# Vital root resection on a maxillary first molar

## Report of a case

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Although some investigators imply that pulp-capping procedures have no place in geriatric dentistry, a case is described in which a 61-year-old patient responded successfully to pulp-capping therapy with bridging of the exposure. Nine years later the patient presented a calcium-hydroxide-stimulated bridge that was still functioning to protect a vital pulp which, for the most part, was uninflamed despite many pulp stones.

The technique of vital root resection to be described was first attempted in 1961, and a description of it was subsequently published in 1966.[1] Four cases were evaluated in the initial report. All were successful, with time periods ranging from 1 to 5 years.

After extensive clinical testing, an evaluation was published in 1969,[2] covering ten cases. Nine of these were successful, whereas the tenth case was the first instance of pulpal failure.

Root amputation[3] in modern dental practice has become commonplace. However, the need for endodontic treatment followed by one or more operative procedures makes the technique rather prolonged. In an effort to find a more practical approach, the following investigation was undertaken.

### CASE REPORT

The patient, a 61-year-old woman in good health, was referred for treatment in June, 1961.

Radiographically the tooth in question, a maxillary left first molar, exhibited hopeless irreversible periodontal destruction around the distobuccal root (Fig. 1). Despite furcation involvement, the remaining bone surrounding the mesiobuccal and lingual roots appeared to be healthy. There was little evidence of recession of either tissue or bone, lingually or mesially. Clinically, the attachment and periodontal ligament appeared to be sound from the lingual, mesial, and mesiobuccal aspects; radiographs confirmed these findings. The tooth showed only slight mobility.

All other necessary periodontal treatment on adjacent tissues had been completed previously.

Presented at the seventy-fourth annual scientific session, Southern California Dental Association.

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*Fig. 1.* Tooth prior to resection. Periodontal involvement includes furcation.
*Fig. 2.* View shows tooth immediately after resection and placement of pulpal seal.

## Preoperative testing

The tests for reaction to heat, cold, and palpation were within normal limits, with a slight sensitivity to percussion. Tests with the vitalometer registered 2½ buccally.

## Treatment plan

In the original treatment plan the intention was to treat the tooth endodontically, followed by root amputation. (The tooth was clasped, already serving as an abutment for a cast partial denture.) However, because of normal pulp test reactions during the preoperative evaluation, the decision was made to retain pulpal vitality and avoid endodontic treatment by vitally resecting the distobuccal root.

## Procedure

With the use of a local anesthetic of Xylocaine with 1:50,000 epinephrine, under a normal saline coolant, the distobuccal root was vitally resected to the point of furcation and removed. The area was packed with sterile gauze, and enough time was allowed for clotting in the socket. With an inverted-cone bur, a small preparation was made directly into the freshly severed pulpal tissue and surrounding dentine. Once again the area was packed to allow time for clotting.

To establish a satisfactory seal over the exposed radicular pulp tissue, a calcium-hydroxide capping was accomplished, followed by zinc-oxide-eugenol cement and an amalgam alloy.[4, 5] Extreme care was taken with each additional layer to avoid pressure on the pulp. Radiographs were taken before, during, and at the completion of the procedure (Fig. 2). The patient was dismissed, with instructions to avoid food and liquids for 3 hours and extreme temperatures and mastication on the left side for approximately 1 week.

## Postoperative testing

Three days postoperatively the patient reported that the tooth was asymptomatic and healing in the socket area was progressing normally. Tests with the vitalometer were recorded at 2 buccally.

Seven days postoperatively the patient noted sensitivity to changes in temperature, with cold eliciting the greatest response. This reaction persisted for approximately 2 months. All other tests were within normal limits. Relief on the mesiolingual and distolingual aspects of the distobuccal cusp was completed in order to distribute any stress over the total area of the two remaining roots. The patient was examined every 6 months, with vitalometer testing every year. On each occasion the tooth was without symptoms. Although supporting both clasp and rests, the additional load did not produce any un-

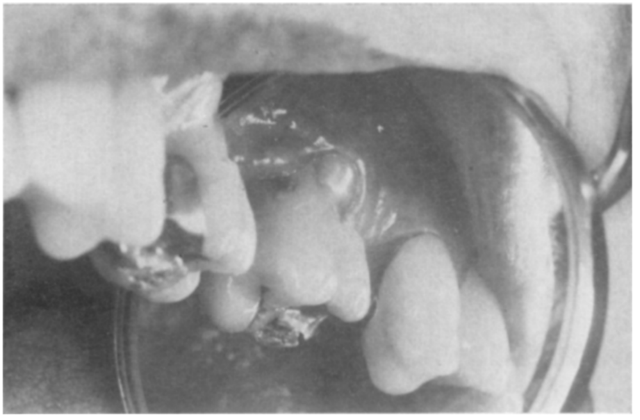

*Fig. 3.* View just before extraction. Restoration can be seen clearly. Tissues exhibit good health. Note the obvious erosion on buccal surface.

*Fig. 4.* Radiograph taken just prior to extraction. Note healthy periodontal ligament.

toward subjective symptoms; nor did the tooth exhibit any appreciable increased mobility as a result.

After 5 years, exhaustive tests showed that the vitality of the tooth was clinically comparable to that of both the adjacent and contralateral teeth in the same arch. The alveolar structures exhibited excellent health and afforded adequate support for the remaining roots.

After 9 years of clinical success, the decision was made to remove the tooth for microscopic evaluation. At the time of extraction, the tooth registered 1½ buccally and 2½ lingually to the electric pulp tester, practically the same as preoperatively. The responses to cold, heat, palpation, and percussion were normal, and the patient described the tooth as being completely asymptomatic. Just prior to extraction, the periodontal tissues exhibited excellent health (Figs. 3 and 4), and only slight mobility of the tooth could be observed.

Immediately after extraction, the tooth was rinsed with normal saline solution and the two remaining root tips were clipped off. Fig. 5 shows the distal surface with the amalgam seal. Deep cervical erosion is again apparent on the buccal surface. The specimen was then placed in a solution of 10 per cent formalin preparatory to sectioning.

## Pathological examination

*Gross examination.*

SPECIMEN A. SCO a 3-rooted molar (maxillary first molar) with the distobuccal root resected. The exposed root canal contained an amalgam restoration. The tooth also had a

Fig. 5

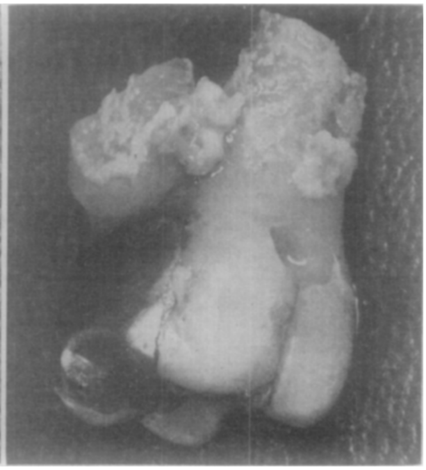

Fig. 6

*Fig. 5.* View shows distal surface with amalgam seal (arrow). Deep cervical erosion is again apparent on buccal surface.

*Fig. 6.* Tooth prepared for fixing. Postextraction Class V preparation may be seen on lingual surface. Root tips have been clipped off to enhance fixation.

large MO amalgam restoration. Erosion was extensive and deep on the labial surface. Some soft tissue was attached between the lingual and mesial roots. No calculus was present. A postextraction unfilled Class V cavity preparation was present on the lingual surface for penetration of formalin (Fig. 6).

SPECIMEN B. This specimen consisted of two root ends.

*Microscopic examination.*

SPECIMEN A. The molar was processed in the usual manner and serially sectioned. As the sections were scanned, starting at Slide No. 43, one could begin to see reparative dentine filling in the former pulp exposure at the level of root resection. By slide No. 49, the orientation was excellent for seeing where the distal root was severed and a plug of immature reparative dentine filled the pulp exposure created by the severance. No vital pulp tissue was seen adjacent to the bridge in this section, however (Fig. 7).

By slide No. 55, vital pulp tissue was seen apical to the dentinal bridge (Fig. 8, *A*). No inflammatory cells were present, only scattered fibroblasts. On the apical margin of the bridge, regenerated odontoblasts could be seen adjacent to the irregular reparative dentine (Fig. 8, *B*). Primary odontoblasts persisted on the other surfaces. With a Masson stain, there was no increase in pulp collagen.

By slide No. 77, there was evidence of continued reparative dentine deposition since pulp stones could be seen incorporated within the expanding calcified mass. The pulp tissue within the chamber contained many stones in all stages of formation accompanied by a Grade II chronic inflammatory response surrounding the pulp stones. In the absence of caries it is difficult to explain the reason for this focus of chronic inflammation in the coronal pulp tissue. Because of the strange texture of some of these pulp stones, it is possible that many of them represented the sequelae of calcium-hydroxide embolism (Fig. 9). The root canal tissue remained vital to the root end, scarred but not inflamed. The attached periodontal tissues were normal and noninflamed.

By slide No. 81 the opposite pulp horn (7 o'clock) could be delineated but was mostly filled in with reparative dentine encompassing additional pulp stones (Fig. 10). At 10 o'clock, where the erosion had created a facet, the stimulus of erosion had caused the pulp chamber to fill in and develop a pseudo-pulp horn. The continued erosion had led to a pulp exposure where neutrophils reached the buccal surface.

In slide No. 85, the exposure caused by erosion made contact with the coronal pulp by way of an interconnecting group of channels containing neutrophils (Fig. 10, *C*).

By slide No. 89, contact was made between the external purulent tract and the coronal

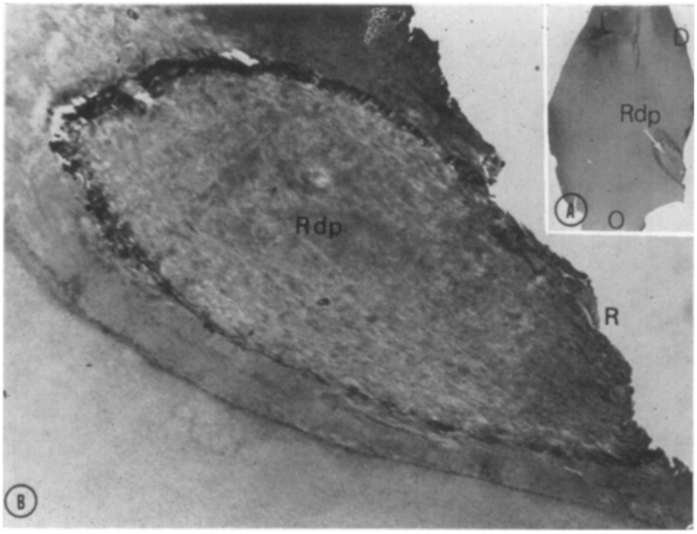


*Fig. 7.* By slide No. 49, the orientation is excellent for seeing where the distal root was severed and a plug of immature reparative dentine fills the pulp exposure. *A*, Slide 50-2; magnification, ×11. *D*, Distal surface; *O*, occlusal surface; *Rdp*, reparative dentine plug. *B*, Slide 49-3, magnification, ×60. *R*, Surface of resection; *Rdp*, reparative dentine plug.

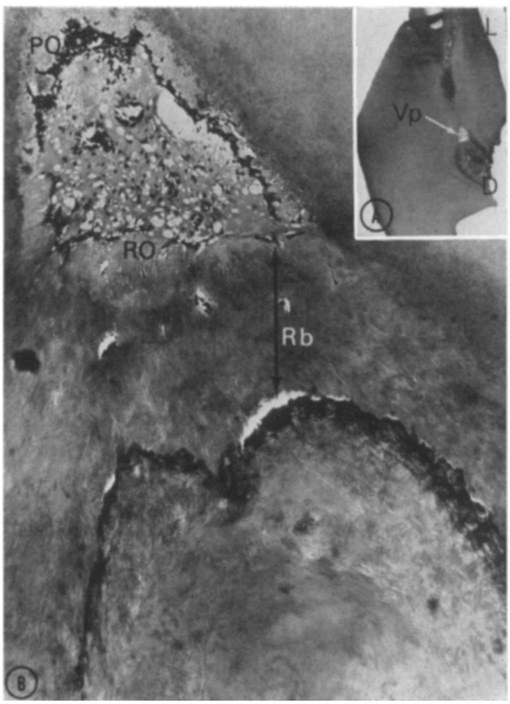


*Fig. 8.* Vital pulp tissue can be seen apical to the dentinal bridge. *A*, Slide 56-3; magnification, ×11. *D*, distal surface; *L*, lingual root; *Vp*, vital pulp. *B*, Slide 55-6; magnification, ×90. A reparative dentine bridge *(Rb)* can be seen with vital pulp tissue apical (above the bridge). Note regenerated odontoblasts *(RO)* on the apical margin of the bridge and the primary odontoblasts *(PO)*.

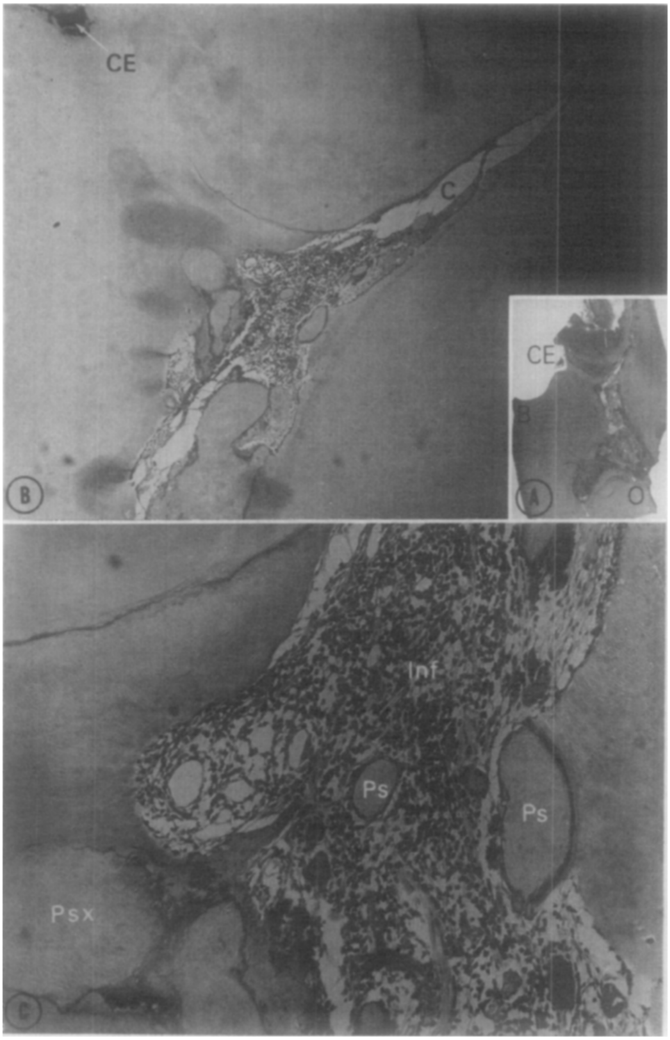


*Fig. 9.* Here there is evidence of continued reparative dentine deposition since pulp stones are being incorporated within the expanding calcified mass. Chronic inflammatory cells infiltrate the remaining pulp tissue in the reduced chamber. *A,* Slide 76-1; magnification, ×11. *O,* Occlusal surface; *CE,* cervical erosion on buccal surface *(B)*. *B,* Slide 77-5; magnification, ×25. The reduced size of the coronal pulp is obvious. Many pulp stones are seen, some free, some adherent, and some incorporated in the drifting effect of the reparative dentine phenomenon. Inflammatory cells can be seen intermingled with the pulp stones and even reaching into the lingual root. *C,* Canal of lingual root; *CE,* area of cervical erosion. *C,* Slide 77-5; magnification, ×120. A higher-power view of *B*. In detail the numerous pulp stones *(Ps)* can be seen. *Psx,* Pulp stones being incorporated within expanding calcified mass. At this power, one can see that some neutrophils are mixed with the chronic inflammatory cells (*Inf,* Grade II inflammatory response).

pulp tissue. An area of necrotic tissue separated the chronically inflamed pulp from the purulence extending from the exposure.

By slide No. 101, the external opening of the exposure was now passed, but a pseudocanal filled with neutrophils persisted.

By slide No. 152, as one moved mesially away from the resected and exposed areas, the coronal pulp persisted above the filled-in pulp horns (Fig. 11, *A*). No root canals were

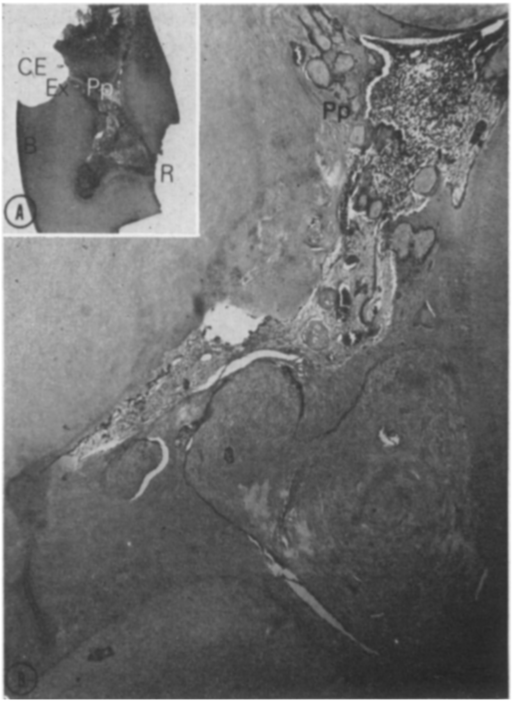


*Fig. 10 A* and *B. A,* Slide 80-6; magnification, ×11. *CE,* Cervical erosion on buccal surface *(B); Pp,* pseudo-pulp horn created by the attempt to protect the pulp from the advancing erosive process; *Ex,* exposure point; *R,* surface of resection. *B,* Slide 81-2; magnification, ×40. At 12 o'clock one can see the outline of the pseudo-pulp horn *(Pp)* with inflammatory cells adjacent to it.

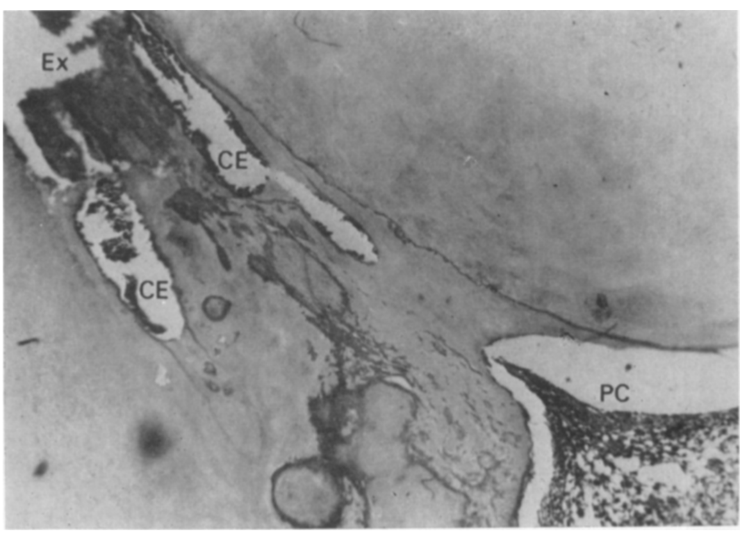


*Fig. 10C.* Slide 85-3; magnification, ×100. The pseudo-pulp horn can be visualized. The remaining channels (*CE,* channels connecting with exposures) within it are transporting neutrophils to the point of exposure *(Ex)* caused by the cervical erosion. *PC,* Pulp in chamber.

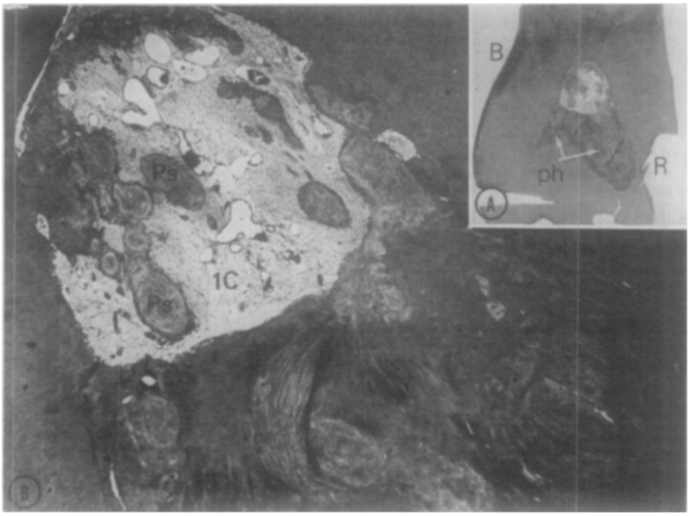


*Fig. 11.* The coronal pulp mesial to the resected and exposed areas is healthy and uninflamed. Pulp stones are numerous, and collagen is increased. *A,* Slide 152-5; magnification, ×11. Intact pulp tissue persists above the filled-in pulp horns *(ph-arrows).* No root canals are evident in this level of sectioning. *B,* Buccal surface; *R,* surface of resection. *B,* Slide 152-5; magnification, ×25. Pulp tissue reveals many pulp stones *(Ps)* and increased amount of collagen *(IC).*

evident. The pulp tissue revealed many pulp stones actively enlarging but no inflammatory cells. The pulp substance was quite collagenized (Fig. 11, *B*).

SPECIMEN B. The pulp of the root ends was vital and scarred and contained dystrophic calcification without inflammatory cells. The diagnoses were (1) partial pulpitis, chronic, with a minute focal exposure due to erosion; (2) pulp stones; (3) dentinal bridge.

## DISCUSSION

Despite severance of at least 25 per cent of the blood supply of the pulp, collateral circulation from the two remaining roots continued to nourish the coronal portion.

This case is unusal in many respects, not the least of which was the age of the patient (61 years) at the time of root resection.

Some investigators imply that pulp-capping procedures have no place in geriatric dentistry. But in this instance, a 61-year-old patient responded successfully to pulp-capping therapy with bridging of the exposure. With a 9-year follow-up, the patient, now 70 years old, presented a calcium-hydroxide–stimulated bridge that was still functioning to protect a vital pulp, for the most part uninflamed despite many pulp stones. No doubt some of these pulp stones were the result of the calcium-hydroxide application, but pulp stones are also very common in the aged. If the erosion had not led to a microscopic pulp exposure, the pulp probably would have been considerably healthier and even less inflamed. It is interesting that the patient did not manifest clinical symptoms, but this is frequently the case when drainage is adequate. No doubt the pulp tissue would have survived for an indeterminate period if the tooth had not been removed for investigative purposes.

Berk and Stanley[6] pointed out, in 1958, that the maturation rate of the callus after pulp-capping procedures required less time in young sound teeth than in older carious teeth. Formation of tubular predentine, could be observed as early as 2 weeks in the sound young teeth, but older teeth required a prolonged production (at least 3 months) of irregular (atubular) predentine or dentine before any evidence of new tubular structure appeared, if at all. Given adequate time, the aged seem to be capable of doing many things that once were considered to be unreasonable.

## Additional clinical suggestions

From the clinical management of subsequent cases, several additional clinical considerations have now been included to augment the original procedure:

(1). Two tablets of Donnatal* may be given one-half hour prior to operation. This tends to relax the patient, but, more important, it controls salivation. The atropine sulfate content (0.0194 mg. per tablet) helps to provide a drier field.

(2). Good judgment dictates that, if possible, the angle for cutting during resection should pass through the radicular, not the coronal, pulp tissue. The amount of root pulp thus exposed will be far smaller in diameter than if the cut is made through the coronal portion. The percentage chance of success should be accordingly greater.

3. After 7 days, a periodontal surgical pack is placed and extended to include at least one or two teeth on either side of the wound, buccally and lingually. The pack is changed approximately every 3 days until 2 weeks have elapsed, thus providing thermal protection for the pulp during its initial healing.

4. Antibiotic therapy may be instituted 2 days prior to operation and continued for 2 days therafter. Erythromycin, 250 mg. every 6 hours, should be satisfactory.

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