# Effects Of Hypercementosis On The Movability Of Teeth During Orthodontic Treatment*

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The varying thickness of the cementum deposited on the roots of teeth has been discussed by several authors.[5,13,31] Even teeth exhibiting lack of cementum have been reported. Recently Bruckner, Rickles and Porter[2] described three cases of general cementum aplasia in deciduous teeth, a finding which may explain the premature shedding of these teeth. Generally speaking, excessive deposits of cementum are fairly common, notably in adult teeth. As a basis for further discussion it may be practical to review briefly some facts concerning the various types of cementum.

It is generally recognized that two types of cementum are deposited on the root surfaces. As stated by Orban,[21] Kronfeld[14] and others, one may distinguish between primary or acellular cementum and, on the other hand, secondary or cellular cementum. Acellular cementum is observed as a fairly thin layer covering the dentin of the root (Fig. 1). The acellular layer contains fibers which are incorporated in an irregularly calcified matrix.

Secondary cementum is as a rule deposited as a layer covering the acellular cementum. Under normal conditions the secondary or cellular cementum is formed notably in the bifurcation area and in the middle and apical thirds of the root (Fig. 2). As shown by Henry and Weimann[10] in some adult teeth an alternating pattern of acellular and cellular cementum may be found.

Cementum is the product of cementoblasts, cells which are observed as a chain along the root surface. These cells are incorporated in the newly formed cementum. Like bone, cementum tends to increase in thickness when tension is exerted on fiber bundles of the periodontal ligament. Such increase is observed during orthodontic tooth movement, which may result in formation of new, uncalcified cementoid on the tension side (Fig. 1).

The term hypercementosis is usually applied in cases in which the secondary cementum layer becomes abnormally thick. The texture of this tissue may

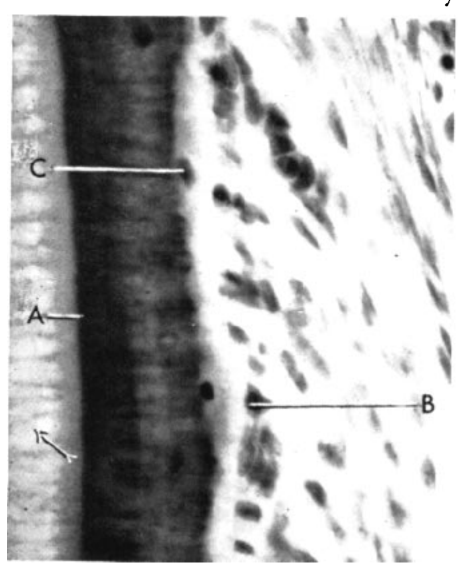


Fig. 1 Root surface of adult tooth, moved for two weeks as indicated by arrow. A, demarcation line between dentin and primary cementum. B, cementoblast bordering widened cementoid layer. C, cementoblast incorporated in cementoid layer. The primary cementum layer of young individuals is slightly thinner.

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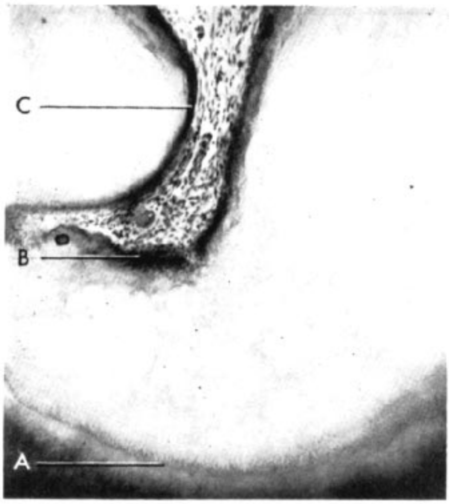


**Fig. 2** Bifurcation area of an upper second molar, forty year old person. A, primary cementum. Layer between points A and B consists of secondary cementum. Note absence of incremental lines. As in the present case, cell lacunae of adult cementum tend to become obliterated. C, darkly stained surface line, nearly always present in the secondary cementum of young as well as of adult teeth.

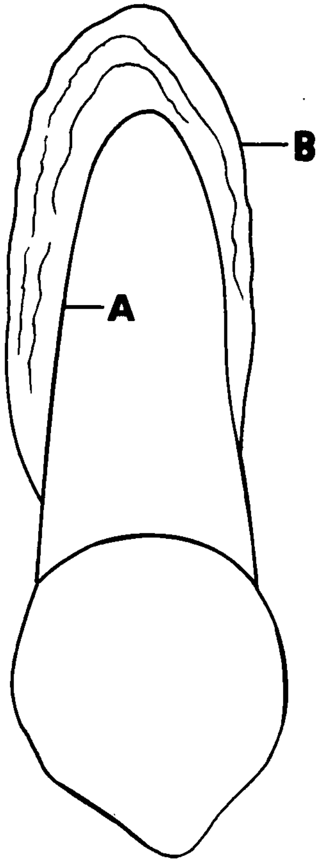


**Fig. 3** Illustrating thickness of secondary cementum in some adult cases. A, primary cementum. B, surface of secondary cementum.

vary considerably. In some instances it resembles bone. This is the reason why it has been termed osteocementum.[31] The prevalence of hypercementosis is highly individual. In many adults there is a general tendency to such formation. On the roots of teeth subjected to heavy function it may be observed as cementum spikes, formed along stretched fiber bundles. If a tendency to hypercementosis exists, thick cementum layers may be formed even on roots of extruded nonfunctioning teeth that remain without antagonists (Fig. 3). Periapical infection is another cause of hypercementosis. In the latter case the new cementum layers are formed mainly in the middle third of the root (Fig. 4).

According to this survey it may be stated that the typical form of hypercementosis is largely an age phenomenon. The atypical form is essentially observed in young individuals. In the present paper histologic sections of three teeth exhibiting excessive cementum formation are described. In addition, observation of the time period required for the formation of such atypical cementum is included and also the effect caused by hypercementosis on the movability of these teeth.

## Case Reports

It has been assumed that early hypercementosis in the permanent dentition may lead to a slow or arrested eruption of individual teeth resulting in infraocclusion. Many cases of infraocclusion have been reported in the literature.[1,6,]

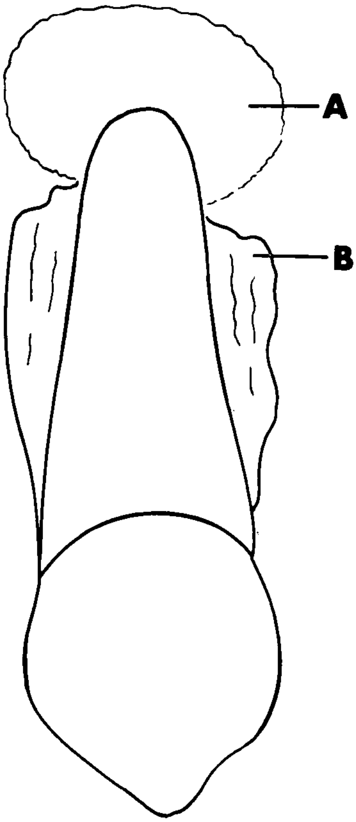


Fig. 4 A, periapical infection. B, increase in the secondary cementum layer as a result of infection.

[8,9,20] Several authors have included histologic findings of ankylosed teeth.[3,9,15,29]

In the present study cases of infraocclusion observed in three members of the same family are included. The family members were a sister, a brother and their second cousin. A summary of the case histories is as follows (Table I):

*The Second Cousin.* The patient, a girl aged fourteen, had been under observation for several years. The upper and lower left deciduous molars had been submerged and were removed surgically. Also the lower first molars were in infraocclusion as well as the upper second premolars and the upper right first premolar. These teeth were

**Infraocclusion**

**The second cousin:** 6┐ ┌6 5┘ └5 4┘

**The sister:** ┌6 ┌7 └7 5┘ 4┘

**The brother:** 6┘ └5

Table I

arrested in their eruption.

*The Sister.* The patient was aged fifteen when first examined with regard to infraocclusion. Clinical and roentgenographic observation of this case revealed that there was arrested eruption of a certain number of teeth. This applies notably to the lower left first and second molars, the upper left second molar and probably also the upper right first and second premolars (Fig. 5).

*The Brother.* This patient had been treated orthodontically more or less as an experiment, and various models and roentgenograms had been taken during the period from eight to seventeen years of age. There was arrested eruption of several teeth, and the bite remained open in the premolar and molar regions. Among the teeth in infraocclusion were the upper right first molar and the up-

Fig. 5 Illustrating arrested eruption of lower molars and upper second molar. The patient is now ten years older, but the teeth still remain in the same position.

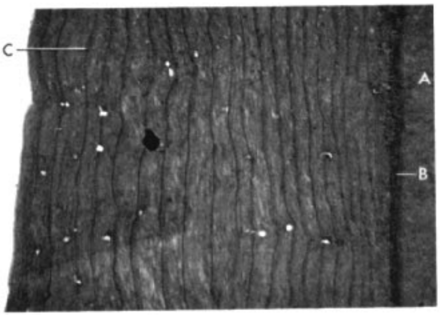


Fig. 6 Primary and secondary cementum of the upper right molar of the brother, area approximately corresponding to B in Fig 7. A, dentin. B, primary cementum. Note thickness of the atypical secondary cementum, which contains incremental lines. C, a finding described by Shmamine (1910). White spots are artifacts, empty lacunae previously containing incorporated cementoblasts.

per left second premolar which will be described further. These two teeth and also the lower left second premolar were removed surgically and submitted for histologic preparation.

## Histologic Examination

Some time after removal of the upper molar, a roentgenogram was taken which revealed a fairly dense bony area situated within the alveolar region of this tooth. When the bone had been removed and histologic sections had been made, one could observe bone trabeculae with small marrow spaces, so-called condensing osteitis, but there were no traces of any cementum formation.

The upper right first molar represents a typical case of early arrested eruption. The histologic sections revealed extensive layers of cementum formed along the root surfaces. A comparison with structures of teeth from other individuals may illustrate that these new cementum layers were much thicker and of a different arrangement. In Fig. 1, a section taken from another person, the acellular cementum is stained bluish with hematoxylin and eosin and there is a line of uncalcified cementum on the root surface. This is also a common finding in patients of the twelve year age group.

On the root surface of the submerged first molar, wide layers of new cementum had been deposited (Fig. 6). It was noted that also some areas of the primary cementum were widened (Fig. 9). The new cementum contained several resting lines, also called incremental lines, running more or less parallel with the primary cementum layer (Fig. 6). The number of these lines varied from twelve to twenty-five. Incremental lines are also observed in adult cementum, but these are usually thicker and thus readily distinguished from the symmetrically arranged incremental lines observed in early hypercementosis. A drawing of the tooth as seen in the sections may illustrate the extent of the

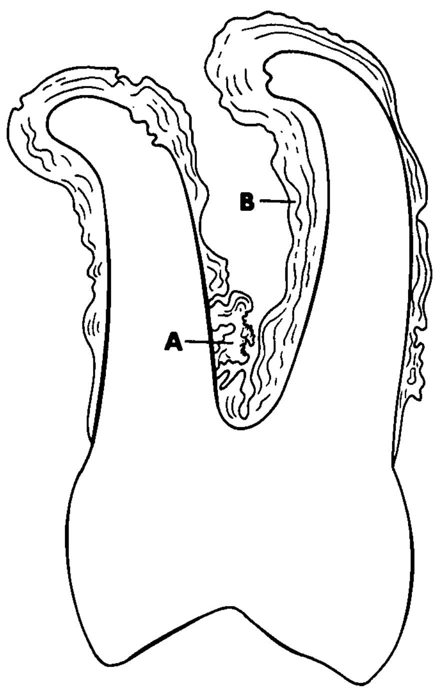


Fig. 7 Upper right first molar of the brother. Note outgrowths of atypical cementum. A, area containing osteocementum and bone, here partly undergoing resorption. B, area shown in Fig. 6.

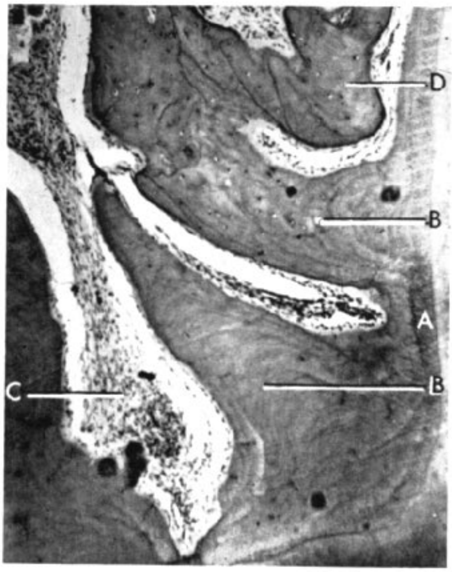


Fig. 8 Bifurcation area of the tooth shown in Fig. 7. A, primary cementum. B, approximate demarcation line between osteocementum and bone. C, periodontal ligament between projecting spicules of atypical cementum. D, bone with darkly stained surface line, a finding not observed along the atypical cementum layer.

new cementum layers (Fig. 7). It is noted that the roots are curved and that the atypical cementum layers vary in thickness. More cementum has been deposited in the bifurcation area and in the apical portion of the roots. No root resorption was observed.

The sections revealed that the root was surrounded by the periodontal ligament except in the bifurcation area where new osteocementum layers were united with the surrounding bone. This was laid down in the form of projecting spicules (Fig. 8). Hence, ankylosis had occurred as in many other molars exhibiting hypercementosis. Remnants of the periodontal ligament could be observed between the projecting spicules. Most of Malassez' epithelial rests were absent, but in two areas strands of epithelial cells persisted surrounded by trabeculae of osteocementum and bone (Fig. 9).[22]

The next tooth, the upper left second premolar, had also been arrested in its eruption. A light continuous force was applied for extrusion of this tooth, but very little movement could be obtained. Since this was a Class II case, the tooth was extracted. Histologic examination disclosed fairly thick layers of atypical cementum with the same parallel running incremental lines. A closer examination of the root surface revealed excessive layers of cementum and osteocementum notably in the middle third of the root where ankylosis had occurred. The apical third of the root was curved in a distal direction. A drawing of the tooth shows the location of the ankylosed area in which thick layers of irregularly arranged cementum and osteocementum could be observed. A small resorbed lacuna of the root surface was repaired by cementum (Fig. 10).

The last tooth to be examined histo-

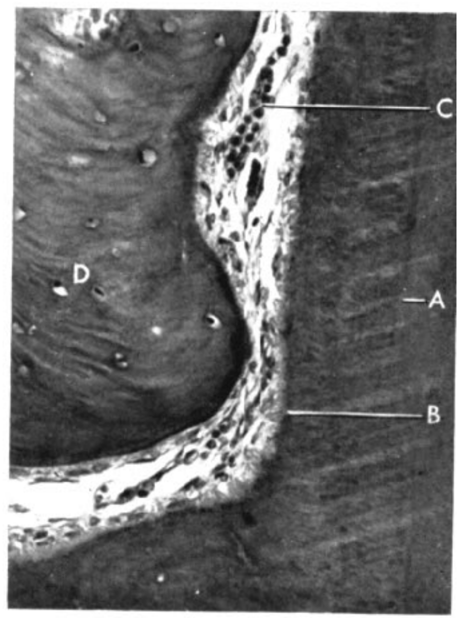


Fig. 9 Area shown at D, Fig. 8. A, border line between dentin and primary cementum, the latter of an increased thickness. B, surface of primary cementum. C, persisting epithelial rest. D, bone. There is atrophy of the periodontal ligament.

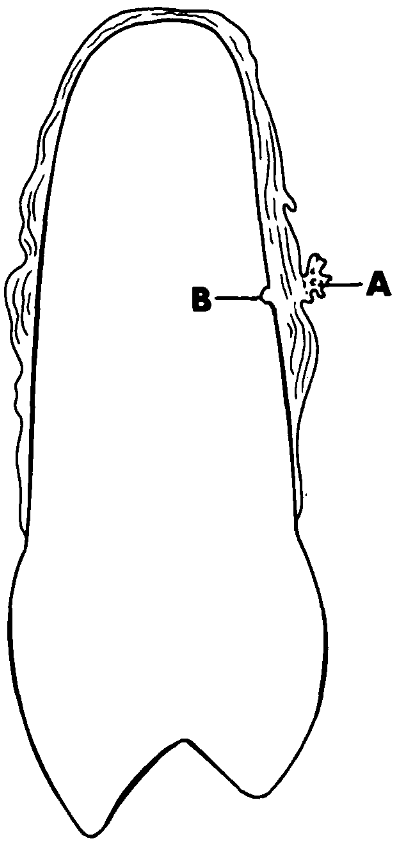


Fig. 10 Illustrating amount of atypical cementum deposited on the root surface of the upper left second premolar. A, ankylosed area containing osteocementum and bone. B, small resorbed lacunae repaired by cellular cementum.

Fig. 11 Eruption stage of the lower left second premolar.

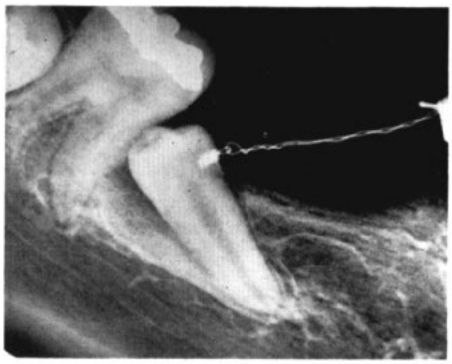

Fig. 12 Uprighting movement of the lower second premolar, tooth shown in Fig. 11. Note thickening of the lamina dura on the distal side as a result of deposition of new bone.

Fig. 13 The tooth shown in Fig. 12. It has come to a standstill and cannot be moved any farther.

logically, the lower left second premolar, was observed roentgenographically at various stages during its eruption. The lower left first molar had been extracted because of profound caries when the patient was seven years old. Figure 11 illustrates the position of the lower premolar one year later. The clearly defined lamina dura indicates that this is a tooth undergoing eruption as in most other cases. Another roentgenogram was taken at the age of 10 years. The tooth was migrating in a distal direction. There was no thickening of the cementum. The next roentgenogram was taken when the patient was thirteen years old. The tooth had migrated farther and was in contact with the second molar. Since the premolar remained impacted, a light force was

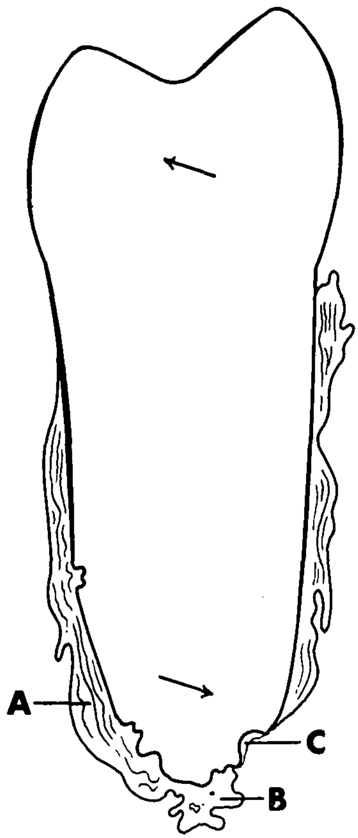


Fig. 14 Atypical cementum layers formed on the root surface of the tooth shown in Fig. 13. A, thickening of the cementum on the mesial side may have been caused partly by tooth movement. B, ankylosed area. C, repaired root resorption. Arrows indicate direction of movement. The cementum layers contain atypical incremental lines.

applied for uprighting the tooth (Fig. 12). The thickened lamina dura on the distal side of the root is the result of this movement. The uprighting occurred as intended until the patient was close to fifteen years old (Fig. 13). At this time no more tooth movement could be observed. Since the tooth was still in a submerged position, it was removed for histologic examination.

A general view of the cementum deposits on the root surface is seen in the next drawing (Fig. 14). As could be observed in the histologic sections, there had been a functioning periodontal ligament except in the apical region. Here ankylosis had occurred in a circumscribed area, and there was formation of osteocementum and bone. The alveolar bone was united with the osteocementum covering the root surface (Fig. 15). Several root resorption lacunae were filled in with cementum. This root resorption was obviously the result of the tipping of the tooth with a fulcrum established somewhere in the middle third of the root. More root resorption had occurred on the disto-apical side of the root, areas that were repaired by new layers of cellular cementum (Fig. 16).

The pulp tissues of the teeth examined histologically did not reveal any unusual findings with the exception of several calcifications. In the first molar the pulp canals tended to become obliterated by formation of new layers

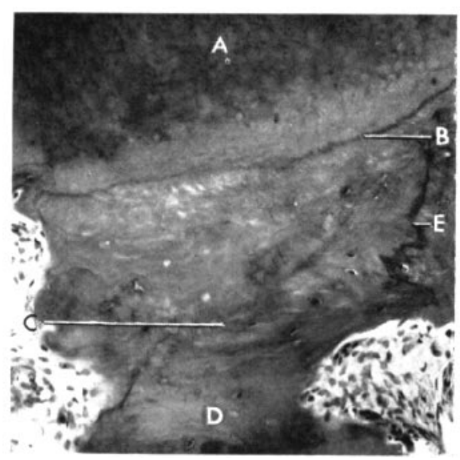


Fig. 15 Area shown at B, Fig. 14. A, dentin. B, primary cementum. Layer from B to C consists of osteocementum. Compression of the periodontal ligament with subsequent ankylosis may have occurred in the area marked C. D, bone surrounded by marrow spaces and, to the left, periodontal ligament. E, reversal line.

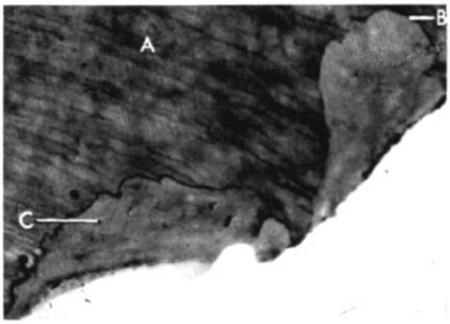


Fig. 16 Area C shown in Fig. 14. Root resorption lacunae filled in with cellular cementum. A, dentin. B, demarcation line between dentin and cellular cementum. C, cementoblast incorporated in the new cementum layer.

of dentin. A general physical examination of the patient and tests of the basal metabolism revealed no significant variations.

## Discussion

In a discussion of excessive cementum formation, it may be of interest to consider primarily the different types of hypercementosis, secondly, its prevalence and finally, its effect on the movability of teeth.

As shown in earlier studies, hypercementosis may be observed in individual teeth or it may occur in several teeth of the same person.[29,30] The present investigation indicates that early hypercementosis can not always be detected roentgenographically. In adults, however, the more advanced type of excessive cementum deposits can readily be observed in the roentgenograms.

Several authors have considered the possibility that systemic disturbances may lead to hypercementosis. Hence, Gardner and Goldstein[7] observed hypercementosis in cases of acromegalia. Rushton[25] has described hypercementosis associated with osteitis deformans. Wolbach and Howe[33] observed increased deposits of cementum as a result of vitamin A deficiency in animal experiments. Most investigators agree that in the majority of human cases with hypercementosis a test of the systemic condition will not reveal variations of any significance. This also applies to the patient tested in this investigation. It must be stressed, however, that a hereditary factor exists which may lead to hypercementosis and infraocclusion in several members of the same family. It is thus likely that the three family members mentioned in this study were all affected by hypercementosis.

According to what has been observed in the present investigation, it is important to distinguish between early hypercementosis and excessive cementum formation in adult teeth. In adult cases the thickness of the cementum varies considerably. It may be observed that in adult teeth which may have erupted normally, hypercementosis is not detected until many years after the eruption period.

The type of hypercementosis in young individuals is different. It occurs in the form of spikes and outgrowths. The difference between normal and abnormal cementum deposits in young individuals can only be determined by histologic methods. Parallel running incremental lines are nearly always present in early hypercementosis. Usually secondary cementum contains few or no incremental lines (Fig. 2). In addition this cementum is frequently bordered by a darkly stained line. In adult teeth this surface line is clearly seen. In a case of early hypercementosis characteristic incremental lines are observed. The darkly stained surface line is missing (Fig. 6). This indicates that new cementum has been constantly added.

Several authors[4,11,29] have considered early hypercementosis a pathologic reaction, a view not supported by others.[14,34] From a histologic standpoint this type of cementum must at least be characterized as strikingly different from the cementum observed in other individuals of a similar age.

While the prevalence of adult hypercementosis is high, the early type observed in young individuals is fairly uncommon. In an investigation of teeth from sixty individuals of the age range eleven to seventeen years, no traces of any hypercementosis could be observed. This indicates that the early type of hypercementosis is restricted to certain individuals or, as a hereditary factor, to certain families. Hence, the orthodontist who takes care of one patient affected by hypercementosis may expect an abnormal tissue reaction in other members of the same family.

Also the incidence of early hypercementosis may vary. Most authors agree that hypercementosis of first molars is fairly common. Not infrequently premolars may become involved and even canines and anterior teeth. Observations of early hypercementosis in several teeth of the same person, as described above, must nevertheless be regarded as fairly uncommon.

As observed in the present study, the early type of hypercementosis may influence the movability of teeth during eruption and orthodontic treatment. When cementum is formed rapidly on the root surface of molars, fiber bundles will be incorporated in the new cementum layers, thus causing disturbances in the rearrangement of the periodontal fibers. This may result in a delayed eruption. Atrophy and shrinkage of the periodontal ligament may also occur, subsequently leading to ankylosis (Fig. 9). In addition, the roots of teeth which have been arrested in their eruption may frequently become curved, a phenomenon which in itself prevents further eruption.

The tissue changes that occur in cases of infraocclusion are highly varying. It has been shown by Gränse,[9] Korkhaus[15] and others that there may be root resorption and ankylosis in many cases of infraocclusion of first molars. But there are other variations. Kronfeld,[12] Gränse[9] and Stones[29] have reported cases of hypercementosis and infraocclusion where no ankylosis occurred. Similar findings were made by Zemsky[34] who observed hypercementosis with curvature of the roots of impacted canines. There was no ankylosis. It is thus likely that hypercementosis per se may cause a delayed or arrested eruption.

Orthodontic tooth movement in cases of early hypercementosis may lead to compression and atrophy of the periodontal ligament with ankylosis between root surface and bone. Such ankylosis was observed in the present study. Of the two teeth moved orthodontically, the upper premolar was obviously ankylosed prior to orthodontic movement. The lower premolar could be moved to a certain extent even if there was hypercementosis. Shortly after the root had been uprighted, however, there was no further movement. Ankylosis had occurred between the osteocementum of the root surface and the alveolar bone whereby tooth movement was arrested (Fig. 15). In addition, ankylosis may occur by formation of osteocementum and bone in the resorption lacunae of the root surface.

In further investigations of this problem, it will be necessary to examine more systematically the cementum of impacted teeth that cannot be moved orthodontically. One may then possibly find that tooth immovability is not always caused by bone density or similar disturbances of the tissue reaction.[23] In a few cases the difficulty of moving certain teeth may be traced back to early hypercementosis.

## Conclusions

The conclusions of what has been

observed in the present study may be summarized as follows:

1. Early hypercementosis is recognized by the presence of parallel running incremental lines, a finding not observed in the secondary cementum layer of other individuals of a similar age. The surface line bordering the secondary cementum is usually absent in cases of hypercementosis.

2. Hypercementosis in teeth of young individuals may cause a delayed tooth eruption, frequently resulting in curvature of the roots. The delayed eruption may lead to ankylosis between bone and root surface with or without root resorption.

3. During the developmental stage of early hypercementosis the tooth may be moved orthodontically to a certain extent. Ankylosis may occur between bone and root surface following compression and atrophy of the periodontal ligament. If there is root resorption, this may be repaired by formation of cellular cementum. In some cases osteocementum and bone tend to fill in the resorption lacunae of the root surface.

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