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Endocrown: A new feather in evolution

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Abstract
The restoration of an endodontically treated tooth with minimal loss of tooth structure left behind is a challenging task for a clinician. The use of post and core was widely followed, but in cases of a short clinical crown its use was not recommended. The use of adhesive principle to restore a badly broken down tooth along with a monoblock concept has shown better outcome. Endocrown is a monolithic ceramic adhesive restoration with a cervical margin in the form of a butt joint and requires other specific preparation techniques. The preparation of an endocrown usually does not extend to any of the root canals except for its modification.

Keywords: endo crown, mutilated teeth, recent advances

Introduction
An extensively decayed tooth requires root canal therapy and buildup of the same for a proper rehabilitation of the tooth. The restoration of a badly broken down tooth is a very technique sensitive procedure. The restorative technique followed is mainly based mainly on the amount of tooth structure remaining, crown root ratio, the anatomy of the tooth and the location of the tooth. An endodontically treated tooth with insufficient coronal tooth structure left behind does not allow for a proper placement of the crown.[1]
A root canal treated toot is brittle when compared to vital tooth because of the loss of structure and integrity of the tooth. The removal of caries, fractured tooth cusps and to have an adequate straight line access of the endodontic cavity lead to an extensive loss of tooth structure.[2] The literatures have shown that the loss of marginal ridges, a large endodontic access, a wide preparation of root canals have led to a weakened tooth structure [3].

Restoration of tooth based on remaining coronal tooth structure
In case of a minimal loss of structure, in cases where the tooth requires endodontic treatment with very minimum amount of tooth loss an adhesive restoration would provide enough strength to withstand the forces acting on the tooth. Composite, Glass Ionomer, Miracle mix can be used as the restorative material [4].
A complete occlusal coverage in the form of full crowns, onlay can serve as a method of restoration of a badly mutilated tooth in which more than half of the crown structure remains [5]. In cases where more than half of the tooth structure is missing, a post and core followed by a full occlusal coverage must be followed. A ferrule should be incorporated in the preparation for a better retention. The posts can cause a weakening of the root canals and can lead to perforation or root fractures at times [6]. The rehabilitation of a grossly destructed tooth with loss of walls and a very short crown length is a challenging task. Orthodontic extrusion and crown lengthening is not always feasible in such cases. Extraction followed by replacement was the choice for such tooth [7]. Nayar *et al* has introduced a concept called as amalcore. Here 2-4 mm of gutta-percha is removed from the root canal and amalgam is inserted into the prepared canal space and the pulp chamber. The pulp chamber should have the strength to allow for the adequate amalgam placement [8].

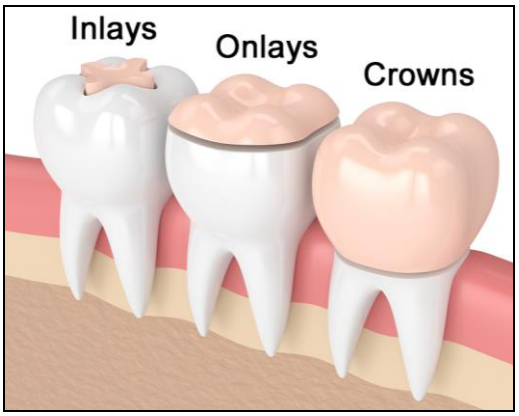

Fig 1: [Picturecourtesy:https://www.drellakofman.com/specialty/inlays-and-onlays/]

Endocrown
The adhesive dentistry has an immense role in the various fields of dentistry. The use of adhesive concepts in restoring tooth has proved to be of a great success because it preserves the remaining natural tooth structure. Bindl and Mormann in the year 1999 introduced the Endocrown as an alternative for the post and core followed by crown preparation. In 2008, Lander and Dietschi presented a clinical report on endocrowns, and in 2009, Magne and Knezevic who were concerned about the choice of reconstruction materials, considered ceramics versus composites for endocrown molar restorations [9, 10]. The main aim of endocrown is to provide adequate strength for the restoration to withstand the forces acting and is minimally invasive of root canals with maximum tissue conservation. It prevents the further weakening of root canals. The

endocrown has its preparation extending to the pulp chamber and not to the root canals. There are various techniques employed for the preparation of an endocrown namely, computer aided techniques and molding ceramic materials under pressure [11].

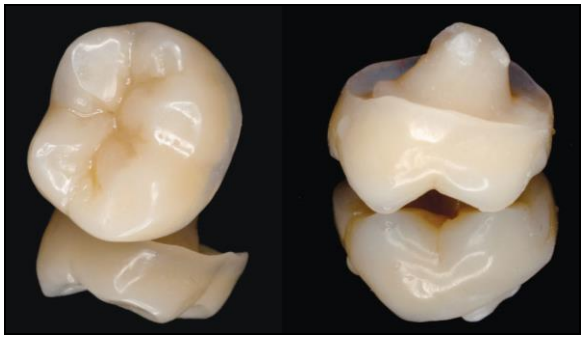

Fig 2: [PictureCourtesy:https://restorativedentistry.org/2018/08/27/the-endocrown-a-different-type-of-all-ceramic-reconstruction-for-molars-by-fages-and-bennasar/]

The endocrown is described as a monolithic ceramic bonded construction characterized by a supra-cervical butt joint, retaining maximum enamel to improve adhesion. The pulpal chamber and cavity walls contributed for the macromechanical retention whereas the adhesive material contributed for the micromechanical retention.
It's a monoblock porcelain technique. It can be used in cases of short clinical crown, calcified root, tortuous root anatomy. It has more esthetic value and require less chair side time. The endocrown has its finish line placed supragingivally allowing for a better health of periodontium. The endocrown is not indicated in case where there is a short pulpal chamber and the adhesion cannot be properly followed [12].

Preparation
The aim is to attain a full crown coverage restoration that is minimally invasive of root canals. The endocrown preparation is different from the conventional full coverage crowns. Apart from the conventional preparation of endocrown, studies have been done on the modification of endocrown designs. The pulpal walls and adhesive cement offer for the retention and the pulpal floor saddle ensures the stability.

Occlusal preparation
A minimum of 2 mm occlusal height reduction in the axial direction should be attained. The ceramic occlusal thickness is usually 3-7 mm. Studies indicated that the fracture resistance of all-ceramic restorations rises with the increase of occlusal thickness. The reduction can be done by making 2mm depth orientation grooves, then with a coarse grit wheel diamond occlusal surface reduction is done. The diamond is directed along the long axis of the tooth, parallel to the occlusal plane. The diamond shape ensures the proper reduction alignment and the desired flat surface, wherein the cervical margin or cervical sidewalk is determined. Ideally, the margins should be kept supragingival allover any undermined enamel with less than 2 mm thickness should be eliminated. The cervical sidewalk is the foundation of the restoration, the objective is to accomplish a wide, uniform, steady surface resistant to compressive stress.

Axial preparation
This step aims at removing the irregularities in the access cavity. A cylindrical-conical green diamond bur with a total occlusal convergence of 7° is used to make the coronal pulp chamber and endodontic access cavity continuous. The bur orientated along the long axis of the tooth, the preparation is carried out without excessive pressure and without touching the pulpal floor. The depth of the cavity should be at least 3 mm.

Preparation of the cavity floor
The preparation is cleaned upto the canal orifices. Gutta percha is removed to a depth not exceeding 2 mm to take advantage of the saddle-like anatomy of the cavity floor. A non-abrasive instrument should be used for the removal of gutta-percha. The pulpal chamber can be cleaned by using ultrasonics if needed.

Bonding
Adhesives such as self-adhesive agents or composites such as Multilink (Ivoclar, Schaan, Liechtenstein) are used for bonding the endocrown to the prepared tooth. [13]

Incorporation of ferrule and retentive grooves
Einhorn in his study evaluated the effect of incorporating ferrule in the preparation. It was concluded that adding ferrule to preparations increased the dentin surface available for bonding. However, there were milling limitations in reproducing the endocrowns inner surface. Hence, it was reported that the more complex the preparation design became because of the addition of ferrule, the resultant endocrown inner surface adaptation to the preparation seemed to reduce. They also concluded that ferrule-containing endocrown preparations revealed significantly superior failure loads than regular endocrown restorations. Another retentive feature is the incorporation of retentive grooves. Grooves were placed on the buccal and lingual axial surface of the external aspect of tooth surface [14, 15]. A study by Bindl and Mormann concluded that overall clinical quality of the endocrown was very good. Bernhart *et al* concluded that endocrowns is a promising result for endodontically treated toot. Biacchi in his study concluded that endocrowns were more resistant to compressive forces and a balanced stress distribution than conventional crowns. Endocrown can be used in restoration of endodontically treated tooth with short clinical crown. If adhesion cannot be ensured the endocrown technique should not be employed [17]. Because of the excellent biocompatibility and wear coefficient similar to natural tooth, glass ceramic can be used for the preparation of Endocrown [16].

Conclusion
Endocrowns have been used as an alternative to conventional post-core and fixed partial dentures in restoration of ETT with extensive coronal tissue loss. The endocrown is a simple, atraumatic restorative technique, without involving the root canals. The supragingival placement of cervical margin ensures a healthy periodontium. The endocrown is based on a monoblock concept which is fabricated either by pressure molding or computer aided technology. More researches have to be conducted on the endocrown design and its fabrication technique for premolars and anterior teeth.

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