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ELECTROLYTIC PRECIPITATION OF ZINC CARBONATE IN THE JAW

An Unusual Complication After Root Resection

Karl-Åke Omnell, Odont. D.,* Malmö, Sweden

R oot resection together with the insertion of an apical seal of silver or copper amalgam filling, is nowadays, along with conservative therapy, a routine method of treatment of periapical osteitis. The result of experimental and clinical work indicates that the tissues tolerate at least the silver amalgam to a reasonable extent.

This article represents a study, utilizing biophysical techniques, of unusual complications after root resections.

CASE REPORT

The patient was E. H., a 44-year-old woman.

In 1952 a fixed bridge was constructed in the upper jaw, extending from the right first molar to the left first molar, with pontics replacing the right canine and the left premolars. Before the bridge was made, the right lateral incisor had a post which was fixed in the root canal by a pin. A roentgenogram (Fig. 1) taken in 1951 shows that there is no root-filling material visible apical to the post and there are no positive roentgenologic signs of periapical osteitis.

The bridge was inserted on Oct. 30, 1952. Some months later, on Feb. 6, 1953, the patient came to the Royal Dental School in Malmö complaining of pain in the front of the maxilla. In the buccal region of the right lateral incisor there was a slight redness of the mucous membrane; a marked tenderness was noted on palpation. There was no swelling or fistula. Roentgen examination revealed destruction of the lamina dura in the periapical region of the right lateral incisor. This destruction was most evident mesial to the apex (Fig. 2).

From the Department of Medical Physics (Head: Professor A. Engström, M.D.), Karolinska Institutet, Stockholm, Sweden, the Department of Oral Roentgen-Diagnosis (Head: Professor A. Sonesson, M.D.) and the Department of Oral Surgery (Head: Professor H. Björn, M.D.), Royal Dental School, Malmö, Sweden.

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^{*}Associate Professor of Oral Roentgen-Diagnosis, Royal Dental School, Malmö, Sweden.

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One week later, on Feb. 12, 1953, the periapical bone destruction had increased but was not so well defined (Fig. 3). Within a small area at the apex, however, the bone showed normal structure, which indicated the formation of a sequestrum.

Because of the roentgenologic findings, a root resection was performed on the right lateral incisor. The apical opening of the root canal was obliterated by a silver amalgam filling. The incision healed by primary union.

Fig. 4 shows a roentgenogram taken after the operation on Feb. 21, 1953. Three months later (May 20, 1953), the apex was surrounded by a well-defined roentgenolucent area (Fig. 5). Above, beside, and below the amalgam filling there was a roentgenopaque area which was demarcated against its surroundings. Distal to the root there were two small roentgenopaque fragments (possibly amalgam) near the alveolar crest.

About one year later (June 15, 1954) the destruction had extended further, particularly distally. Its roentgenolucency was more pronounced, indicating that the pathologic area had become limited (Fig. 6). The roentgenopaque area around the apex had also increased and showed greater contrast to the normal bone. The roentgenopaque substance was not homogenic but seemed to be deposited in irregular layers around the apex and the amalgam filling.

Another surgical procedure was undertaken, and the root was resected to the post. The diseased tissues were removed, and a new silver amalgam filling was inserted. The wound was sutured. The extent of the operation is evident from the roentgenogram shown in Fig. 7.

The postoperative course was clinically without complications. Three months later, however, on Sept. 21, 1954, a new roentgenogram (Fig. 8) revealed that bone destruction was still continuing. Close to the amalgam filling there was a small roentgenopaque and homogenic area. Around this area but at some distance from it there was, in addition, some roentgenopaque substance.

A few months later, on Jan. 25, 1955, the destruction had extended toward the alveolar crest and had reached further toward the nasal cavity. The amount of roent-genopaque substance around the apex had also increased (Fig. 9).

In a third operation (Jan. 26, 1955) the whole root and the surrounding supporting tissues were removed. Clinically, no signs of malignancy could be detected. The post-operative roentgenogram is shown in Fig. 10.

It appeared that the roentgenopaque substance was connected with the complications experienced in this case, and therefore a part of this material was subjected to analysis.

Investigations of the Removed Pathologic Tissues.—The specimens from the operations of June 15, 1954, and Jan. 26, 1955, were fixed in 10 per cent formalin, decalcified in formic acid, and passed through the routine histologic process.

The roentgenopaque specimen, which was 1 mm. in diameter, was embedded in methylmethacrylate. After polymerization, thin sections were prepared for subsequent analysis by microroentgenography and roentgen diffraction. (For reference to the technical procedures, see Engström, Björnerstedt, Clemedson, and Nelson.⁴)

Histopathologically, there was in both cases a nonspecific inflammation with an invasion of plasma cells and giant cells. Scattered through the tissue were areas of hyaline degeneration (Fig. 11). Around the necrotic areas there was no evidence of foreign body reaction. These pathologic changes were more advanced in the specimen removed at the last operation (Jan. 26, 1955).

In addition to the classical signs of a chronic inflammation, there were, in the specimen removed at the operation of June 15, 1954, numerous small rodlike crystals scattered through the tissue (Fig. 12). These crystals gave a negative response to a histochemical test for iron.

The microroentgenogram of the roentgenopaque substance showed a somewhat "blistered" structure (Fig. 13). Light and dark areas indicate varied absorption of the



Fig. 1.--No root-filling material visible in the lateral incisor, with the exception of the metal post. There are no signs of osterits around the apex. Feb. 17, 1951.

Fig. 2.—Destruction of the lamina dura at the apex of the lateral incisor. The destruction is most marked mesial to the root. Feb. 6, 1953.

Fig. 3.-Bone destruction around the apex of the lateral incisor and possibly a sequestrum formation at the apex. Feb. 12, 1953.

Fig. 4.--Roentgenogram taken after the operation. Feb. 21, 1953.

Fig. 5.—The apex of the right lateral incisor surrounded by a well-defined bone destruction. There is a roentgenopaque area close to the amalgam filling. May 20, 1953. Fig. 6.—The bone destruction at the right lateral incisor as well as the roentgenopaque area has increased in size. June 15, 1954. Fig. 7.—Roentgenogram taken after the second root resection of the right lateral incisor. June 15, 1954. Fig. 8.—New deposition of roentgenopaque substance at the apex of the right lateral incisor. Sept. 21, 1954.

Fig. 9.—There is still an increase in both the bone destruction and the roentgenopaque formation at the apex of the right lateral inclsor. Jan. 25, 1955. Fig. 10.—Roentgenogram taken after the last operation. Jan. 26, 1955.

roentgen radiation. The absorption seemed to be greatest in the periphery of the specimen. Separate layers or concentrically arranged laminae could not be detected. There were no cell spaces or signs of vascularization.



Fig. 11.

Fig. 12.

Fig. 11.—Areas with hyaline degeneration in different stages of necrosis. (Hematoxylin and eosin stain. Magnification, ×100; reduced ¼.)
 Fig. 12.—Rodlike crystals scattered through the soft-tissue specimen (from the operation of June 15, 1954). (Hematoxylin and eosin stain. Magnification ×400; reduced ¼.)

The roentgen diffraction examination of the roentgenopaque substance (Fig. 14) indicated small crystals (about 10-5 cm.) without preferential orientation. The diffraction pattern had no resemblance to those normally found in calcified tissues (hydroxy apatite).



Fig. 13.—Microroentgenogram of a thick section of the roentgenopaque substance 100 μ thick at the apex of the right lateral incisor. Varied roentgen absorption within the specimen but no signs of separate layers. (20 kv., Eastman Spectroscopic Plate No. 649.) (Magnification, X115; reduced $\mathcal{Y}_{4,1}$)



Fig. 14.—Flat-film roentgen diffraction pattern of roentgenopaque substance at the apex of the lateral incisor (left) and from a basic zinc carbonate (right). Note that the diffraction lines correspond in detail. (Ni-filtered Cu-radiation.)

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When the roentgen diffraction was recorded on the heated specimen, the well-defined lines in the diffraction pattern could be assigned without doubt to a zinc oxide. With this information, the diffraction lines in the nonheated specimen could be shown to be derived from zinc carbonate.

DISCUSSION

The roentgenograms first indicated that the roentgenopaque area around the apex of the upper right lateral incisor would consist of mineral salts usually found in the mammalian organism. Such mineral deposits are generally associated with the presence of tumors, cysts with concrements,² or dental calculus.

Clinically, however, no signs of such pathologic changes were detected. Because of the doubtful situation, the pathologic area which had to be removed for elinical reasons was subjected to a thorough analysis. This resulted in the surprising disclosure that the roentgenopaque deposition consisted mainly of zine earbonate.

The zinc carbonate most probably was deposited by an electrolytic process, and such processes are known to develop in bone when metals forming electric elements are present.^{1, 3}

Physiologically, zinc occurs in trace amounts in the organism, but it does not seem possible to reach such concentrations as were detected in this case. In all probability, the zinc ions were derived from the silver amalgam filling (containing about 1 per cent zinc), where zinc is the element which has the lowest solution potential. However, there also exists a possibility that the zinc ions in this roentgenopaque substance came from the root canal post.

Among many hundreds of cases treated in the same manner and followed up with postoperative roentgen examinations, only this one has reacted in the way described.

SUMMARY

An unusual complication after root resection of an upper lateral incisor in a middle-aged woman is described. There was bone destruction together with deposition of a roentgenopaque substance around the silver amalgam filling which had been inserted in the apical opening of the root canal after resection, and this substance reappeared after a second root resection. The increase of deposited material was studied by a series of roentgen examinations.

Microroentgenography and roentgen diffraction investigations revealed that the roentgenopaque substance consisted of zinc carbonate. It is suggested that the zinc salt was deposited as a result of an electrolytic process.

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