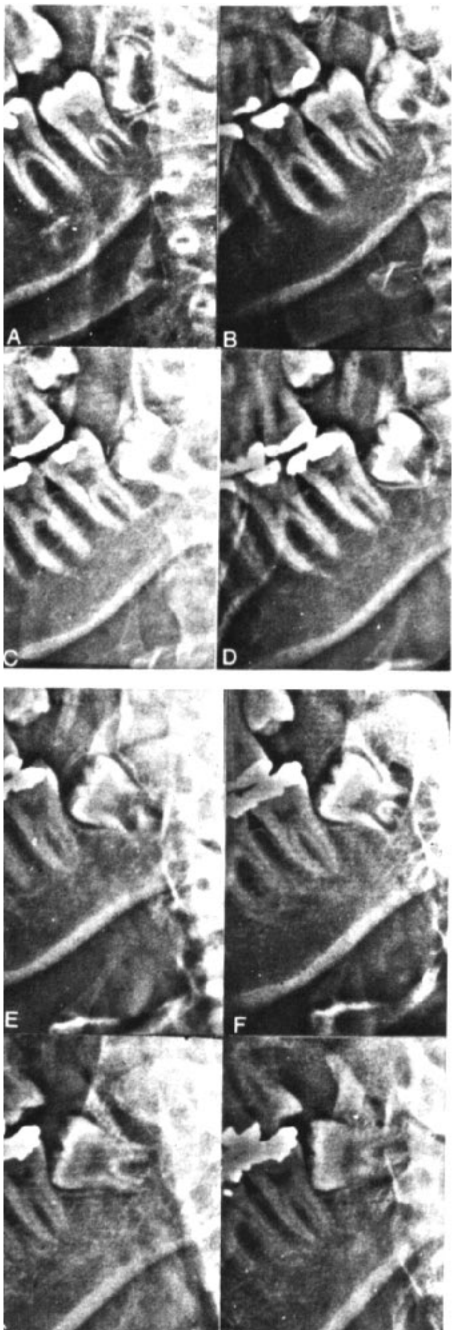

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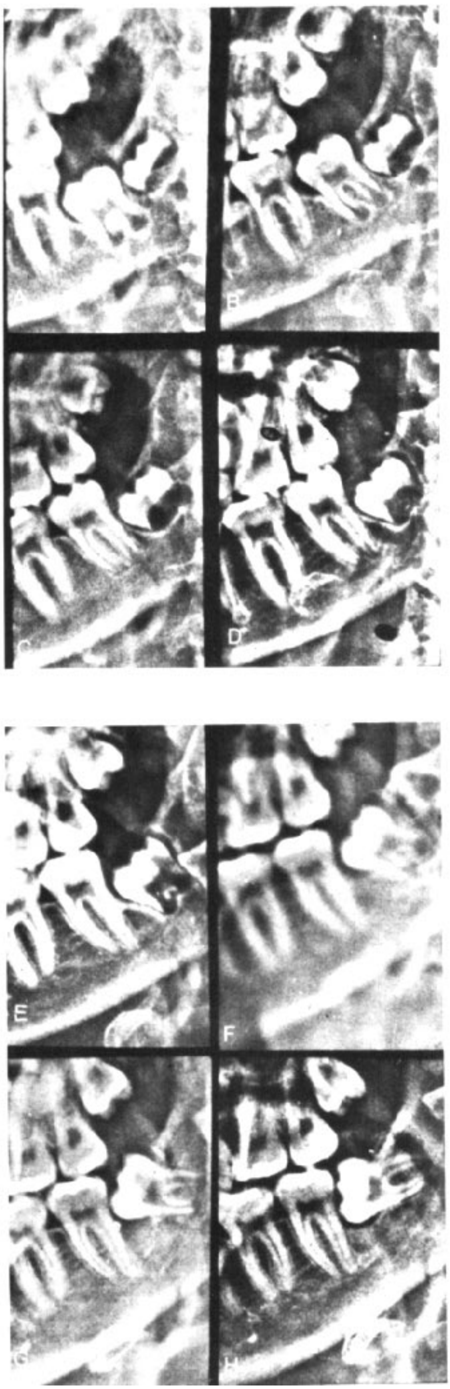
Fig. 2 Radiographs of a mandibular third molar which became impacted in an angular position relative to the mandibular plane similar to its original position. Uprighting occurred in the first 3 years, B, C, D. A reverse angular change began, E, and the tooth continued to tip mesially, F, G, H.



reverse angular changes, an example of which is illustrated in Figure 3.

Discussion

Observations made on the present material seem to suggest that growth at mesial and distal crown surfaces and mesial and distal roots of mandibular third molars does not always proceed at the same rate. It seems possible that this differential growth may be the factor responsible for changing the angulation of the tooth.

Normal uprighting movements seem to occur by growth at the mesial crown surface and root proceeding in advance of the distal.

Salzmann[4] quoted figures, supplied by Moorrees, Fanning and Hunt, which indicated that root completion and apex closure occurred earlier in the mesial root of mandibular molars than in the distal root. Mean differences between mesial and distal roots ranged from 0.2 years for root completion in females to 0.8 years for apex closure in males.

Further evidence to support the differential root growth theory is the typical root configuration of mandibular third molars which have erupted (Fig. 1, G and H). The distally curving mesial root can often be observed on routine lateral jaw radiographs, in mandibular third molars, and in first or second molars which also start their development in a mesially tilted position.

Uprighting movements of the third molar do not necessarily result in its eruption. Contact with the second molar may prevent further eruption resulting in mesioangular impaction.

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Fig. 3 Radiographs showing the development of a mandibular third molar which became horizontally impacted. Initial uprighting B, C, and D is followed by reverse angular change E, F, G and H.

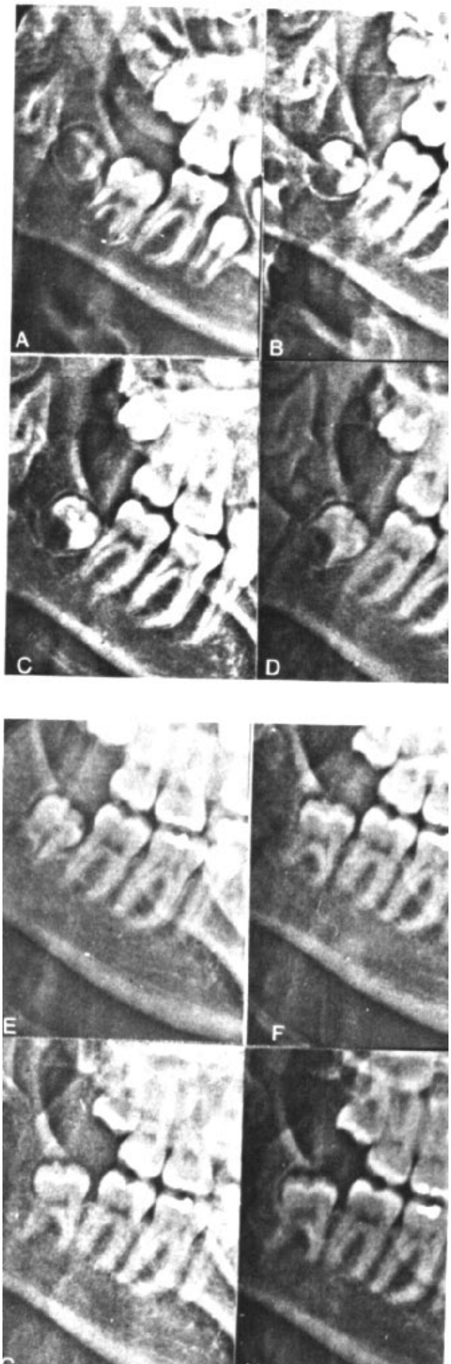

Fig. 4 From annual 60° lateral cephalometric radiographs showing the development of a mandibular third molar which became distoangularly impacted.

It also seems possible that continued growth at the mesial root while the crown is prevented from eruption distally can result in vertical or distoangular impaction. Two such cases occurred among the longitudinal study records and one is illustrated in Figure 4.

Growth at the distal crown surface and distal root in advance of the mesial has been observed in association with reverse angular changes or mesial tilting of the third molar. The longer, mesially curving distal root, noted in some such cases, is further evidence of the part played by differential root growth in the production of mesial tilting movements.

Whether differential root growth is under any kind of control or occurs purely by chance is still a matter for conjecture. It has been suggested that contact with the second molar may prevent uprighting, while continued growth at the distal root initiates a reverse angular change. This is not always the case as mesial tilting movements have been observed when the third molar was still well-spaced from the second.

Root configuration of impacted third molars was examined on pan-oral radiographs of 160 consecutive patients admitted for their removal. No longitudinal records were available for these subjects but a high proportion of them exhibited root configurations consistent with the patterns previously described. The mesioangular and horizontal impactions frequently had a longer distal root with a mesial curve, while the distoangular and vertical impactions usually had a longer mesial root which curved distally.

Although radiological examination reveals only incremental changes in the calcified structures of the tooth, it is conceivable and indeed probable that differential deposition and resorption of bone is also taking place around the crypt of a developing tooth. It is arguable whether root growth or bone growth is the primary factor in movement of the tooth. Since it has long been realized that root growth alone cannot account for all the movements of a tooth, it seems likely that a combination of root growth and bone growth may be responsible.

These observations are consistent with Sicher's[6] description of pre-eruptive and eruptive tooth movements. He describes the tooth germ surrounded by a "cushioned" dental capsule. . . . "Shift of such germs is caused by growth of bone in certain areas of the inner surface of the crypt. . . ." Pressure thus exerted on the tooth germ causes it to move and produce resorption of bone on the surface toward which it moves. Later eruptive movements are attributed by Sicher to proliferation of the pulp and deposition of bone on opposite sides of the "cushioned hammock ligament," and later still when this ligament disappears through growth of cementum and bone at the bifurcation of the roots.

However, these theories are not universally accepted. Ten Cate[8] states . . . "How pre-eruptive tooth movements are determined is unknown. . . ." He goes on to discuss theories of eruptive tooth movement, dismisses root growth, vascular pressure, and bone growth as primary causes and denies the existence of the cushioned hammock ligament. He believes that there is evidence to suggest that the periodontal ligament is the prime mover of teeth, although how the tractile force is generated in this tissue is unknown.

This does not seem to be an entirely satisfactory explanation of tooth movement. It is obvious from the material presented here that considerable movement occurs long before the periodontal ligament is formed. The dividing line between pre-eruptive and eruptive movements is very poorly defined, particularly in respect of the mandibular third molar which can undergo a wide range of movements never resulting in eruption.

It seems conceivable that a variety of mechanisms exists which can bring about tooth movement, and that their interaction, overlapping, natural or unnatural progression may account for the eruption or impaction of a tooth.

Conclusions

1. It would appear that the developing mandibular third molar is continually changing its angular position relative to the mandibular plane and adjacent teeth.

2. For normal uprighting and eruption to occur growth at the mesial root must dominate.

3. In the absence of sufficient space, uprighting movements of the mandibular third molar may result in mesioangular impaction.

4. Vertical and distoangular impactions can be explained by continued growth at the mesial root while the crown is prevented, at its distal surface, from erupting.

5. If growth at the distal root becomes more influential, severe mesioangular or horizontal impaction may occur.

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