Pulpotomy of carious vital teeth with periapical involvement

M. K. ÇALIŞKAN

Department of Endodontics, Ege University Dental Faculty, Bornova, İzmir-Turkey

Summary
Twenty-six permanent vital molars with carious pulp exposures and periapical involvement presenting as radiolucencies or radiopacities on radiographic examination, in patients aged between 10–24 years, were treated using an atraumatic surgical technique with calcium hydroxide alone.

The healing was evaluated using clinical and radiographic criteria: absence of clinical symptoms, sensitivity of the radicular pulp, formation of a hard tissue barrier in the exposed area, resolution of periapical involvement and no intraradicular pathosis radiographically. Assessed by these criteria, successful results were achieved in 24 teeth. The observation period following pulpotomy treatment was 16–72 months. The favourable results of this study demonstrate that pulpotomy treatment in teeth with cariously exposed vital pulps and with periapical involvement may be an alternative treatment to root canal therapy.

Keywords: calcium hydroxide, periapical healing, pulpotomy

Introduction
Vital pulp therapy consists of pulp capping and pulpotomy. The aim of these treatment methods is to preserve the vitality and function of the coronal or remaining radicular pulp tissue. Calcium hydroxide has been the drug of choice for use in vital treatment, but the exact mechanism for its action is still not understood (Berk & Krakow 1972, Stanley 1989).

A pulpotomy is still the preferred treatment for an open apex. This is regarded as a temporary treatment that should be followed by pulpectomy, when the root development is completed (Langeland et al. 1971).

Grossman et al. 1988). However, the success of pulpotomy employed for the treatment of cariously or traumatically exposed inflamed pulps, regardless of whether the apex was open or closed has been demonstrated in clinical (Cvek 1978, Santini 1986, Çalışkan & Sabah 1992, Çalışkan 1993, Çalışkan & Sepetçioglu 1993) and histological studies (Masterton 1966, Cvek & Lundberg 1983).

There is also evidence in the literature that some carious teeth with vital pulps and periapical lesions can be treated by pulpotomy (Russo et al. 1982, Moule & Oswald 1983) or even indirect and direct pulp capping (Moore 1967, Sapone 1976, Jordan et al. 1978). The purpose of this clinical study was to evaluate the success of pulpotomy clinically and radiographically in permanent mature teeth with cariously exposed vital pulps and periapical involvement.

Materials and methods
The material consisted of 26 permanent teeth (20 mandibular and six maxillary molars) in 25 patients ranging in age from 10 to 24 years. At the first examination before the treatment, the teeth included cariously exposed pulps (four teeth with pulp polyps) and all had periapical radiolucencies involving one or more roots radiographically, except three cases with osteosclerosis. The teeth responded within normal limits to an electrical pulp test while the four with extensive caries showed a delayed response. There was no mobility and tenderness to percussion. Generally, the teeth were symptomless, except during mastication when pressure of the food bolus caused mild pain in some patients. No history of spontaneous, prolonged pain was noted. The patients were systemically healthy and the teeth had no previous operative treatment.

The pulpotomy procedure was standardized in the following way. All procedures were performed under block anaesthesia using an anaesthetic solution without vasoconstrictor (Citanest; Eczacibaşı, İstanbul, Turkey).
After isolation with rubber dam, the carious dentine was removed and the pulp at the junction of the coronal and the radicular pulp was amputated with ISO no. 010–012 cylindrical and ISO no. 018–021 cone-shaped sterile diamond burs in a high-speed handpiece under continuous irrigation with sterile saline solution. Bleeding was controlled by using saline solution and sterile cotton pellets with slight pressure. Pure calcium hydroxide (Merck, Darmstadt, Germany) mixed with distilled water was placed against the wound surface to ensure tissue contact. The cavity was sealed with zinc oxide–eugenol cement (Austenal Dental Products Ltd, UK) and high copper amalgam (Contour Kerr, Romulus, MI, USA).

The teeth were reviewed clinically and radiographically 2 months after the treatment and thereafter at 3- or 4-month intervals for up to 1 year and then at further intervals, until the end of the study. The treatment was considered successful if the following criteria were met: no clinical symptoms; sensitivity to electric stimulation; presence of a dentine bridge detected clinically and sometimes observed radiographically; complete resolution of the periapical radiolucency and osteosclerosis; absence of any intraradicular radiographic pathosis.

The follow-up examination ranged from 16 to 72 months. In 12 instances, it was more than 24 months.

Results

After removing the restorations of 24 teeth after 6–9 months, under aseptic conditions, a complete dentine bridge was detected clinically and remaining radicular pulp responded positively to electrical pulp testing. In addition to these healing criteria, the periapical radiolucencies associated with 21 teeth had disappeared (Figs 1 and 2). In the other three cases with periapical osteosclerosis, reappearance of the lamina dura and resolution of the zone of osteosclerosis was also observed radiographically (Fig. 3). Failures such as internal dentine resorption, obliteration of the root canal and recurrence of periapical involvements were not observed radiographically 16–72 months after treatment. Failure after pulpotomy was observed in only two teeth. In one of the unsuccessful cases the patient had spontaneous pain two weeks after treatment. The tooth was tender to percussion clinically and was not sensitive to electrical stimulation. Radiographically disclosed enlargement of the periapical lesion. In the second case, necrosis of the pulp occurred without clinical symptoms 6 weeks after treatment. These teeth were treated with root canal treatment.

Discussion

In general, clinicians agree that radiographically demonstrable periapical involvement is always associated with total pulp necrosis or irreversible pulpitis. The first recommended treatment in irreversible pulpal pathological conditions is root canal therapy or even extraction (Grossman 1974, Smulson & Sieraski 1989).

Regardless of radiographic involvement of the apical area of the teeth in the present study, chronic open pulpitis (hyperplastic or ulcerative pulpitis) was diagnosed, which is considered as irreversible pulpitis in

Fig. 1. a. Periapical radiograph showing mandibular left first molar with radiolucencies in the apical region of both mesial and distal roots. Radiograph taken immediately after pulpotomy and placement of restoration (arrows). b. Follow-up 36 months after pulpotomy treatment. Periapical radiograph showing healing of periapical tissues and restoration of the integrity of the lamina dura.
the literature (Smulson & Sieraski 1989). However, it has been suggested that in these two diseases, the chronic response may be limited to the pulp chamber and that the apical pulpal tissue may be normal, except for some vasodilation and minimal chronic inflammation (Spouge 1973, Grossman 1974, Walton et al 1985, Smulson & Sieraski 1989).

It has been reported that chronic pulpitis associated with periapical involvement presenting as radiolucenty on radiographic examination or radiopacities often exhibit pulp vitality (Jordon et al. 1978, Russo et al. 1982, Bender & Mori 1985, Smulson & Sieraski 1989). Histological studies have shown that early periapical pathosis may not be necessarily associated with total pulp necrosis (Mitchell & Taraplee 1960, Langeland 1981) and that some teeth with periapical radio-
lucencies had vital pulps with few inflammatory cells in the apical portion of their root canals (Russo et al. 1982).

Moore (1967) and Sapone (1976) demonstrated that even indirect or direct pulp capping was effective in treating teeth with vital pulps and periapical lesions. Jordon et al. (1978) also obtained nearly 50% success after this conservative management. After pulpotomy of teeth with extensive cariously exposed pulps (Foreman 1980, Moule & Oswald 1983), or with hyperplastic pulpitis (Çaşkan 1993), the resolution of periapical lesions radiographically has also been demonstrated in a few cases. The similarity between this present study and those clinical studies (Jordon et al. 1978, Russo et al.
1982) was the young age of the patients, in which the young pulp tissue does not become necrotic following exposure because its natural defences and rich blood supply allow it to resist bacterial infection (Kim & Trowbridge 1987). As there is adequate drainage, no build up of intrapulpal pressure occurs in an open chronic pulpitis, so that the final tissue breakdown is delayed (Walton et al. 1985).

Clinical studies have demonstrated that the original state of the pulp and individual’s immunological capacity are probably more important than the size and the exact time of exposure of the pulp to the oral environment before vital pulp treatment (Masterton 1966, Čevk 1978, Russo et al. 1982, Çalışkan & Sabah 1992, Çalışkan 1993, Çalışkan & Sepetçioğlu 1993).

Russo et al. (1982) showed a healing process radiographically and histologically in teeth with inflamed pulps and periapical lesions following pulpotomy. They also suggested that the success rate was increased if a pulpotomy was performed using an anti-inflammatory dressing followed by calcium hydroxide. However, in addition to the original state of the pulp, many factors could influence the final outcome of pulpotomy, including the amputation technique, the extra-pulpal blood clot, the type of anaesthetic solutions used, the choice of material placed over the pulpotomized pulp and the appropriate restorative material (Schröder 1973, Baum & Holz 1981).

By using an anaesthetic solution without vasconstrictor, no circulatory disturbances occurred (Massler 1972, Santini 1986), the use of an atraumatic surgical technique for the removal of coronal inflamed pulp tissue prevents damage to the underlying radicular pulp tissue (Granath & Hagman 1971) and paste-type calcium hydroxide material is consistent in promoting healing of pulp exposures (Lim & Kirk 1987). In addition to the better wound control with pulpotomy, the operational area was effectively protected by zinc oxide-eugenol cement (Langer et al. 1970, Holland et al. 1981). These above-mentioned processes provide a better healing potential for the pulp.

The major problem in pretreatment diagnosis is to distinguish clinically between reversible and irreversible pulpitis, as there is a lack of correlation between the clinical findings and the histopathological condition of the pulp (Dummer et al. 1980, Langeland 1981, Hayman & Cohen 1984).

While some authors have limited the indications of vital pulp therapy by suggesting many conservative clinical criteria (Langeland et al. 1971, Seltzer & Bender 1976, Weine 1989), others have claimed the success rates of between 80% and 96% of vital pulp therapy in clinical studies, regardless of criteria (Cvek 1978, Haskell et al. 1978, Horsted et al. 1985, Lim & Kirk 1987, Stanley 1989, Çalışkan & Sabah 1992, Çalışkan 1993). These figures compare favourably with the success rate of 85–90% that can be expected from root canal treatment (Swartz et al. 1983).

Conclusion

The results of this clinical study have shown the success of pulpotomy which was performed using an atraumatic amputation technique followed by dressing with calcium hydroxide alone in teeth with cariously exposed vital pulps and periapical radiolucencies or osteosclerosis. Resolution of the periapical osteosclerosis and a return to a normal trabecular bony pattern and healthy periodontal ligament space and, in addition, dentine bridge formation was observed in the cases with periapical involvement. Similar observations, after pulp capping procedures, have also been made by Sapone (1976), Jordan et al. (1978) and Bender & Mori (1985).

The clinical observation of healing in both this and previous studies was confirmed and it is concluded that the indication for vital pulp therapy may be greater than previously has been thought.

References


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