

# Restoration of Endodontically Treated Anterior Teeth by Modified Conservative Endocrowns: A Case Report with a 30-Month Follow Up

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(Submitted: 30 January 2021 – Revised version received: 20 February 2021 – Accepted: 23 February 2021 – Published online: Spring 2021)

**Objectives** Restoration of severely damaged endodontically treated anterior teeth typically poses a challenge. Specific indication of post-retained restorations in such teeth has reasonably been questioned because of the potential tooth structure weakening. The present study aimed to describe a modified conservative endocrown (modified refers to intracanal extension while conservative refers to preparation at the finish line) to rehabilitate severely damaged anterior teeth.

**Case:** Endodontically treated lower right central incisor had inadequate remaining tooth structure and restored by endocrown restoration as a definitive treatment and followed for 30 month.

**Conclusion** Considering the clinical outcome after 30 months of follow-up, it seems that this specific type of endocrown could efficiently serve as a conservative treatment approach to restore endodontically treated anterior teeth.

**Keywords** Root Canal Therapy; Composite Resins; Case Reports; Tooth Bleaching.

## Introduction

Endodontically treated teeth have inadequate residual sound tooth structure due to caries, cavity preparation, or minor trauma with a significant risk of biomechanical failure compared with vital teeth.<sup>1</sup> The selection of restorative materials and restorative procedures that properly preserve the residual tooth structure plays a significant role in tooth longevity.<sup>2</sup> Posts and cores were typically considered the traditional treatment option to efficiently manage such selected cases.<sup>3</sup> However, installing a post is associated with some critical risks such as root perforation and removal of radicular dentin to provide the required space for the post, which leads to weakening of the remaining coronal and radicular structures.<sup>3</sup>

Because of the advances in adhesive dentistry and great emphasis on minimally invasive principles, a current therapeutic option has been developed to restore endodontically treated teeth, referred to as endocrowns.<sup>4,5</sup> Furthermore, considering their essential role in the possible restoration of coronal anatomy, endocrowns have been known to properly seal the access to the root canal, preventing bacterial microleakage and positively affecting the long-term success of endodontically treated teeth.<sup>6</sup> Additionally, in case of endodontic failure, interventions can be made more easily.<sup>7</sup> Therefore, endocrowns are undoubtedly considered an esthetic and conservative restorative alternative.<sup>8-11</sup>

Recently, endocrown restorations were introduced as a

monoblock for both core and crown with butt margins and a radicular extension indicated in specific cases of severely destroyed crowns.<sup>12</sup> The restoration is characterized by its reasonable cost, ease of fabrication, and reduced chair time.<sup>13</sup> Also, endocrowns are an alternative restoration in teeth with short clinical crowns and curved or short root canals.<sup>8,10</sup>

In addition to a pleasant appearance, the used materials are biocompatible, and their coefficient of thermal expansion is similar to that of enamel.<sup>14</sup> This specific type of restoration is indicated for cases with excessive loss of the coronal structure or limited inter-occlusal space.<sup>8</sup> Moreover, the supra-gingival margins facilitate oral hygiene practice and clinical examination.<sup>3</sup>

Postoperative complications after root canal treatment refer to unresolved radiolucencies around the apex of the roots. According to the literature, the prognosis of surgical treatment is poorer than orthograde retreatment.<sup>15</sup> Surgical treatment has limited indications, such as when the root canal obstruction cannot be removed, or there is a high risk of unfavorable damage to the crown or restoration.<sup>15</sup> Several studies have shown high success rate of endocrowns in molars and higher fracture resistance compared with posts.<sup>10, 14-17</sup> In vitro studies have shown higher fracture resistance and reduced stress concentration in the modified preparation design of endocrown restorations compared with the conventional preparation design for endocrowns.<sup>18</sup> According to an in vitro study, anterior teeth can be conservatively restored with endocrowns.<sup>19</sup> Although there is no previous report

accurately comparing the performance of anterior and posterior endocrowns in the same standardized manner, one could expect that endocrowns would fail at a higher rate when placed on the anterior teeth than on posterior teeth.<sup>20</sup> Like premolars, incisors and canines naturally undergo stronger non-axial forces (compared with more axially directed forces) than the posterior molar teeth during the masticatory function.<sup>20, 21</sup> This case report describes a modified approach for the restoration of anterior endodontically treated teeth by conservative endocrown restoration along with a focused discussion about its practical advantages and possible disadvantages.

## Case Report

A 58-year-old male patient was referred to the Department of Restorative Dentistry at the School of Dentistry of Tehran University of Medical Sciences for restoration of mandibular teeth. His medical history was unremarkable. The clinical examination showed the loss of the central incisor's extensive restoration and discoloration of the left central incisor (Fig. 1).

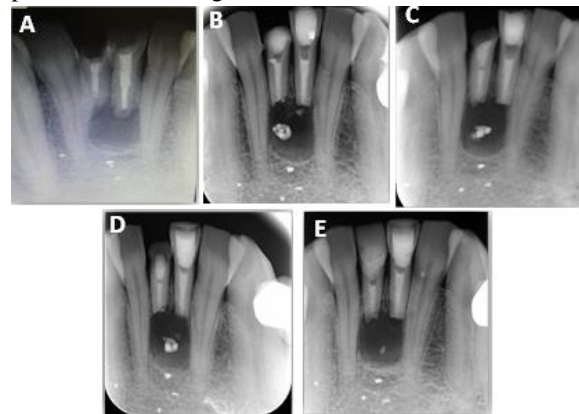


**Figure 1- Before treatment; (A) labial view; (B) lingual view**

No submucosal swelling was observed. Radiographic examination revealed resected roots with asymptomatic periapical periodontitis. Based on his dental history, an apicoectomy had been previously carried out on both teeth. There were neither any signs and symptoms nor mobility in these teeth (Fig. 2). However, considering the periapical lesions on the radiograph and coronal microleakage, a decision was made to retreat the root canals before the restorative procedures.

After local anesthesia administration with the infiltration technique using 36 mg of lidocaine and epinephrine (Lignospan® standard, Septodont, USA) and rubber-dam isolation, the occlusal restorative material was entirely removed. The gutta-percha in the root canals was gently

removed with #2 Gates-Glidden drills and hand instruments. The root canals were prepared with stainless steel hand instruments (Besancon, France). The root canals were irrigated with 2.5% NaOCl and EDTA activated with an ultrasonic device. The disinfection procedure was carried out with  $\text{Ca(OH)}_2$ , and a temporary filling material was used to obtain coronal seal. Two weeks later,  $\text{Ca(OH)}_2$  was removed, and the root canals were obturated with RetroMTA (BioMTA, Seoul, South Korea) due to the lack of an apical stop. Considering the discoloration and thin residual axial walls of the left central incisor, a non-vital bleaching procedure and composite restoration were performed (Fig. 3). The pulp chamber was sealed adequately with glass-ionomer restorative material, and the external (Easy White® Ready, DeltaMed, Spain) and internal (Easy White® Office, DeltaMed, Spain) office bleaching was initiated. After four sessions of bleaching, tooth whitening was completed (Fig. 3). After 2 weeks, the access cavity was restored by bonded (3M™, ESPE, Scotchbond™, Universal Adhesive, Germany) composite resin material (3M™, Filtek™, Universal Restorative, USA). Due to the extensive loss of the tooth structure (>70%), a modified conservative endocrown restorative procedure was performed for the right central incisor.



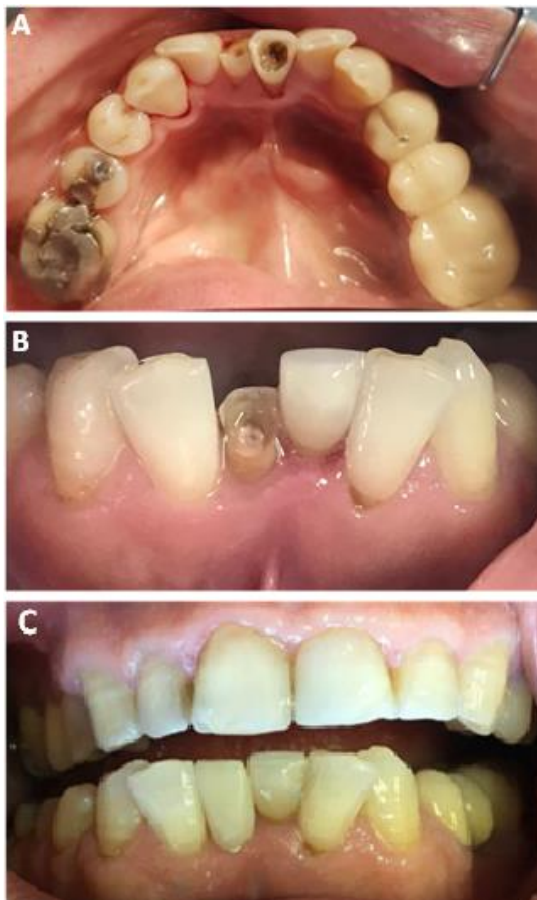
**Figure 2- Periapical radiographs show the mandibular central incisors with resected roots and periapical radiolucency: (A) before retreatment; (B) at the end of retreatment with MTA; (C) after six months; (D) after 12 months, and (E) after 18 months**

First, a simple gingivectomy procedure for the right central incisor's labial margin was carried out using a tissue trimer bur (NTI® Soft Tissue Trimmer, Kerr, USA) for crown lengthening to achieve the ferrule effect. After controlling the gingival bleeding by a hemostatic gel (PREVEST DENPRO®, India), a shallow chamfer finish line was prepared by using a round-ended, medium-grit, tapered diamond bur (856.31.016, Brasseler USA, Savannah, GA, USA) in the labial margin with 4 mm intra-canal extension for the retention of restoration (Fig. 3). Next, an impression was made with addition silicone impression material (3M™, Express™, STD, USA). After adjusting the endocrown ceramic (IPS eMax; Ivoclar Vivadent, Schaan, Lichtenstein), it was cemented by Panavia™ V5 (2-28 Kurashiki-cho, Tainai, Niigata 959-

2653, Japan) cement according to the manufacturer's instructions in the next session. In this endocrown, macro-mechanical retention was achieved by the internal portion of the pulp chamber and the cavity margin, and micro-retention was obtained by an adhesive cementation technique<sup>16, 17</sup> (Fig. 4). Besides, the gingival tissue was healthy (Fig. 5).



**Figure 3- Sequence and final results of external and internal office bleaching for the left mandibular central incisor: (A) labial view after the first visit; (B) labial view showing the final result of bleaching (4th session)**



**Figure 4- (A) occlusal view of teeth before treatment; (B) after-treatment of the mandibular left central incisor with direct composite resin; (C) mandibular right central incisor was treated with modified conservative endocrown**



**Figure 5- Follow-up visit at 24 months after treatment; (A and C) labial view; (B) lingual view**



**Figure 6- (A) Before treatment; (B) 30- months after treatment; (C) labial view; (D) lingual view; (E) bimaxillary interception view.**

The postoperative situation indicated this restorative approach's exceptional potential to provide adequate function and esthetics and biomechanical integrity of structurally compromised anterior non-vital teeth restored by direct and indirect restorative procedures (Figs. 4 and 5). After 30 months of follow-up, there was no tooth mobility and no signs and symptoms; however, a slight change in the left central incisor's color was observed. The periapical radiograph revealed evidence of healing around the lateral margins of the lesion (Fig. 6).

## Discussion

The periapical radiolucency was noticeable in this case. It has been recommended that orthograde retreatment remains the first choice for management of postoperative endodontic disease.<sup>22</sup> Therefore, retreatment was undertaken for both central incisor teeth.

Pissis introduced the endocrown technique, describing it as the 'monoblock porcelain technique'.<sup>5</sup> The practical term "endocrowns" was first described in 1999 by Bindl, and Mormann<sup>23</sup>, as adhesive full-porcelain crowns placed on endodontically treated posterior teeth. These crowns would be anchored to the pulp chamber's internal portion and on cavity margins; thus, obtaining macromechanical retention provided by the pulp chamber walls (the cavity depth must be >3 mm); micro-retention would be obtained with adhesive cementation.

Generally, the clinical survival of restored teeth depends on the restorative material, technique, remaining tooth structure, and the interactions between material, teeth, and the oral environment.<sup>23</sup> Therefore, Otto and Mörmann (2015) reported survival rates of up to 12 years for endocrowns in molar and premolar teeth to be 90.5% and 75%, respectively.<sup>24</sup> Besides, Bindl et al. evaluated the performance of premolar and molar endocrowns and reported that premolars showed more failures than molars due to adhesion failure.<sup>18</sup> Adhesive failure in premolar endocrowns might be functional because of the diminished surface of adhesive bonding compared with molars, smaller pulp chamber for mechanical retention, and the increased proportion of the prepared tooth structure to the overall crown causing higher leverage for premolars than molars.<sup>25</sup>

In a notable attempt to improve the success of premolar endocrowns, the need for further intra-radicular extension might be a necessary prerequisite.<sup>26</sup> Gulec and Ulusoy compared two typical designs with and without intraradicular extension; they reported that the modified endocrown design with intraradicular extension protected the remaining tooth structure better than the conventional endocrown design.<sup>27</sup> Regarding the stresses in enamel, modified endocrown restoration design transmits less stress, highlighting a more tooth-friendly design. However, the local stresses in restorative materials and maximum principal stress values were higher with the

modified endocrown restoration design.<sup>27</sup>

Presence of a ferrule in full-coverage crowns supported by post and core was thoroughly investigated and well-acknowledged to increase fracture resistance and fatigue cycles to possible failure.<sup>28-31</sup> Einhorn et al.<sup>32</sup> investigated the consequence of the incorporation of ferrule features on molar endocrown failure resistance. The results showed that adding a ferrule to the preparation will increase the dentin surface area available for bonding. The overlooked importance of preserving a minimum amount (2 mm) of coronal dentin height after preparation in the fracture resistance and prevention of root fracture in endodontically treated teeth has been reported in various studies.<sup>33, 34</sup> Endocrown is presently considered a highly recommended restorative option for restoration of endodontically treated teeth. It preserves the tooth structure and has several mechanical and esthetic advantages.<sup>35</sup> However, its clinical application in teeth with small pulp chambers, such as lower anterior teeth, has not been reported.

In this case report, a modified conservative endocrown was considered for the right central incisor because of no pulp chamber space. Therefore, we used a 4-mm intra-radicular extension to achieve macromechanical retention. Since the residual labial structure was limited, a gingivectomy procedure was carried out to increase the tooth surface for micromechanical retention. Therefore, it was possible to provide conservative preparation with a shallow chamfer finish line. However, the ceramic thickness at the margins reached 0.5 mm, increasing the risk of marginal breakdown and ceramic chipping. The configuration of restoration and strong bonding between the ceramic and tooth structure resulted in distribution of the occlusal forces appropriately, preventing marginal breakdown. Clinical examination of this patient on the recall appointment after 30 months confirmed this opinion with normal overjet in anterior occlusion, and canine guidance in parafunctional movements, and there was discoloration in the left lower central incisor in maximum intercuspation occlusion as shown in Figure 6.

Various materials like feldspathic porcelain, glass ceramics, hybrid composite resin, and the novel computer-aided design/computer-aided manufacturing resin blocks can be used to fabricate endocrowns. In this specific case, lithium disilicate reinforced glass-ceramic (IPS eMax Ivoclar Vivadent) was used, which provided adequate mechanical strength and esthetics. Biacchi and Basting (2012) compared the compression forces of a traditional crown with fiber post and endocrown and reported more favorable results with endocrown.<sup>8</sup>

The endocrown fits perfectly with the bio-integration concept and can serve as the most conservative and esthetic option for non-vital teeth. However, other options could also be considered to manage this compromised case:

1. Dental implants: Evaluation of the remaining space between the left and right lower lateral incisors

showed insufficient space for inserting two dental implants in this area. Despite the apparent bone loss, there was a possibility of one dental implant insertion in this area and restoration with two units of the partial dental fixed prosthesis (cantilevered). This situation was controversial considering esthetics and dental implant survival rate.

2. Fiber-reinforced composite resin: It was controversial because replacing two extracted teeth increases the fracture risk of fiber-reinforced composite restorations. Furthermore, the composite wear, discoloration, and potential loss of its luster are undoubtedly among other disadvantages of this treatment plan.
3. Fixed partial dental prosthesis: The risk of pulpal exposure during preparation of malposed lateral

incisor teeth would be high. Furthermore, achieving a perfect esthetic outcome in such cases is extremely difficult by this method.

## Conclusion

Considering the clinical outcome after 30 months of recall, it seems that this type of endocrown can be a conservative treatment approach for restoration of endodontically treated anterior teeth.

## Conflict of Interest

No Conflict of Interest Declared ■

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**How to cite:**

Kermanshah H , Al-Tufaili MY, Ghabraei S, Sahibm AM, Sadeghi Mahonak F. Restoration of Endodontically Treated Anterior Teeth by Modified Conservative Endocrowns: A Case Report with a 30-Month Follow Up. *J Dent Sch* 2020;38(2):84-89.