Root canal treatment as a treatment modality for temporary tooth retention in adolescent patients
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In certain cases root canal treatment may be an adequate intermediate therapy, mainly for severely traumatized teeth in adolescent patients that probably cannot be retained permanently. The treatment aims at temporary retention of otherwise hopeless teeth until definite treatment, for example insertion of bridges or dental implants, may be performed. This kind of treatment can help to avoid the application of removable prostheses in young patients. This treatment modality requires intensive information to be presented to the patients and their parents on the benefits and risks of the treatment procedures, endodontic treatment under aseptic conditions respecting the general guidelines for root canal treatment, and a strict recall regimen to avoid occurrence or increase of pathological conditions. Four cases (five teeth) of temporary tooth retention by endodontic treatment are presented.

INTRODUCTION

Root canal treatment in the permanent dentition aims at the long term retention of teeth with an irreversibly damaged pulp or pulp necrosis. If it seems impossible to reach this goal root canal treatment of such teeth is not recommended. The following case reports will demonstrate that root canal treatment also may be performed on a short term base in certain cases. This modification of therapy mainly addresses juvenile patients in whom alternative treatment options, such as bridgework, dental implants, combined endodontic-surgical procedures seem not indicated because of medical, psychological or orthodontic reasons or because of poor oral hygiene. Endodontic therapy in such cases may be a valuable adjunct to retain teeth with a poor long term prognosis until definite treatment may be performed without traumatizing adolescent patients by removable prostheses or preparation of healthy teeth.

CASE 1

A 16-year-old female patient presented at the Dental Clinics with a draining sinus tract in the buccal mucosa of the left maxillary central incisor and increasing discoloration of the tooth. Medical history was noncontributory, but dental history revealed a dental trauma eight years ago. Clinical examination showed a fistulous tract buccally of the left central maxillary incisor. The tooth showed a grayish discoloration of the caries free crown. The tooth was tender to percussion and slightly mobile. Both the first right and left maxillary central incisors did not respond to thermal and electric vitality testing. Radiographic examination showed apical periodontitis, internal and apical resorption with a lateral resorptive perforation of the left first maxillary incisor. The gutta-percha point inserted into the fistulous tract indicated that tooth as origin of the sinus tract. The right central maxillary incisor also showed apical pathosis, internal and apical resorption (Fig. 1).

Both teeth were judged to be hopeless, but because of the patient's age, poor oral hygiene, and severe anxiety a decision was made against extraction and integration of dental implants and for temporary tooth retention by endodontic therapy on both teeth. Following isolation with a rubber dam the teeth were opened and the root canals carefully cleaned using copious irrigation with peroxide and sodium hypo-chlorite. The canals were packed with freshly mixed calcium hydroxide and temporarily sealed. Medication was renewed several times. Fifteen months after initial treatment radiographic examination revealed some

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evidence of hard tissue formation on both teeth. In the left central incisor a hard tissue barrier could be probed in the middle of the root canal which could not be penetrated with a No. 15 reamer. The tooth was carefully obturated with vertically condensed gutta-percha. The control radiograph showed a satisfactory seal, even the lateral perforation looked well sealed (Fig. 2). The cavity was sealed with an acid-etched composite filling. Three months later subgingival crown fracture occurred and the tooth had to be extracted 18 months after initial treatment. Eight months later, the patient now being 18 years old, a dental implant was inserted by the Department of Oral Surgery. The right central incisor was obturated one month later, 27 months after initial treatment, when an apical hard tissue barrier could be probed. Again vertically condensed gutta-percha was used for obturation. Whereas, retention of the left central incisor failed after 18 months from crown fracture, treatment of the right central incisor has been successful for about ten years. Nevertheless, due to the bad crown-root ratio tooth retention still should be considered temporary (Fig. 3).
CASE 2

A 14-year-old girl was referred to the Department of Operative Dentistry for emergency treatment of tooth 21. The patient for several years had been treated in the Departments of Oral Surgery and Orthodontics where the impacted tooth 21 had been extruded. Clinically both maxillary left incisors showed signs of amelogenesis imperfecta, the maxillary left canine was missing. It had been removed surgically because of impaction and odontoma-like malformation some time before (Fig. 4).

The actual radiograph showed the left maxillary central incisor with an extremely short root and apical periodontitis (Fig. 5). The prognosis for long term tooth retention was judged poor due to short root and difficulties in adequate coronal restoration. On the other hand fixed prosthetics or a dental implant were contraindicated during the course of orthodontic treatment.

A decision was made to start endodontic therapy and try to preserve the tooth as long as possible. A rubber dam was fixed with wedges and ligatures and the tooth was opened, cleaned and shaped, and temporarily with calcium hydroxide.

One year later the radiograph showed excellent apical healing and the root canal was obturated with laterally condensed gutta-percha. Both maxillary left incisors were restored with composites (Fig. 6 and 7).

Fig. 4 Case 2 Preoperative radiograph showing dentinogenesis imperfecta and crown malformation in teeth 21 and 22 and odontoma-like malformation of the impacted tooth 23.

Fig. 5 Case 2 One year later pulp necrosis has occurred in tooth 21 and has resulted in apical periodontitis. Tooth 21 has been orthodontically extruded.

Fig. 6 Case 2 Teeth 21 and 22 before coronal restoration showing severe structural anomalies. Photograph was taken during electrosurgery.

A control radiograph three and a half years after initiation of endodontic therapy still shows no signs of apical pathosis (Fig. 8).

CASE 3

The 9-year-old girl had suffered dental trauma at the age of 7 years with luxation of the left maxillary primary incisor, subluxation of the teeth 52 and 62 and...
a partial extrusion of the maxillary right central incisor. The right maxillary central incisor had been reopened and splinted under general anesthesia. Pulp sensibility was reported positive at that time.

Two years later the patient, now at the age of 9 years, presented with a draining fistula at the buccal mucosa of the right central maxillary incisor, which did not respond to thermal and electric vitality testing.

Radiographically incomplete root development was diagnosed as well as apical periodontitis (Fig. 9).

Fig. 7 Case 2: Teeth 21 and 22 following coronal restoration with acid-etched composite fillings.

Fig. 8 Case 2: Control radiograph 3 and a half years after initiation of treatment showing no signs of apical pathosis.

Fig. 9 Case 3: Preoperative radiograph showing arrested root development with a diverging apex and apical periodontitis.

Fig. 10 Case 3: After 2 years some reduction in the size of the apical lesion is evident but no signs of apical hard tissue barrier.
Again an attempt of root canal treatment was considered to be the best treatment option. At the first appointment the tooth was opened and a radiograph for determination of working length was taken. The root canal was cleaned and enlarged to ISO 130 under heavy irrigation using an endodontic ultrasonic device with 1% NaOCl. Calcium hydroxide was used as intracanal medicament. The intracanal medicament was changed in intervals of 3-8 months over a period of three years.

Radiographically a decrease in the size of the periapical lesion could be observed but there was no evidence of apical hard tissue formation (Fig. 10).

Three years after initiation of endodontic therapy, now at the age of 12 years, the patient again was traumatized. The crown of the right central incisor was fractured at the cemento-enamel junction so that restoration seemed impossible (Fig. 11). Extraction was recommended. Further treatment was performed by a general dental practitioner. Tooth retention had been successful for three years.

CASE 4
A 10-year-old girl was referred from the Department of Orthodontics. The patient had suffered dental trauma at the age of 8 years. The right maxillary central incisor had been completely luxated and had been reopened by a general dental practitioner. The trauma had resulted in arrested root development, pulp necrosis and apical periodontitis. An attempt of root canal treatment already had been undertaken by a general dental practitioner, but due to insufficient coronal access, proper cleaning and sealing of the root canal had failed (Fig. 12).

The tooth was isolated with rubber dam and reopened and a length determination radiograph was taken. The radiograph additionally showed severe external inflammatory root resorption (Fig. 13). After cleaning and shaping under copious irrigation (1% NaOCl with an endodontic ultrasonic device) the root canal was medicated with freshly mixed calcium hydroxide. The medication was replaced in three monthly intervals over a period of 16 months.

Finally definite obturation was undertaken with gutta-percha using a combined lateral and vertical condensation technique. The control radiograph shows good apical healing, no signs of ongoing root resorption and satisfying seal of the root canal. The resorption lacuna at the distal aspect at least seems partially obturated (Fig. 14). Tooth retention meanwhile has been successful for 24 months. Permanent retention seems questionable because of the incompletely sealed lateral resorptive perforation, short root and fragile root canal walls.
DISCUSSION

It has been shown that root canal treatment has a good long-term prognosis even in young patients. Several studies on treatment outcome showed success rates between 88.2% and 93% for patients younger than 20 years. For a group of adolescents from 6 - 14 years, Herforth et al. reported a success rate of 77.0% after 4 - 8 years. Ingle et al. after two years found 88.4% success in children younger than ten years.

Due to large diameter of the root canals cleaning and shaping mostly is less difficult than in adults’ teeth, but sometimes it is impossible to achieve tight obturation with lateral condensation techniques. In these cases vertical condensation or other thermoplastic obturation techniques have to be used.

The situation in many cases changes dramatically after traumatic injuries. Some sequelae of trauma result in irreversible damage to the tooth structures, such as pulp necrosis, inflammatory resorption, or arrested root development. Although apexification techniques using calcium hydroxide finally may result in apical closure or - in vital cases - even in further root growth, there are only rare cases of further length growth after pulp necrosis. Excessive weakening of dental hard tissues by root canal preparation or resorption sometimes may further deteriorate the chance for long term tooth preservation. In very young patients with poor oral hygiene, reduced compliance or severe anxiety or in patients still undergoing orthodontic therapy alternative treatment options may present severe problems.

Dental implants in most cases are contraindicated at this age or during orthodontic therapy, removable prosthesis for temporary replacement of lost anterior teeth may result in psychological problems and any kind of bridgework in most cases would require preparation of healthy teeth.

The cases presented may demonstrate that root canal treatment in certain of these otherwise hopeless cases may be a valuable therapy to avoid early tooth extraction in adolescent patients. Most of the cases presented are sequelae of dental trauma with severe damage of tooth structure or disturbances in tooth development. Pulp necrosis, apical periodontitis, arrested root formation and inflammatory resorption were common findings and in all cases long term preservation of the teeth seemed questionable.

Alternatives to endodontic treatment would have been extraction and resin-retained bridges, dental implants, orthodontic closure of the resulting space, or removable prostheses. As some of the patients were undergoing orthodontic therapy dental implants would have been contraindicated as well as fixed prostheses. Extreme anxiety and deficiencies in oral hygiene of the young patients presented additional problems. The decision for endodontic treatment in all cases pre-
sented had two primary goals: to avoid any further
damage of oral tissues and to win as much time as pos-
sible. This could be achieved at least for three of the
five teeth, whereas, one case failed after three years
probably due to repeated trauma resulting in crown-
fracture.

Secondary crown fractures at the level of the cemen-
to-enamel junction are not uncommon in nonvital teeth
with incomplete root formation. Cvek in a retropec-
tive clinical study found cervical root fractures during
or following endodontic treatment in 168 of 885 luxat-
ed non-vital teeth. The frequency of cervical fractures
was markedly higher in immature than mature teeth.
Nevertheless, even in this failing case extraction of
the tooth could be postponed for three years.

In another tooth which fractured 18 months after
initiation of therapy due to insufficient coronal resto-
ration a dental implant could be inserted a few
months after extraction. Probably this fracture might
have been avoided using an adhesive filling technique
to strengthen immature teeth as described by Rabie et
al. They acid-etched even the coronal part of the
root canal and then sealed the whole cavity with a
bonding material and a light-cured composite. In two
experimental studies Trope et al. could show that frac-
ture resistance of endodontically treated teeth can be
significantly increased by this technique.

It should be stressed that this treatment modality of
temporary tooth retention by endodontic therapy
requires carefully informing the patients and their par-
ents (informed consent), including any potential risk
and the temporary nature of the treatment as well as
possible treatment alternatives. Additionally a strict
supervision should be guaranteed to avoid occurrence
or increase of pathological conditions as ongoing
resorption, apical periodontitis, fistulation, or acute
evaceration. If clinically or radiographically signs of
increasing pathosis were visible endodontic therapy
should be stopped and the tooth be extracted.

Otherwise treatment guidelines do not significantly
differ from regular endodontic treatment: root canal
preparation and disinfection should be performed
under strict aseptic conditions, a temporization with
calcium hydroxide seems favorable to promote peri-
apical healing and eventually stop resorption. If the
case responds to the treatment even definite obtura-
tion may be performed using standard techniques as
lateral condensation, or, because of root canal anato-
my, vertical condensation or other thermoplastic obtu-
ration techniques.

CONCLUSION

In certain cases early extraction of hopeless perma-
nent teeth in adolescent patients may be postponed by
temporary endodontic therapy. This treatment modali-
ty may be helpful in cases with severe sequelae follow-
ing dental trauma or severe dental malformations.
Thorough debridement under aseptic conditions, calci-
um hydroxide as temporary intracanal medicament,
and sometimes even definite obturation of the root
canal may help to retain such teeth at least for some
time and thus improve conditions for postextraction
treatment options. Thus, root canal treatment may be
indicated as a temporary therapy.

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