

Crazing Level after Pin Insertion in Anterior Primary Teeth: A Preliminary In Vitro Study

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Abstract

Objectives: This study aimed to investigate dentinal crack rate following parapulpal pin insertion in anterior primary teeth.

Methods: Thirteen sound freshly extracted primary canine teeth were horizontally sectioned 1 mm above the cemento-enamel junction (CEJ). All samples were thoroughly inspected to ensure that the teeth had no cracks. The teeth were then mounted in acrylic blocks, and subjected to drilling and insertion of a single parapulpal pin in the prepared hole. The teeth were then sectioned perpendicular to the already prepared surface at 1, 2 and 3 mm depths for further evaluation under a stereomicroscope ($\times 12$ and $\times 25$ magnifications).

Results: No crack or crazing was observed in teeth in the control group while one out of 11 teeth in the case group had a crack.

Conclusion: The use of 0.53 mm diameter self-threading pin did not increase the risk of crack formation in dentin of anterior primary teeth prior to composite restoration.

Key Words: Tooth, Deciduous; Dental pins; In Vitro Techniques

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Introduction

Severe destruction of tooth crown is commonly seen in the anterior primary teeth occurring mainly following early and rapid carious attacks or even dental trauma. To date, extraction has been the most commonly performed treatment option for such teeth (1). Early loss of the anterior primary teeth usually leads to masticatory dysfunction, loss of vertical dimension and engagement in para-functional habits such as tongue thrusting. This, in turn, may cause psychosocial problems due to esthetic and speech problems, malocclusion and loss of space (2). Ignoring the treatment of such teeth is in contrast to the principles of

prevention and health policies. Where there is active lesions on teeth, microorganisms continue to grow and proliferate, compromising the dentition and tooth structure (3). Amongst the currently available tooth-colored restorative materials, composite resins are considered as the main choice for restoration of anterior primary teeth due to their high strength, acceptable wear resistance and optimal esthetics (4). In the recent years, the use of intracanal posts and intracanal retainers has been highlighted in order to improve the retention of composite restorations in severely decayed teeth (1,2,5-8). However, there remain a potential concern for the use of intracanal posts and that is interference with the

eruption of permanent successors. In addition, there is an increased fracture risk due to stress accumulation within the canal of the treated teeth (1,2,9). Self-threading pins are widely used for restoration of permanent teeth due to their high retention potential (10, 11). Strain and crazing in dentin are common following pin insertion (12). Masticatory and lateral forces may result in crack propagation and subsequent fracture and even pulp exposure (13). Several factors that may affect crack formation around parapulpal pin have already been examined including the pin type (13-15), the pin size (14,16), the distance between pins (16-18), the distance from the pin to the dentinoenamel junction (14), angle of the pin relative to the pulp chamber (19), the insertion method (12,20), bending (21), the drill sharpness (13), and the pressure applied by the operator (13). Stereomicroscope is usually used to detect micro-cracks (15), but other methods may also be employed including: dark field microscope (16), scanning electron microscope (12,22), staining with fluorescent solution (13,14) and photoelastic (23) and clearing methods (24). Overall, since the application of these pins has not been the focus of attention for researchers in primary tooth restoration, such potential could be the subject of investigation. The aim of this pilot in vitro study was to evaluate any potential micro-cracks formed following the use of drill to create a pin hole and pin insertion process in the anterior primary teeth.

Methods

A total of 13 sound freshly extracted human primary canine teeth with at least two-thirds

of the root remaining were included in this study. The study protocol was approved in the ethics committee of our university (IR.SBMU.RIDS.REC.1394.125). The teeth were immersed in 0.1% chloramine T solution for two weeks for disinfection and then stored in saline solution at room temperature. The coronal portion of the teeth was removed by perpendicular sectioning 1 mm above the cemento-enamel junction (CEJ), using a new long shank cylindrical diamond bur (Jota AG, Rüthi, Switzerland) mounted on a water sprayed high speed hand piece (NSK, Tochigi, Japan). The teeth were mounted in blocks of putty silicon impression material (Speedex, Coltene, Alstatten, Switzerland) up to 2 mm below the CEJ. All samples were carefully checked for any preexisting cracks before pin insertion. A stereomicroscope (SZX9; Olympus, Tokyo, Japan) was used to study the surface in the palatal aspect at 2 mm from the sectioned surface ($\times 12$ and $\times 25$ magnifications). Acrylic powder and liquid (Meliodent, Heraeus Kulzer Ltd, Newbury, Germany) were mixed according to the manufacturer's instructions and the teeth were mounted in blocks at the CEJ level perpendicular to the long axis of the tooth. In order to prevent the exothermic effect of acrylic polymerization on the teeth and formation of bubbles, all acrylic blocks were placed in a pressure pot for 10 minutes at room temperature. Two teeth received no intervention and considered as controls. A pin hole was prepared parallel to the long axis of the tooth in the thickest palatal portion of the surface. A new drill was used for pin hole preparation in order to reduce crack formation caused by drill action. The 0.53mm diameter parapulpal pin (TRI-

JET, NTL, Kahla, Germany) was then inserted using a hand wrench in a clockwise direction until the pin was separated from the handle itself. Each acrylic block was then placed inside the Accutom-50 diamond cutter (Struers, Ballerup, Denmark) clamp. Transverse sections were randomly made at different depths of the teeth and carefully evaluated under a stereomicroscope (SZX9, Olympus, Tokyo, Japan) at $\times 12$ and $\times 25$ magnifications.

Results

No dentin cracks were observed in the control group (Figure 1). Amongst the 11 samples, only one case had a lateral crack almost perpendicular to the longitudinal axis (Figure 2) while no cracks were observed in any other tooth in this group (Figure 3).

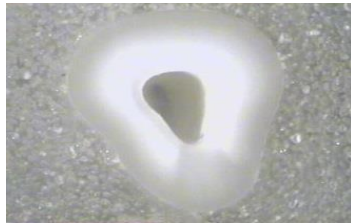


Figure 1- No dentin crack observed in the control group ($\times 12$)



Figure 2- Horizontal view; the arrow shows the lateral crack perpendicular to the pin ($\times 25$)

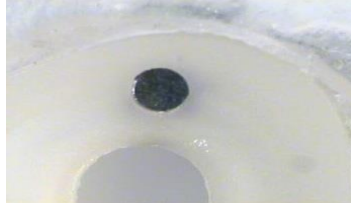


Figure 3- Horizontal view; no crazing is observed in tooth ($\times 25$)

Discussion

When pins are threaded into dentin, most of the force is concentrated at the end of the threads. The potential energy stored during pin insertion is transformed to kinetic energy, and miniature cracks are formed (12). In endodontically treated teeth, it is advisable to use only the smallest self-threading pins and possibly increase the inter-pin distance if two or more pins are to be used (16), especially in the anterior primary teeth that have relatively small dentin thickness, there is a higher risk of pulp or root perforation (11). Only a minim pin in each tooth in this study and almost the center spot was pointed as parallel to the longitudinal tooth axis as possible. Minim pins with 0.53 mm diameter was used in the current study since it was believed to be in a suitable diameter range and sufficient length to provide appropriate retention for anterior composite restorations (25,26), while being more secure than regular pins (24, 25). A new drill was employed for pinhole preparation in order to eliminate friction defects. Limiting the use of drills to a number less than 20 times can ensure no crack formation when creating the pin holes. Avoiding the heat from the use of old drill or reducing the impact of creating the pin hole can also be effective in this regard (13). Dentinal cracks are considered as a potential problem associated with self-threading pins (13). Several earlier studies were carried out to assess the crack formation rate in the extracted teeth using longitudinal sections (12,13,15,20,27,28), transverse sections (14,16) or both (22). It is believed that evaluation of cracks through transverse and serial sections can be more reliable in

extracted tooth samples (16). Serial transverse sections were used for evaluation in the current study using a stereomicroscope with $\times 10$ and $\times 25$ magnifications. Microscopic evaluation of the cases studied here revealed that only one sample (9.9%) had a crack, which was perpendicular to the pin axis in the apical third of the root. An earlier study reported no cracks in duplicated samples observed under a scanning electron microscope (SEM); the presence of cracks in the main samples was told to be related to the preparation process for SEM assessment and not the pin hole preparation or pin insertion (22). On the contrary, Šegović *et al.* (12) reported that 54.5% of samples with manual pin insertion had some degrees of cracks. This higher rate of cracks may be explained by the differences in sample preparation process for SEM observation as samples normally undergo high vacuum pressure in their preparation process when covering the surfaces with a conductive metal (22). Based on a study by Chan *et al.*, (20), 40% of the

regular pins placed manually showed cracks (20); the main reason for this higher crack formation rate may be their larger size (15,16,24,25) compared to minim pins used in this study.

Conclusion

Considering the limitations of this preliminary study, it seems that the use of parapulpal pins in primary anterior teeth could be considered relatively safe provided that the remaining small dentinal structure is carefully considered.

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Conflict of interest: “None Declared”

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