Vital amputation of permanent teeth

The vital amputation (VA) of deciduous teeth with the goal of maintaining their function for a limited period is a widely accepted measure. Vital amputations of permanents, however, is only ap-proved for limited indications. While teeth can be amputated free of calculi hydroxide Ca(OH)2 and mineral trioxide aggregate (MTA) are recommended for VAs, formaldehyde CH2O containing agents are a controversial subject.

The European Society of Endodontontology (ESE) defines pulp amputation as a procedure during which part of the exposed vital pulp tissue is removed with the aim of maintaining vitality and function of the remaining parts of the pulp. The ESE recognises the following indications for VAs (i.e. pulpotomy):

1. treatment of deciduous teeth; 2. treatment of permanents with incomplete root growth; and 3. emergency measure.

Indications 2 and 3 include the option of a later definitive root-canal treatment (RCT). Seidler recommends VA for the accidentally opened pulp of young molars and extremely curved, narrow root canals. Stern considers difficulty in opening the mouth an indication for VA of molars.

McDougal et al. extend the indication for pulpotomy when there are dental concerns, as some patients are unable or unwilling to bear the expense of a RCT. According to Swift et al., a successful VA may be expected following non-perforated CH2O-salts, glutaraldehyde, ferrous sulphate, zinc oxide eugenol and polycarboxylate cement. Salako et al. compared MTA, formocresol, ferrous sulphate and bin-actively glass with regard to their pulpotomy compatibility and found MTA to be the ideal pulpotomy agent. Actors that contain CH2O are recommended for deciduous and permanent teeth. Massler et al. report a clinical success rate of 92% following VA with CH2O. Taking post-operative X-rays into account, the success rate was reduced to 75% after 6 months and grouped to 65% after two to five years.

McDougal et al. report on 75 endodontically sound permanent molars and premolars. A clinical success rate of 90% after six months and 78% after 12 months was observed. The teeth, which were amputated at the primary pain at check-up, were diagnostically controlled and it was shown that 49% of the teeth were free of pathological findings after six months and 42% after 12 months.

According to Jensen, pulpotomy is an attempt to stimulate hard tissue healing at the area of amputation.6 Fountain andCamp point out that a pulpotomy may result in canal calcification, internal resorption or necrosis of the pulp.8 Kozlow andMassler refer to literature that reports the formation of a dentine bridge in rat teeth under non-calcium-containing materials, such as wax, amalgam, acrylic resin and zinc oxide eugenol.9 In human teeth, the bridging under Ca(OH)2 was successful in 45% of the cases.10 Pathologies occurred in 23% of the cases. During their own tests on rat teeth, the authors assessed good reparative reactions with complete bridging following pulpotomy with Ca(OH)2, zinc oxide eugenol, cortisone and silver amalgam.

According to Alcam, various materials are recommended for pulpotomy: Ca(OH)2, formocresol, glutaraldehyde, ferrous sulphate, zinc oxide eugenol and polycarboxylate cement.10 Salako et al. compared MTA, formocresol, ferrous sulphate and bin-actively glass with regard to their pulpotomy compatibility and found MTA to be the ideal pulpotomy agent.11 Actors that contain CH2O are recommended for deciduous and permanent teeth. Massler et al. report a clinical success rate of 92% following VA with CH2O. Taking post-operative X-rays into account, the success rate was reduced to 75% after 6 months and grouped to 65% after two to five years.

The authors suggest several reasons for this failure: pulpotomy is already heavily inflated initially; too much pressure applied during application; and disposal of the blood coagulum via haemostatic agents.

Mejare andCvek performed partial pulpotomies using Ca(OH)2 on 57 permanent teeth (55 molars, 2 premolars).15 The patients were six to 15 years old and their pulpotomies had to be performed at least two years prior to inclusion in the study. Check-ups were performed at an average of 56 months (24 to 140). The teeth were separated into two groups (Table 1). Two failures occurred in the first group, in teeth with incomplete root growth (after ten days and 48 months). The other 29 teeth (95.5%) were treated successfully. In the second group, two failures occurred (after 10 and 24 months) in teeth with periodontal gap enlargement (one tooth with complete root growth and the other with incomplete root growth).

Molen states that there were no pathological findings in 1,391 root-filled roots in 51.6% of the cases and in 256 pulpotomized roots in 65% of the cases.14 Asgary andEghbal report the successful use of a new VA agent called CEM, a cement mixture enriched with Ca, in 205 pulpotomies on molars.15 For comparison, 202 molars were extrapiliated vitally. The root-canal filling (RCF) was performed via lateral condensation with AH Plus (DENTSPLY DeTrey) as sealant. After seven days, 58% of the pulpotomy-treated and 60% of the root-canal-treated patients reported needing analgesics. After six months, 89.94% of the patients underwent a radiological check-up. The pulpotomy patients revealed a significantly higher success rate (p<0.001).

The most frequently used VA agent for deciduous teeth is formocresol, a mix of CH2O, cresol, glycerine and water. A survey showed that formocresol pulpotomies on deciduous teeth were performed by general dentists in 75% of the cases and by paediatric dentists in 25% of the cases.16 The frequency of use on permanent teeth was lower: 18.9% for general and 55.4% for paediatric dentists.

Fisch published the results of pulp amputations of 600 teeth, which were performed with the CH2O-containing preparation Triospal.17 Check-ups were done between six months and 18 years after amputation. Examination of the X-ray controls revealed a patho-logical apex in 9%. Eleven teeth were histologically examined. Hard substance formation was observed in the form of apical foramen closures and apposition at the lateral canal walls, which partially led to obliterator-ation of the canal lumen.

During an accelerated test lasting up to 2.5 months, Overdieck tested N2 as CH2O-containing VA agent on human teeth. He observed that for several weeks following application there was a possibility of a hard substance barrier forming.18 Over a period of 12 years, Stern carried out 175 N2 pulpotomies under relative isolation on teeth with complete root growth, regardless of possible anamnestic pain. Fifteen per cent of the patients experienced increased pain after treatment, which subsided within 48 hours. Four patients, however, developed pulpsitis, which resulted in the extraction of three teeth and conservative RCT of one tooth. Stern was able to track the outcome of 55 vitally amputated teeth over a longer period. During the course of check-ups, two teeth were extracted, one of them due to a fracture. Five years after treatment, Stern observed advanced calcification of the nerve channels.

Frankl considers the advantage of pulpotomy compared with RCT as there being no instrument fractures or perforations during pulpotomy. A possible failure could always be countered with a RCT. He asserts that Ca(OH)2 pulpotomies can be successful only if teeth are asymptomatic prior to treatment and if accidentally opened pulp and, therefore, bleeding from the pulp.
According to the literature, N2 cases on deciduous teeth contain significantly fewer failures than Ca(OH)2 pulpotomy. Therefore, Frankl performed N2 pulpotomies on permanent teeth as well.19,20 He selected only asymptomatic teeth whose pulp had not been previously exposed for treatment. The treatment was performed under a rubber dam and thus pulp bleeding did not have any effect. Two hundred and fifty cases were re-examined for up to 16 years, and 202 patients were between 22 and 35 years. Failures manifested by pain in 48 hours amounted to 2%. The aim of the following study was to analyse the success and risks of N2 pulpotomies on permanent molars, and to compare these rates with vital molar extractions done within the same period.

Material and method

The study was conducted in my dental practice, which is located in a rural area. Between 1990 and 1998, 959 N2 Cases and 945 Ca(OH)2 pulpotomies (Table I) were performed on permanent molars, and to compare these rates with vital molar extractions done within the same period.

Table I

<table>
<thead>
<tr>
<th>Age</th>
<th>N2</th>
<th>Ca(OH)2</th>
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<tbody>
<tr>
<td>0-10</td>
<td>120</td>
<td>236</td>
</tr>
<tr>
<td>11-20</td>
<td>181</td>
<td>265</td>
</tr>
<tr>
<td>21-30</td>
<td>226</td>
<td>369</td>
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<tr>
<td>31-40</td>
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<td>211</td>
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<td>41-50</td>
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<tr>
<td>51-60</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>61-70</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>

Results

Of the N2 patients 47.6% were male and of the VE patients 52.4% were male. The practice owner treated 70.1% (n=498) of the VA patients and all the rest were treated by an assistant. The average age of VA patients was 45.6 years and that of VE patients was 50.6 years. The average observation period was 55.5 months (max 165) for VA and 49.4 months (max 169) for VE. Of the 710 VA cases 546 (77.1%) and of the 852 VE cases 496 (58.1%) were subject to follow-up X-ray controls.

A total of 61 VA and 77 VE failures were registered and classified as without accompanying X-ray (Mi1) or with accompanying X-ray (Mi2). Fifty-one of the VI VE failures were followed-up with X-rays. Not all of the accompanying X-rays of the Mi2 failures revealed a failure. Two VA patients with X-rays and ten VE X-ray failures were wrongly evaluated as negative. Ten VA MI1 cases were removed because pain, three of them within a few hours after VA. In two cases, a granuloma at an extracted root was indicated in the patient files. In two additional cases, the extraction failed after six and 11 hours, respectively. In 16 of the VE cases, extractions were performed because of pain (one case 4 months after VE). Patients who visited the practice after pulpotomy made a negative reference to anamnestic symptoms.

Anamnestic pain causing an increased frequency of failure in VA cases, which was also observed by Teixeira et al. following Ca(OH)2 treatment.8 was statistically significant. However, the extraction reason “endodontic failure” varied in 50% of the probability rate of the VE teeth as compared to the VA teeth. Anamnestic pain causing an increased frequency of failure in VA cases, which was also observed by Teixeira et al. following Ca(OH)2 treatment.8 was statistically significant.

Discussion

A direct comparison between VAs and VE cases, especially as regards incomplete root fillings, was only possible in certain limits, as the number of VAs consisted mainly of a negative selection, which would otherwise have been even larger. The twice as high extraction frequency of Vital amputations compared to the VA cases was due to the vital extripated teeth (28.6% versus 14.4%) may be attributed to the adverse base-line situation. Fractured or destroyed teeth were the reason for extraction for 51.9% of all VA cases and in 23.3% of the VE case. Anamnestic pain causing an increased frequency of failure in VA cases, which was also observed by Teixeira et al. following Ca(OH)2 treatment.8 was statistically significant. However, the extraction reason “endodontic failure” varied in 50% of the probability rate of the VE teeth as compared to the VA teeth. Anamnestic pain causing an increased frequency of failure in VA cases, which was also observed by Teixeira et al. following Ca(OH)2 treatment.8 was statistically significant.

A comparison of 710 N2 VA cases and 852 N2 root-filled molars after VA was done. The average follow-up period was 7.4 years for VAs and 4.9 for VEs. The total failure rate (radiological and clinical) was 14.4% for VA and 11.9% for VE. Previously, Fisch encountered with the Trispian 17. Frankl reports only 2% of failures after N2 VA, although he had done strin- gent exclusions and selection, 10.20 In contrast, the radiological-pathologi- cal findings concerning pulp necrosis in pain-free teeth amounted to 9% after extraction.4 Fifty per cent of all Ca(OH)2 pulpotomies are statistically significant compared to failure in eight to 10 months.7 Massler et al. showed total failure of 5% to two years after Ca(OH)2VEs.12

The correlation between failure and VE were investigated. Ade- quately filled teeth (-1.2 apicad) showed a failure rate of 2.1% and underfilled teeth a rate of 22.1%. Hence, the conclusion may be drawn that the underfilled root filling corresponds to the one of properly performed root fillings following VEs, and is far superior to a no- ticeably underfilled root filling. Molven attributes a more favourable apical situation to pulp necrosed than to root- filled crowns.14

In their study, Asgari and Eghbali did not explain the techni- cal performance of the RCF15. However, they ex- tailish that pulpotomies are statistically sig- nificantly superior to RCFs of vi- tal teeth, whereas the behaviour of vital teeth is neither defined nor nu- merically expressed. Additionally, the follow-up time of six months is considered very brief.

Summary

A comparison of 710 N2 VA cases and 852 N2 root-filled molars after VA was done. The average follow-up period was 7.4 years for VAs and 4.9 for VEs. The total failure rate (radiological and clinical) was 14.4% for VA and 11.9% for VE. Previously, Fisch encountered with the Trispian 17. Frankl reports only 2% of failures after N2 VA, although he had done strict- engent exclusions and selection, 10.20 In contrast, the radiological-pathologi- cal findings concerning pulp necrosis in pain-free teeth amounted to 9% after extraction.4 Fifty per cent of all Ca(OH)2 pulpotomies are statistically significant compared to failure in eight to 10 months.7 Massler et al. showed total failure of 5% to two years after Ca(OH)2VEs.12

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The practice

The patient should be advised of possible pain fol- lowing the subsiding anaesthetic effect. Analgesia is usually indicated. An N2 VA is more successful than an insufficient root filling after VA. Vital amputation is in- dicated in cases of almost inaccessible canal systems, open apical foramina and for eco-nomic rea- sons.

Instead of an extraction or the inadequacy of a VA, apice- out root filling, it is possible to consider—besides a full pulpo- tomies, which was the subject of this study—to a partial pulpotomy on:

- upper molars: VA of the buc- cal canals, filling of the pal- linal root;
- lower molars: VA of the mesial canal, filling of the distal root; and
- deep crown margin caries, partial removal of the pulp cavum.

TABLE VE: Failures of molars according to RCF-Fractions.