A clinical variant on the use of calcium hydroxide, referred to as the 'Biocalex' or calcium oxide expansion technique, by Bernard(1), is a method devised for treating infected and purulent pulps.

Although the technique is supported by clinical and laboratory evidence, supplied largely by Bernard, the somewhat exaggerated claim of the expansive properties of Biocalex and the instruction that the preparation of canals to their apices is not only unnecessary but contra-indicated, has resulted in a general lack of interest by endodontic specialists throughout the world. Notwithstanding, the author has experimented clinically with the material in otherwise unsavable teeth, obtaining a surprisingly high rate of success. This has led to the conclusion that there is hope for further independent clinical and laboratory investigation of the nature of the action of calcium oxide in infected root canals.

The basic concept, claimed by Bernard, is the chemical action between calcium oxide (in a chemically pure form) and water to produce calcium hydroxide and a release of chemical and physical energy. The reaction is slowed down by the mixture of four parts of ethylene glycol to one part of water, thus limiting the exotherm which accompanies the expansion of the mass and the chemical "incineration" of necrotic tissue in the canal.

The original Biocalex 4 formulation, in which the powder consisted solely of calcium oxide, was reputed to expand 250-400 percent, but it was replaced by Biocalex 6:9 which consisted of a heavy form of calcium oxide, to which was added zinc oxide. This combination, it was claimed, expands 600-900 percent. Zinc oxide is incorporated with the calcium oxide in the ratio of 1:2, ostensibly to provide radiopacity so that the expanded mass can be left in situ as a radiographically visible root filling.

Bernard considers that the carbon dioxide given off as a result of the breakdown of complex protein molecules, reacts with calcium hydroxide to give calcium carbonate and water. The calcium carbonate aids in blocking the canal system which the water reacts with calcium oxide to provide further calcium hydroxide. Thus the expansive reaction, with dissemination of the hydroxide and carbonate throughout the canal system, is purposed to sterilize and fill all the canals.

This dubious contention has not been proved by independent experimentation. The author, however, using the Biocalex as a canal medication and not as a filling, has achieved excellent results, especially in infected teeth which it was impossible to root treat by accepted methods, because the canals were not amenable to instrumentation to their apices.

**Biocalex-indications and contra-indications**

1. When the whole pulp is necrotic, with or without periapical lesion. However, Biocalex should never be used in canals in which there is vital pulp tissue, because there can be an acute inflammatory response. Furthermore, it should never be used during the acute phase of a periapical inflammation.

2. Because there is a risk of an acute reaction, the calcium oxide suspension should not be placed further apically than half way down the root canal. Thus, if the canal is wide initially and an instrument can be placed without hindrance to the apical foramen, Biocalex should not be used, unless a sinus is present.
3. Where a root canal appears to be blocked and the blockage is due to uncalcified organic tissue, Biocalex may facilitate subsequent instrumentation as a result of chemical breakdown of the necrotic debris.

4. Pronounced apical curvature of the roots can prevent adequate preparation and debridement of canals. Biocalex has proved to be invaluable for sterilizing and rendering inert the apical necrotic pulp tissue. Clinical evidence to substantiate this statement is found in the early disappearance of a discharging sinus and rapid healing of a periapical area.

Although it has not proved possible to obtain the 600-900 percent expansion, claimed by Bernard, there is a wealth of clinical evidence to substantiate his claims of success. In all probability, the most important factor in relation to healing is the high pH of calcium hydroxide which, following the expansive reaction is deposited in the fine canals and secondary canaliculi. This exerts a bactericidal action and stimulates osteoblastic activity in areas of pathosis around the root. Thus it would appear to provide the conditions needed for the initiation and progress of healing.

A technique for the use of Biocalex

An acute apical periodontitis or periapical abscess must first be brought under control by means of drainage, antibiotic (oral or parenteral), and relief of masticatory stress. The canals are shaped and cleaned to a point approximately half way to the apices or to the point beyond which an instrument cannot be advanced, and it may be necessary, if symptoms are severe, to leave the canal open to the mouth for one or two days until the acute condition has been rendered chronic. At that stage, rubber dam is applied and all the canals are filed as far as the half way point, enlarging them to size 80, if possible. A wide canal will thus accommodate a large reservoir of Biocalex.

The canals is then irrigated with liberal quantities of a 2-5 percent solution of sodium hypochlorite, and this is then washed away with distilled or boiled water. The canal is partly dried leaving the walls moist so that the residual water can react with the calcium oxide. Water straight from the tap should not be used because it contains dissolved gas, which would come out of solution, thus reducing the volume of the expansion.

Biocalex is prepared by incorporating sufficient powder into the liquid to produce a thick creamy paste (719), which is introduced into the canal on a spiral filler, operated at slow speed as it is withdrawn along one wall, and repeating the action until the prepared part of the canal and the pulp chamber are completely filled. The dressing is covered with a piece of pink denture wax and the access cavity is filled with polycarboxylate cement or Cavit (720). No cement which contains eugenol or oil of cloves should be used, because there would be a chelation with calcium oxide to produce calcium eugenolate, thus arresting the expansion on which the action of Biocalex depends.

It is important the occlusal load on the cavity seal be checked before the patient is dismissed, because a severe apical periodontitis could result from a traumatogenic occlusion. Should there be an acute exacerbation between visits - a rare complication if this technique is followed carefully - the Biocalex should be replaced with a corticosteroid/antibiotic preparation.

The Biocalex is removed after 6-8 days and an attempt is made to prepare the remainder of each canal to the level of the apical constriction. If this can be done, the working lengths of the canals are calculated; they are then prepared and dressed with a calcium hydroxide suspension, and filled at the next visit if clean and free from symptoms. In the event that the canals are impassable, a second dressing of Biocalex should be inserted, and replaced finally by a well-condensed gutta percha and AH26 root filling, as far as the original limit of preparation. A radiographic check is made after six months and thenceforward annually.

Success, in the first instance, is demonstrated by the disappearance of a discharging sinus and the restoration of pain-free mastication, and ultimately by radiographic evidence of healing.

Although, in the event of failure, re-treatment with Biocalex is possible, there is no guarantee that the apical part of the canal has not been blocked by sealer, hence a surgical approach would be more appropriate.

Treatment with Biocalex offers no panacea, but it is worth reserving for those difficult teeth which defeat conventional, accepted procedures.
The above material is contained on pages 178-180 of the Color Atlas of Endodontics. Figure 719 was not reproducible. However, figure 720 is reproduced below.

![Diagram of a tooth with labels: Biolex, Cavit]