

Chronic maxillary sinusitis caused by root canal overfilling of Calcipex II

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This is a case report of chronic maxillary sinusitis caused by root canal overfilling of Calcipex II (Techno-Dent). A 60 year-old male complained of dull pain in the right maxillary molar area after complicated endodontic treatment using Calcipex II paste and was finally diagnosed with a chronic maxillary sinusitis through a clinical and radiological observation. In the biopsy examination, the periapical granuloma contained a lot of dark and translucent Calcipex II granules which were not stained with hematoxylin and eosin. They were usually engulfed by macrophages but rarely resorbed, resulting in scattering and migrating into antral mucosa. Most of the Calcipex II granules were also accumulated in the cytoplasm of secretory columnar epithelial cells, and small amount of Calcipex II granules were gradually secreted into sinus lumen by exocytosis. However, chronic granulomatous inflammation occurred without the additional recruitment of polymorphonuclear leukocytes (PMNs) and lymphocytes, and many macrophages which engulfed the Calcipex II granules were finally destroyed in the processes of cellular apoptosis. It is presumed that Calcipex II granules are likely to have a causative role to induce the granulomatous foreign body inflammation in the periapical region, and subsequently to exacerbate the chronic maxillary sinusitis in this study. (*Restor Dent Endod* 2014;39(1):63-67)

Key words: Calcipex II; Foreign body granuloma; Maxillary sinusitis

Received September 15, 2013;
Accepted October 22, 2013.

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Introduction

Previously we reported that Calcipex II (Techno-Dent, Bangkok, Thailand) was able to be widely dispersed into the periodontal tissues, primarily engulfed by macrophages, and resulted in foreign body granuloma in the absence of acute inflammatory reaction.¹ Calcipex II is a temporary canal filling paste which contains water-based calcium hydroxide (Ca(OH)₂), barium sulfate (BaSO₄) and propylene glycol (C₃H₈O₂), which is comparable with other root canal filling materials.²

Among the temporary root canal dressing materials, the iodoform-based Vitapex paste (Neo Dental Chemical Products Co., Tokyo, Japan) was known to disappear after a short period of time in periapical area.³ The principal advantages of the Vitapex paste are that it resorbs from the apical tissues in one week to two months, is apparently harmless to permanent tooth germs, is radiopaque, does not set to a hard mass, and is easily inserted and removed.^{4,5} Nevertheless, the Vitapex composed of calcium hydroxide and iodoform with the addition of silicone oil may damage tissue at the sites of direct contact. A pure calcium hydroxide paste, TempCanal (Pulpdent Corporation,

Watertown, MA, USA), is a temporary root canal treatment paste for an antimicrobial intracanal dressing. It may be easily dissolved in tissue and does not adhere to dentin or resin restoration.⁶ On the other hand, the Calcipect II paste is known to have benefits of high radiopacity, easy application and removal, and it is a readily ionized strong alkali paste (up to pH 12.4) providing the antimicrobial effect and bone regeneration effect.² However, Calcipect II has not been precisely evaluated for its physiological and pathological effects *in vivo*, although it is widely used as a root canal temporary dressing materials.

In this study we found lumps of Calcipect II spilled during root canal treatment into the periapical region of maxillary premolar and molar, which were complicated in endodontic treatment. The overfilled materials of Calcipect II were gradually scattered in the marrow space of maxilla and passed through the mucoperiosteum of maxillary sinus wall, resulting in chronic maxillary sinusitis in two years.

Case report

A 60 year-old man complained of the continuous dull pain on the upper right second premolar and first molar area, where had received endodontic treatment in a private dental clinic about two years ago, and was referred to the Department of Conservative Dentistry in Gangneung-Wonju National University Dental Hospital (GWNUDH). His systemic medical history was not relevant to the present lesion.

In panoramic view and standard radiogram there found that the root canal fillings were incomplete, and small amount of root canal materials was spilled into the periapical area. During the retreatment it was found that both teeth were filled with temporary canal filling materials rather than the gutta-percha cone. The temporary root canal materials were confirmed Calcipect II materials through the document information from the private dental clinic. Both teeth were carefully irrigated with 1% NaOCl solution to remove the remaining Calcipect II paste, but accidentally some amount of Calcipect II paste were spilled again into periapical area (Figure 1a). The teeth were refilled with gutta-percha cone. The periapical radiopaque image of Calcipect II almost disappeared after two months, and the teeth became asymptomatic. However, in one and a half year after the canal filling treatment he felt mild pain in the right maxillary molar area, and was diagnosed maxillary sinusitis caused by periapical granuloma through the clinical and radiological observation (Figure 1b).

The periapical lesions including the sinus mucosa were surgically removed *via* the enucleation of lesion through intra-oral approach. The removed specimen was fixed in 10% neutral formalin, embedded in paraffin, and sectioned in 4 μ m thickness. The usage of biopsy specimens filed in the Department of Oral Pathology, Gangneung-

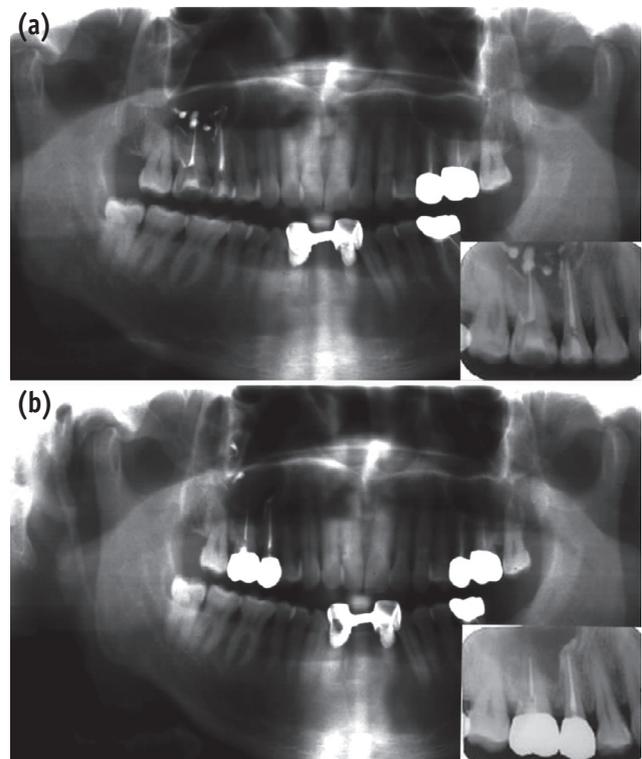


Figure 1. (a) Panorama radiographs and standard radiographs (inlet square) after temporary root canal dressing material using Calcipect II, which was spilled into the periapical area; (b) Panorama and standard radiographs (inlet square) in one and half year. Some Calcipect II granules were gradually migrated into maxillary sinus through the mucoperiosteal space, although their radiopacity was reduced.

Wonju National University Dental Hospital was approved by our institutional review board (IRB2013-2). In the microscopic observation, the removed periapical lesion and sinus mucosa showed lumps of Calcipect II granules which were gradually scattered into the surrounding tissues (Figures 2a1 and 2a2). In high magnification the Calcipect II granules were about 1 - 2 μ m in diameter, and slightly dark and translucent in the center of grayish black granules (Figure 2a3). Most of the Calcipect II materials were engulfed by infiltrated macrophages, and they were dispersed into the periapical area without the additional recruitment of polymorphonuclear leukocytes (PMNs) and lymphocytes (Figures 2b1-2b3). Some macrophages were filled with the Calcipect II granules in their cytoplasm, and gradually undergone to cellular apoptosis instead of the degradation of Calcipect II granules and multinucleated giant cell formation (Figures 2c1 - 2c3). However, it was conspicuous that the Calcipect II engulfment

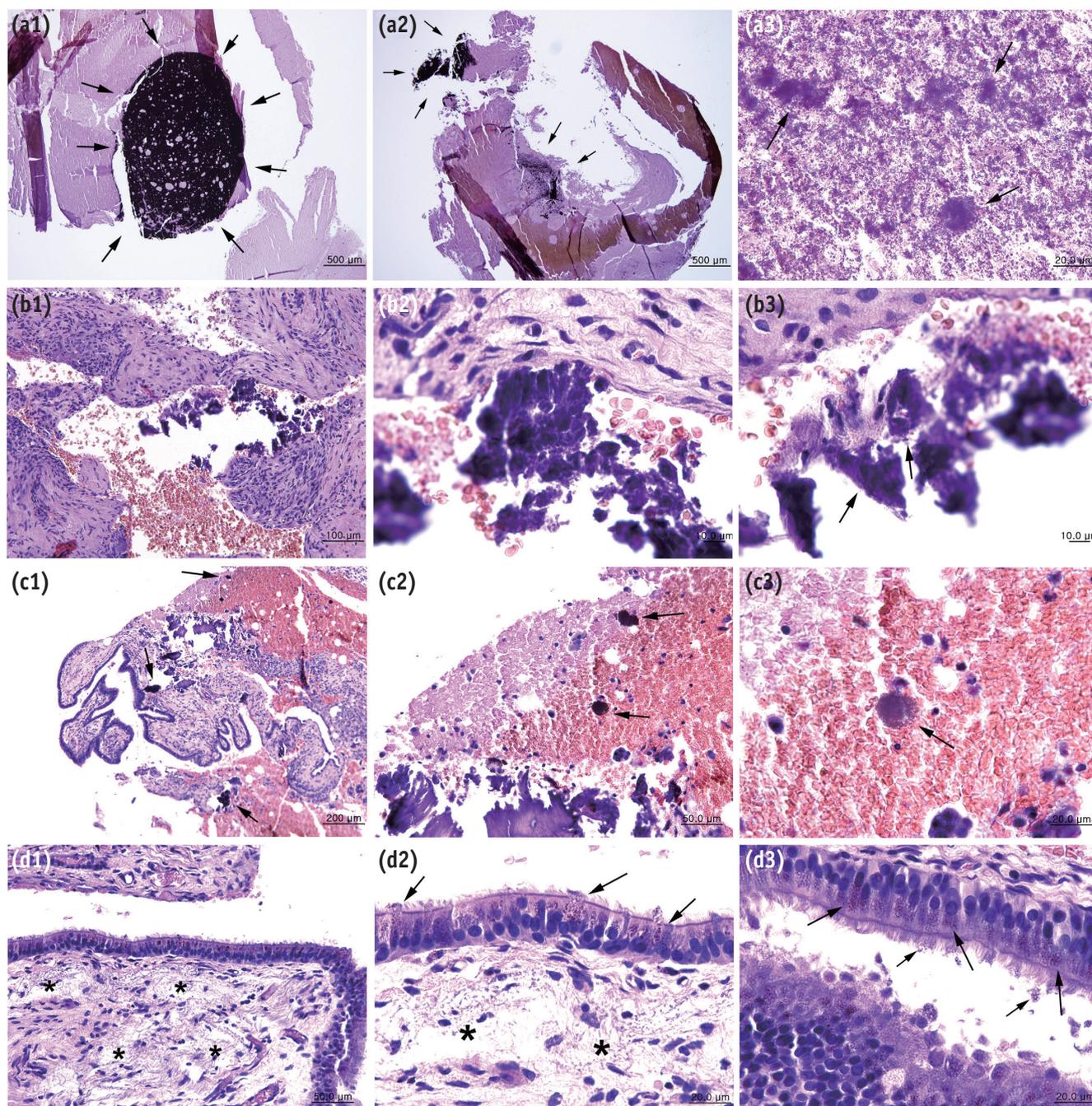


Figure 2. Photomicrographs of Calcipex II-related periapical granuloma involving maxillary sinusitis. H&E stain. (a1) A huge lump of Calcipex II; (a2) The Calcipex II materials scattered into the surrounding fibrous tissue; (a3) High magnification of panel (a2), grayish black fine granular materials of Calcipex II in macrophages (arrows); (b1) Frequent dystrophic calcifications (arrows); (b2 and b3) Calcipex II granules (arrows) were diffusely found around the calcified materials without inflammatory reaction; (c1) Diffuse granulomatous inflammation in the sinus mucosa; (c2 and c3) High magnification of panel (c1), enlarged macrophages filled with Calcipex II granules; (d1) Tissue degeneration (asterisks) containing abundant Calcipex II granules; (d2 and d3) High magnification of panel (d1), exocytosis of Calcipex II granules into the antral cavity (arrows); (d3) Accumulation of Calcipex II granules (arrows) in the cytoplasm of ciliated columnar cells.

by macrophages was processed without chemotatic inflammatory reaction of PMNs and lymphocytes, consequently resulting in the chronic foreign body granulomatous inflammation in the periapical region and antral sinus mucosa.

The Calcipect II granules scattered diffusely into the connective tissue were gradually accumulated in the secretory epithelial cells of antral mucosa (Figures 2d1 - 2d3). A lot of Calcipect II granules were found in the distal cytoplasm of the ciliated columnar epithelial cells (Figure 2d2), particularly, some Calcipect II granules were secreted into sinus lumen via the exocytosis of the columnar mucous epithelial cells (Figure 2d3). However, the maxillary sinusitis generally showed granulomatous rather than the ordinary suppurative inflammation, and healed uneventfully after the removal of granulomatous lesion containing Calcipect II granules. On the other hand, several foci of dystrophic calcification appeared in the periapical granuloma tissue (Figures 2b1 - 2b3). The dystrophic calcified bodies were small and irregular in shape (Figure 2b2), usually aggregated with one another, and admixed with the fine granules of Calcipect II in their periphery (Figure 2b3).

Discussion

Root canal filling materials which contain irritating substances such as magnesium and silicon can evoke a foreign body reaction at the periapex, leading to the development of asymptomatic periapical lesions that may remain refractory to endodontic therapy for long periods of time.⁷ The unique feature of the lesion was the presence of vast number of large multinucleated cells which resembled foreign body giant cells and their cytoplasmic inclusion bodies.⁸ Calcium hydroxide could inhibit macrophage function and reduce inflammatory reactions in periapical tissues or in dental pulp when it is used in root-canals therapy or in direct pulp capping and pulpotomy, respectively, probably because calcium hydroxide is able to decrease the substrate adherence capacity of macrophages.⁹

The efficiency of calcium hydroxide containing root canal sealers may indicate a decline of radiopacity within the canals and an almost complete resorption of the cement overfillings in obturated canals examined radiologically after one year.¹⁰ It was also known that the calcium hydroxide can induce periapical repair through the closure of the foramen and apical root development in teeth with incompletely formed roots associated with periapical lesions.¹¹ However, although the extensive extrusion of calcium hydroxide into the periapical tissues does not appear to comprise periapical healing, the deliberate extrusion of dental materials into the apical tissues should not be advocated.^{12,13}

According to the manufacturer, the Calcipect II is

composed of calcium hydroxide, barium sulfate, propylene glycol, and water. Both of calcium hydroxide and barium sulfate are supposed to be safe and to play a beneficial effect in the periapical area and are slowly resorbed without tissue damage. But the propylene glycol, another major component of Calcipect II as a root canal penetrating solvent to enhance the antimicrobial effect of calcium hydroxide, remains to be elucidated for its biological effect.¹⁴ Propylene glycol is usually used as a cosolvent in different kinds of drugs for intravenous administration, but it may produce allergic reaction in some patients when used in high dose.¹⁵⁻¹⁷

Actually the application of high concentrations of propylene glycol under occlusive dressings in ultrasonic examination may give rise to skin reactions of a primary irritant character which may closely simulate an allergic reaction.¹⁸ Thus, it is also suggested that the propylene glycol be able to produce toxic effect of potentially life-threatening iatrogenic complications such as unexplained anion gap, unexplained metabolic acidosis, hyperosmolarity, and/or clinical deterioration.^{19,20} However, if a small amount of propylene glycol contained in Calcipect II paste was extended into periapical tissue due to the overfilling of Calcipect II, its toxic effect may appear as the primary foreign body reaction by macrophages rather than the severe inflammation or allergic reaction.

In the present case the spilled Calcipect II granules were primarily engulfed by macrophages without hypersensitive immune reaction. The macrophages could not resolve the Calcipect II granule completely; rather they were destroyed by the overloading of Calcipect II granules. As a result, the Calcipect II granules were dispersed into connective tissue and phagocytosed again by other macrophages, which were subsequently destroyed by the same mechanism as Calcipect II overloading. These foreign body reactions of macrophages against Calcipect II granules seemed to be relatively bioinert but still could induce chronic inflammation through macrophage-related cytokines. However, they did not produce the multinucleated giant cells in the granuloma as usual.

On the other hand, the Calcipect II granules were found in the area of dystrophic calcification, where bony regeneration was abortive. The water-based calcium hydroxide paste of Calcipect II might play a role to enhance the calcification at the granuloma tissue and to inhibit the bacterial growth, if alkali-sensitive microorganisms were infected.

Conclusions

Although the Calcipect II was reported to be relatively bioinert, the present study demonstrated that the overfilling of root canal by Calcipect II resulted in chronic foreign body granuloma in periapex and propagated to

maxillary sinusitis. Among the composition of Calcipex II, calcium hydroxide and barium sulfate were known to be readily resorbed, while the other major organic compound of Calcipex II, propylene glycol, was not easily resorbed, and supposed to induce foreign body granuloma. Therefore, the propylene glycol beads of Calcipex II granules remaining until one and half year after endodontic treatment is probably a causative element of periapical granuloma and maxillary sinusitis in this study. Further studies on the adverse effects of Calcipex II should follow.

Conflict of Interest: No potential conflict of interest relevant to this article was reported.

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