

Assessment of Alterations in Permanent Premolars After Endodontic Treatment of Predecessor Primary Molars: A Prospective Study.

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Introduction

Early childhood caries and traumatic dental injuries are the main cause of pulpal damage which affects the permanent successor tooth germ, such as the reduced enamel epithelium or gubernacular canal. This may result in enamel hypomineralisation, hypoplasia, arrested development of the permanent tooth, formation of dentigerous cysts, germ expulsion resembling bone sequestration in osteomyelitis, and alterations in the follicular structure.

Pulp therapy in primary teeth is performed to maintain the tooth until natural exfoliation to maintain space for the permanent successor and development of the dental arch.

Pulpectomy is indicated when there are clinical and radiographic signs of irreversible pulpitis or pulp necrosis. Successful endodontic treatment of primary teeth involves eliminating bacteria from the complex root canal curvature which can pose significant challenges to instrumentation. Irregular root resorption also complicates the determination of a precise apical limit for both instrumentation and obturation.

Obturation materials need to be biocompatible with periapical tissues and the developing permanent tooth germ, resorption rate similar to the primary tooth root, antiseptic properties, good adhesion to canal walls, ease of application and removal, radiopacity and absence of tooth discolouration. As no material fulfils these requirements, the most commonly used root canal filling in paediatric dentistry include zinc oxide-eugenol (ZOE) paste, iodoform-based pastes, and calcium hydroxide-based formulations. In some studies, ZOE has a higher clinical success rate while others have shown no superiority over alternative materials. Overfilling with ZOE has been associated with potential alterations in the eruption path of the permanent successor and slower resorption rate than the primary roots.

The primary objective of this study was to assess the developmental and eruptive alterations in permanent premolars after endodontic treatment of their primary molar predecessors. Potential demographic, tooth and treatment related variables were also investigated as possible explanatory factors associated with alterations in successor premolars.

Methods

This prospective study involved longitudinal assessment of 197 patients enrolled in three randomised controlled trials at the Postgraduate Program in Dentistry at Universidade Federal de Santa Catarina (Federal University of Santa Catarina, Brazil). Each patient had

endodontic treatment on one primary molar. Individuals who received orthodontic treatment or any restorative procedure involving the successive premolar were excluded.

Clinical and radiographic assessment was conducted to evaluate signs such as fistula, abscess, oedema, interradicular lesion and pathological resorption. Endodontic treatment was performed in a single session by one of three trained PhD candidates in paediatric dentistry.

Between 2016-2018 children aged five to nine years of age returned for treatment under local anaesthesia. Root canals were instrumented using manual K-files or rotary files under rubber dam, irrigated with 1% sodium hypochlorite and filled with ZOE paste.

The primary outcome of this investigation was the rate of developmental or eruption-related alterations in permanent premolars. Hypomineralisation was identified as a demarcated opacity greater than 1mm in diameter as either a white, creamy or brown discolouration. Hypoplasia was defined as the presence of pits, grooves, areas of enamel loss with rounded, smooth borders adjacent to the surrounding enamel.

Ectopic eruption was defined as the malpositioning of permanent premolars that failed to achieve proper occlusion and crown rotation referred to the rotation of the tooth around its longitudinal axis. Radiographs were taken at the follow-up periods to detect deviation of the eruption path of the permanent successor. A silicone bite registration was fixed to the Rinn device to aid with reproducibility of the X-ray.

Results

Of the 197 patients, 142 were classed as dropouts as most were not contactable. Fifty-five patients were reassessed, eight were excluded due to orthodontic treatment (n=6) or the presence of extensive restorations in the permanent successor tooth (n=2).

The majority of the participants were boys (n=27) with an age of 11-15 years at the time of follow-up of the successor premolar and a mean follow-up time of six years. Most teeth had pulp necrosis (93.6%) and interradicular lesions (85.1%) and pathological root resorption in 14.9% of cases. Rupture of the follicular bone crypt was present in 4.3% of cases.

Of the 47 participants, five teeth had ectopic eruption, ten had crown rotation, one had hypoplasia, three had hypomineralisation and 32 had no alterations. From the regression analysis, none of the demographic or treatment related variables including pulp status, interradicular lesion, root resorption, or root filling extravasation, demonstrated a statistically significant association with the occurrence of alterations in the successor premolars.

Discussion

Chronic infection in a primary tooth can extend to the follicle of the developing permanent tooth. Previous studies have shown chronic apical periodontitis in primary teeth can affect the growth, development and eruption of permanent teeth resulting in enamel hypoplasia, hypomineralisation, abnormal tooth morphology, ectopic eruption and odontogenic cyst formation that may result in necrosis of the permanent tooth germ.

This study showed that crown rotation and ectopic eruption were the most frequently observed alterations in permanent premolars following endodontic treatment of primary molars. Alterations of the permanent successor are more associated with the pre-existing infection rather than the endodontic procedure. Maintaining the primary tooth prevents loss of arch space, eruptive alterations, speech impairments, masticatory dysfunction and psychological issues related to early loss of primary teeth.

Overfilling of the root canal with the ZOE paste has been of concern. ZOE has a slower resorption rate compared with the primary tooth roots. This may interfere with the natural exfoliation of the tooth and alter the eruption pathway of the permanent successor. This was not observed in this study.

Delayed treatment (over the age of six years at the time of intervention) may increase the exposure of the developing tooth to inflammatory byproducts from interradicular lesions. The stage of calcification of the tooth germ is a critical factor.

This study was prospective with a long-term follow-up and used clinical and radiographic data. Alterations in the permanent teeth were diagnosed by consensus between the two examiners. Limitations of this study were that the sample size was small due to a high attrition rate. There was no control group such as the contralateral tooth which restricted comparative analysis. The contralateral tooth was not feasible as many had not fully erupted. Although there was specific training to identify development and eruptive alterations, no formal calibration was conducted.

These results have limited generalisability due to the single geographic location and high dropout rate. Further studies need to be conducted with a larger sample size and multi-centre samples to improve statistical power and generalisability of results. Efforts to reduce attrition such as maintaining contact details using digital platforms would be useful. A control group would also improve comparative analyses.

Conclusion

Nearly one-third of permanent premolars exhibited alterations following the exfoliation of endodontically treated predecessor primary molars. Crown rotation and ectopic eruptions were most frequently observed. Developmental enamel defects were less common. No significant association was identified between the evaluated tooth or treatment and the occurrence of alterations in eruption or development of the permanent tooth.

Questions

1. Hypomineralisation is identified by:
 - a. Pits and grooves
 - b. Brown discolouration
 - c. Areas of enamel loss
 - d. Areas less than 1mm
2. From the 47 participants, how many teeth had ectopic eruption?
 - a. 32
 - b. 10
 - c. 5
 - d. 1
3. Zinc oxide-eugenol (ZOE) has been shown to have a similar resorption rate to primary roots. TRUE or FALSE.
4. Limitations of this study included:
 - a. Small sample size
 - b. Multiple centres
 - c. Calibration of examiners
 - d. Use of a control group
5. One of the main reasons for pulp therapy in primary teeth is to:
 - a. Avoid damage to the permanent successor
 - b. Prevent irregular root resorption
 - c. Provide space maintenance for the permanent successor
 - d. Prevent early childhood caries
6. The incidence of interradicular lesion in the primary molar was?
 - a. 4.3% of cases
 - b. 14.9% of cases
 - c. 85.1% of cases
 - d. 93.6% of cases
7. Alterations of the permanent successor are more associated with the pre-existing infection. TRUE or FALSE
8. Chronic apical periodontitis of the primary molar can affect the permanent successor tooth germ such as:
 - a. Sequestering of bone
 - b. Obliteration of the permanent root canal space
 - c. Affecting the formation of periodontal tissues
 - d. Arrested development of the permanent tooth

9. Ectopic eruption occurs when:
- a. A tooth fails to achieve proper occlusion
 - b. The crown is rotated around the longitudinal axis
 - c. The root has an abnormal sharp curve
 - d. There is a creamy discolouration of the crown
10. Obturation materials for endodontic treatment in primary molars needs to be:
- a. Non-resorbable
 - b. Bacteriostatic
 - c. Biocompatible
 - d. Radiolucent