Germany

The vital amputation (VA) of deciduous teeth with the goal of maintaining vitality for a limited period is a controversial subject. While the European Society of Endodontology (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: formaldehyde (CH₂O) containing agents are a controversial subject.

The European Society of Endodontology (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.1 ESE recognises the following indications for VAs: (i) pulpotomy: (a) treatment of deciduous teeth; (b) treatment of permanent teeth with incomplete root growth; and (c) 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.2 Sterngold considers difficulty in opening the mouth an indication for VAs.3,4,5 McDougall et al. extend the indication for pulpotomy when there are economic concerns, as some patients are unable or unwilling to bear the expense of a RCT.6

According to Swift et al., a successful VA may be expected following complete root resorption and a carious pulp exposure.5 We consider predictable success with the following prerequisites: (a) non-inflamed pulp; (b) bacteria-proof closure; and (c) use of a pulp-compatible capping material.

Seidler states the following regarding the success of VA:2

- A higher rate of success is observed in cases of iatrogenic pulp exposure.
- Treatment success is reduced in cases of complete root growth.
- Molars are more successfully treated than incisors.

For a pulpotomy with Ca(OH)₂, Jensen presupposes that there is no pain present anamnestically.6 Teixeira et al. corroborate the significance of pain prior to VA.7 In their study of 41 Ca(OH)₂ vitally amputated permanent teeth, anamnestic pain existed in 12 cases. The pulpotomies of these aching teeth led to failure after six to eight months in 50% of the cases (n=6), while all other vitally amputated teeth were considered successfully treated.

McDougall et al. report on 75 euthanized rat pulpotomies on achting permanent molars and premolars.4 A clinical success rate of 90.7% after six months and 78.2% after 12 months was observed. The teeth, which were separated into two groups (Table I), failed to be repaired reproductively five times with Ca(OH)₂ and four times with ZOE. Cortisone and silver amalgam.

According to Acamam, various materials are recommended for pulpotomy: Ca(OH)₂, formocresol, glutaraldehyde, ferrous sulphate, zinc oxide eugenol and polycarboxylate cement.10 Salako et al. compared parapulotomies and parapulpomies, having a significantly higher success rate of 25% in 23% of the cases. During their own tests on rat teeth, the authors assessed good reparative reactions with complete bridging following parapulpotomy with Ca(OH)₂, zinc oxide eugenol, cortisone and silver amalgam.

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Assuming that CEM is a cement mixture enriched with Ca, in 205 pulpotomies on molars, 15 for comparison, 202 molars were extripated vitally. The root-—canal filling (RCT) was performed via lateral condensation with AH Plus (DENTSPLY DeTrey) as sealer. After seven days, 58% of the pulpomies were extripated and 60% of the root—canal—treated patients reported needling analgesics. After six months, 88.94% of the patients underwent a radiologial checkup. The pulpomies 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 pulp—tomies on deciduous teeth were performed by general dentists in 75% of the cases and by paediatric dentists in 98.2% 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 Tropicare.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 obliteration 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 N₂ application there was a possibility of a hard substance barrier forming.18

Over a period of 12 years, Stern carried out 175 N₂ pulpomies under relative isolation on teeth with complete root growth, regardless of possible anamnetic pain. Fifty percent of the patients experienced increased pain after treatment, which subsided within 48 hours. Four patients, however, developed pulpsitis, which resulted in the extraction of the remaining 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.19 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 for accidentally opened pulp and, therefore, bleeding from the pulp.
According to the literature, N2 is used on deciduous teeth when significant apical periodontal abscesses are found or failures of Ca(OH)2 pulpotomy. Therefore, Frankl performed N2 pulpotomies on permanent teeth as well.19,20 He selected only asymptomatic teeth whose pulp had been incidentally 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 the present study and the rest of the patients ranged between 22 and 55 years. Failures manifested by pain in within 48 hours amounted to 2%. The aim of the following study was to analyse the success and failure rates of N2/Va pulpotomies and N2/X-rays 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 1995 and 1997, 283 N2 and N2/Va pulpotomies were performed on 112 vital deciduous teeth.12 The failure rates were then determined from this sum. The statistical analysis was performed using SPSS (version 18).

Results

Of the VA patients 47.6% were male and of the VE patients 52.4% were male. The practice owner treated 70.1% (n = 489) 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 months (max. 165) for VA and 49.4 months (max. 169) for VE. Of the 710 VA cases, 535 (74%) 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 non-vital pulpotomy failures.17 In 51 cases, apical and periradicular radiographic findings were diagnosed (X-ray). Fifty of the 61 VE failures were followed-up with X-rays. Not all of the accompanying X-rays of the Mi2 failures revealed a failure. Two VA failures, X-rays and ten VE failure X-rays were wrongly evaluated as negative. Ten VA Mi failures were removed because of 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 followed after six and 11 days. In 12 of the 16 VE cases, extractions were performed because of pain (one day after VE). Patients who visited the practice after pulpotomy failed to make a negative reference to anamnestic symptomatic pain. 241 times and 157 times, respectively. Subsequently, the failure rate was 10.8% (n = 26) in the test group and 7.0% (n = 11) in the latter case. The difference was in- significant statistically (p = 0.114).

The failure diagnosis after VA was most frequently made for the lower second molar (14.8%) and after VE for the lower first molar (19%). The lower wisdom teeth were conspicuous because the failure rate was only 4.7% after VA, and no failure at all was observed. Not every failure diagnosis led to therapeutic consequences such as extractions.

Altogether, 206 (28.6%) VA and 125 (14.4%) VE X-rays were extracted during the follow-up phase (statistically insignificant difference; p = 0.000). The largest number of extractions, namely 51.9% (n = 107) of the VA cases (50.6% [n = 57] of the VE cases) were performed because the teeth had been destroyed or fractured. The lower wisdom teeth were the most frequently affected in the case of pulpotomy (61.8% [n = 21]) and the upper second molars in the case of VE (84% [n = 16]).

A failure was decisive for the removal of 25.3% (n = 48) of the failures due to filled root canals, 47.4% (n = 85) due to unprepared root canals, 5.9% (n = 11) due to remnants of the pulpotomy material, and 27.5% (n = 50) due to inadequate root filling of the cuspal horns. In the case of pulpotomy, the lower teeth were removed twice as high extraction frequency (42.7% versus 21.1%) in the pulpotomy group compared with that of vitaly extricated teeth (28.6% versus 14.4%). This was not statistically significant.

For the practice

The patient should be advised whether the VE level following VA had any significance with regard to the failure rate was pur- sued. The BCF levels were divided into three levels. The total failure of these three groups was calculated as described under material and method (Table V).

Without considering the indication range, anamnestic symptoms, tooth position and BCF level, the total failure rate was 11.9% for 13 VA versus 15% for VE (statistically insignificant; p = 0.064). The VE failure rate of the BCF level 1 corresponded exactly to the VA failure rate of 11.9%. There was no statistically significant difference (p = 0.220) in failure rate between VE levels -4, -3, -2 and -1. The BCF level of -5 showed significantly more failures (p-comparisons with the BCF level of -4, -3, p = 0.029) and -2, -1 and 0 (p = 0.002).

Discussion

A direct comparison between VA and VEs, especially as regards incomplete root fillings, was only possible in a certain range, namely, as the number of VEs consisted mainly of a negative selection, which otherwise would have been excluded in the study. The twice as high extraction frequency of vitaly amputated teeth compared with that of vitally extricated teeth (28.6% versus 14.4%) may be attributed to the adverse healing and reaction of the root canal system. Fractured or destroyed teeth were the reason for extraction for 51.9% of all failures in the case of VEs and 34% in the case of VA failures. This was observed during our study as well. Neverthe- less, the total failure rate for vitally amputated teeth was lower (11.9%) than for VA failures (15.1%) for vitally extricated teeth.

The evaluation of pulpotomy cases only with ac- accompanying X-rays revealed a failure rate of 10.1%, which is comparable to the 9% Fish encountered with the Triopaste.17 Frankl reports only 2% failures after N2 VA, although he had done strin- gent selection, 10.20 In contrast, the radiological-pathologi- cal findings concerning pulp vitality in pain-free teeth amounted to 50%.14 Forty per cent of all VA/VE pulpotomies resulted in failure after six to eight months.7 Massler et al. observed a total failure of 65% in 2 to five years after Ca(OH)2 VA/VE.12

The correlation between failure and BCF level following VEs was investigated. Adequate filled teeth (-2, -1 ad Impress) showed a failure rate of 0.6%. Inadequate filled teeth (0 or 1) a failure rate of 22.1%. Hence, the conclusion may be drawn that the failure rate of the studied teeth corresponds to the one of properly per- formed root fillings following VEs, and is far superior to a no- ticeably underfilled root filling. Molven attributes a more favourable peri-apical situation to pulpotomised than to root- filled crowns.14

In their study, Assgary and Eichmann do not explain the techni- cal performance of the BCF.15 However, they ex- habits that pulpotomies are statistically sig- nificantly superior to RCGs of vi- tal teeth. Endodontic failure is neither defined nor nu- merically expressed. Additionally, the failure rates of six months is considered very brief.

Summary

A comparison of 710 N2 VA and 852 N2 root- filled molars af- ter VE was done. The average fol- low-up period was 53.8 months for VAs and 49.4 for VE. The total failure rate (radiographical and clinical performance of the RCF) was 11.9% for 13 VA versus 15% for VE (statistically insignificant). VE failures com- pared with the BCF level of -4, -3, p = 0.029) and -2, -1 and 0 (p = 0.002). The VE failure rate of the BCF level 1 corresponded exactly to the VA failure rate of 11.9%. There was no statistically significant difference (p = 0.220) in failure rate between VE levels -4, -3, -2 and -1. The BCF level of -5 showed significantly more failures (p-comparisons with the BCF level of -4, -3, p = 0.029) and -2, -1 and 0 (p = 0.002).

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