



## Restoration of Endodontically Treated Teeth

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### Introduction

Bacteria have been shown to be the cause of endodontic infections.<sup>1</sup> To minimize reinfection of the root canal system, a permanent coronal restoration is necessary. The permanent restoration of endodontically treated teeth is one of the most important aspects of root canal therapy and should be placed as soon as possible.<sup>2</sup> The purpose of this Clinical Update is to review the factors associated with the restoration of endodontically treated teeth.

### Evaluation

Before making an endodontic referral, the provider should examine the tooth for restorability. An understanding of the available materials, including the limitations of those materials, is critical when planning the ideal restoration for endodontically treated teeth.<sup>2</sup> The referring provider's evaluation and treatment should include the removal of all caries and defective restorations prior to referring the patient for endodontic therapy. In certain instances, prior to endodontic therapy, replacing the existing defective restoration is necessary to provide an adequate coronal seal and a reservoir for irrigants used during endodontic therapy. Communication between the endodontist and restorative provider is crucial in achieving the best outcome for the patient. As an integral part of root canal therapy, the tooth must be restored with a definitive restoration as soon as possible.<sup>2</sup> In accordance with BUMED instruction, cusps of posterior endodontically treated teeth should be covered with a full-coverage amalgam or cast restoration.<sup>3</sup> In most instances; permanent restorations are not placed the same day the root canal is completed. This necessitates the timely replacement of the temporary with a permanent restoration.

### Timing

A delay in placement of the permanent restoration may result in leakage around the temporary, which may lead to the tooth requiring endodontic retreatment. A retrospective study of 775 root canal treated teeth showed a higher survival rate if restored within 2 weeks.<sup>4</sup> Delaying placement of the permanent restoration can also lead to loss of tooth structure due to fracture. Safavi and others reported higher success rates in teeth with permanent restorations versus those with temporary restorations,<sup>5</sup> and a meta-analysis by Ng and others reported the main condition that increased the survival of endodontically treated teeth was a crown restoration.<sup>6</sup>

### Dental Dam Isolation

All restorative procedures involving root canal treated teeth should be performed utilizing dental dam isolation in order to minimize contamination of the canal space. The American Association of Endodontists states that only "dental dam isolation minimizes the risk of contamination of the root canal system by indigenous oral bacteria."<sup>7</sup> There is no published literature to determine the isolation efficacy during root canal treatment using Isolite®. Therefore, providers should only use a dental dam for isolation during placement of the core build-up. A dental dam is also indicated during post fabrication or placement.

Without proper isolation, these procedures allow the canal to become contaminated with bacteria. In a retrospective, chart review study, teeth restored without a dental dam had a 73.6% success rate, while teeth restored using dental dam isolation had a 93.3% success rate.<sup>8</sup> This contamination, which can occur in as little as three days,<sup>9</sup> may necessitate endodontic retreatment.

In addition to minimizing contamination of the root canal system, the dental dam protects the patient from swallowing or aspirating materials used during treatment.

### Intraorifice Barriers

Intraorifice barriers (IOB) are restorative materials placed in the coronal 1-2 mm of root canals immediately following obturation. Placing a barrier over the coronal gutta percha reduces the chance of recontamination of the root canal system. Wolcott noted IOBs should be a different color than tooth structure, not interfere with the final restoration, be easy to place and bond to tooth structure.<sup>10</sup> One of the most commonly used materials for IOB is Fuji Triage®, a glass ionomer. This material has been tested in numerous studies and fulfills the criteria discussed by Wolcott. A Navy study by Maloney and others demonstrated 1 mm of Triage was as effective as 2mm when evaluated in an in-vitro leakage model.<sup>11</sup> Vitrebond™ has also proven to be an effective IOB,<sup>12</sup> however, due to the material's color, it is not as distinguishable from tooth structure as Triage. When restoring endodontically treated teeth with IOBs, the barrier should not be removed unless canal retention is needed to retain the core. However, it is important to remove cotton pellets beneath the temporary prior to placing the core. Cotton fibers can wick moisture and harbor bacteria that can contaminate the root canal system long after the permanent restoration is placed.<sup>13</sup>

### Post Space

The need for a post should be clearly noted in the dental record, and conveyed to the endodontic provider. Studies indicate less leakage potential when the post space is prepared with a heated plugger versus post drills.<sup>14</sup> This, combined with the aseptic technique used during root canal therapy, reinforces the idea that post space should be prepared during root canal therapy by the endodontic provider. If a post is used, the apical extent of the post should be in contact with gutta percha. Moshonov and others reported that 83% of the cases were evaluated as normal with no radiolucency. When a gap between the gutta percha and post was present, the rate decreased to 54% (>0 - 2mm) and 29% (>2mm) respectively.<sup>15</sup> However, the need for a post or extension of core material into the canals may not be necessary when at least 4mm of chamber height is present.<sup>16</sup>

### Core Materials

Strength may be the most important property of an ideal core material. The stronger the material, the more resistant the core is to deformation and fracture. Greater strength will also provide better stress distribution and more stability to the tooth. All of these fac-

tors can increase the long-term retention of the tooth. Amalgam has been the traditional material used for core build-ups. However, adhesive dentistry has offered an alternative to amalgam cores. A study by Kalay and others determined that adhesive cuspal coverage increased the fracture resistance of premolars with MOD cavity preparations to a level comparable to intact teeth. Adequate cuspal reduction of at least 2.5 mm provided the most favorable results.<sup>17</sup> When using composite as a core, highly filled materials are preferred due to their superior physical properties and improved clinical performance. In addition, injectable self- and dual-cured composite core materials such as ParaCore® offer advantages over visible light-cured composites by providing better adaptation to the tooth walls and require little or no photopolymerization, an important consideration in difficult access situations.<sup>18</sup>

### Full Cuspal Coverage

When restoring posterior endodontically treated teeth, full cuspal coverage is recommended.<sup>19</sup> Studies report the placement of a crown is directly correlated to long-term survival of root canal treated teeth.<sup>20</sup> Teeth, not restored with crowns, were lost at a rate 6 times more than crowned teeth.<sup>21</sup> Multiple studies echo this finding. Salehrabi and Rotstein reported 85% of root canal treated extracted teeth did not have full cuspal coverage.<sup>22</sup> A Swedish study confirmed that crown placement was a significant predictor of the survival of endodontically treated teeth.<sup>20</sup> Removal of enamel and dentin due to endodontic access or caries weakens the tooth even though restorative materials are used to replace the missing tooth structure. In fact, access cavity preparation for endodontic therapy is reported to be the greatest influence on weakening teeth.<sup>23</sup> A study comparing adhesive versus non-adhesive restorations showed that gold crowns exhibited the highest resistance to fracture, while teeth restored with bonded ceramic partial crowns showed a higher fracture resistance than fillings and inlays. Noncuspal coverage amalgams demonstrated the worst outcomes.<sup>19</sup>

### Anterior teeth

While full cuspal coverage is the standard for posterior teeth, the same is not always required for anterior teeth. The amount of remaining tooth structure influences the choice of restoration. A study by Abduljawad and others reported the placement of a glass fiber post significantly improved the fracture resistance of maxillary central incisors with cervical cavitations or abfractions.<sup>24</sup> In addition, a study by Dastjerdi and others demonstrated the fracture resistance of composite was less favorable than cast posts or fiber posts when restoring anterior teeth with significant tooth loss.<sup>25</sup>

### Conclusion

The topic of restoration of endodontically treated teeth is very extensive and broad. This Clinical Update attempts to reinforce some of the important aspects of this topic from an endodontic perspective. Root canal therapy is an effective treatment with high success rates. However, root canal therapy is not complete until the permanent restoration is placed. Dental dam isolation must be used during endodontic therapy and should be utilized in every phase of treatment where the canal space or gutta percha could be exposed to saliva. If there are questions regarding restorative materials, the use of a post or preparation design, an advanced trained restorative provider should be consulted. All providers involved should begin with the end result in mind and plan the treatment accordingly. Communication between the restoring dentist and endodontist will help provide the patient the optimal outcome.

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