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Endocrown: Reconstructing the molar

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Abstract
Endodontically treated molar which is weakened by removal of carious tooth structure and access cavity preparation, is generally reinforced using post and core treatment modality. Studies have shown that this further weakens the tooth as it requires removal of more tooth structure. Endocrown, is a more viable available since the advent of adhesive bonding in dentistry. A less extensive tooth preparation and monobloc prosthesis that can be bonded to remaining tooth structure, makes it superior to conventional methods. The improved stress distribution in this prosthesis imparts better fracture resistance thereby reducing failure rates.

Keywords: Adhesive prosthesis; aesthetics; endocrown; endodontically treated teeth; lithia disilicate

Introduction

"Aim of prosthodontics is preservation of what remains rather than replacement of what is missing" – MM Devan

MM Devan's dictum has been the guiding principle of dentistry. Reconstruction of endodontically treated tooth (ETT) with extensive coronal damage poses a challenge to prosthodontists. Teeth which are heavily damaged by dental caries or fractures have been conventionally reinforced with a post and core followed by a crown. The preparation of post space sometimes leads to thinning of roots, perforation etc. This is further complicated by the anatomy of the root, narrow canals or presence of retained broken instruments [1]. Earlier dehydration or physical changes in the tooth structure was thought to be the primary reason for reduced fracture resistance in ETT. However, now it has been proved that it is actually due to the loss of tooth structure caused by dental caries, fracture and large cavity preparation [2].

The type of post obturation restoration and materials used for ETT affects the longevity of the treatment [3]. Therefore for teeth with minimal loss of tooth structure, only conservative adhesive restorations such as composites are usually indicated [4]. Adhesively retained onlay and endocrown are indicated for cases where up to one half of the coronal tooth structure is missing [5]. However when more than half the tooth structure is missing, then post and core restoration becomes necessary to increases the strength of the tooth. The occlusal anatomy and function is then restored with a full coverage crown [6].

Recent studies show that post and core restoration do not increase the strength of the tooth but only act as a retentive aid for the coronal prosthesis [7, 8]. Such a restoration leads to multiple interface in the final prosthesis which further deteriorate the mechanical behaviour of ETT. Also the added risk of perforating the root or making it structurally weak by over preparation, has led to many authors discouraging the use of post [9]. The introduction of adhesion in dentistry, especially dentin bonding has opened doors to better treatment options for ETT [10]. Endocrown is a recently proposed alternative for restoration of such teeth with fixed prostheses [5]. Teeth with short clinical crown requiring crown lengthening procedure or teeth with calcified, curved or short root canals that are not conducive to receive post can be restored with endocrowns [7]. Increased fracture resistance, improved aesthetics, less cost and clinic time are the advantages of endocrowns [8]. These crowns are anchored to the internal portion of the pulp chamber and on the cavity margins. The macromechanical retention is provided by the pulpal walls, and micromechanical retention is obtained by the use of adhesive bonding [10]. On comparison, teeth restored by endocrowns were seen to be more resistant to failure than those with fiber reinforced posts as reported in a 3D Finite Element Analysis [11].

Case report

A 23 year old female patient reported with an endodontically treated 36, restored five months ago. On examination, it had an extensive post obturation composite restoration (Figure 1). There was no pain on percussion. Radiograph revealed the endodontic treatment was satisfactory (Figure 2). She had acceptable oral hygiene and favourable occlusion (Figure 3). The patient was selected for monolithic lithium disilicate (IPS e. Max CAD/CAM) endocrown restoration as she had adequate tooth structure for adhesive bonding.

Fig 1: Post obturation restoration in 36

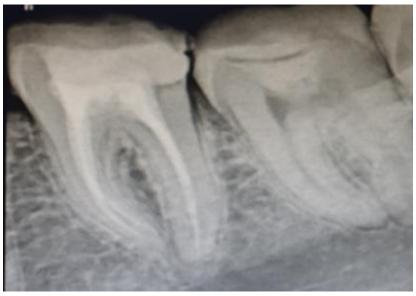

Fig 2: Radiographic evaluation

Fig 3: Pre-operative Occlusion

The preparation for endocrown is different from that of a conventional crown as it aims at preserving as much tooth structure as possible for adequate bonding to be achieved.

- The burs required for the preparation are TF-13, TR-13, WR-13 AND SF-13 (Figure 4).

Fig 4: Burs for preparation TF-13, TR-13, WR-13 AND SF-13 respectively

- Initially, the entire post obturation restoration is removed using a TF-13 diamond bur and the canal access openings are exposed. (Figure 5)
- A TR-13 bur is used to provide an occlusal divergence of 7° to the axial walls creating a continuity between the endodontic access cavity and the pulp chamber. The bur is placed parallel to the long axis of the tooth at all times. This prevents development of undercuts.
- Occlusal reduction is done using WR-13 bur initially to create a clearance of 3mm (Figure 6) and then refined with a sf-13 bur to develop a butt joint or a "cervical-sidewalk" for the occlusal margin (Figure 7). This helps resist the compressive stresses that are most common on molars [12].

Fig 6: Occlusal clearance of 3mm

Fig 7: Cervical Sidewalk

- Any enamel wall less than 2mm height has to be eliminated. The depth of the pulp chamber at this time should be a minimum of 3mm.
- The shape of the pulp chamber which is usually trapezoidal in mandibular molars and triangular in maxillary molars enhances the retention and stability of the restoration [13].
- Difference between the levels of various cervical margin should be linked with a slope of not more than 60° to avoid staircase effect [14].

A check cast was made to ensure no undercuts in the preparation. The pupal floor was lined with composite to prepare a flat base. Shade selection was done using Vita Classical Shade Guide. The impression was made with double mix single impression technique using *Zermack* condensation silicone (Figure 8). The prepared tooth was temporarily sealed with *MD-Temp* temporary restorative cement.

Fig 8: Impression

A bisque trial was done to confirm the margins and occlusion. The final restoration (Figure 9) was then adhesively bonded to the tooth using *Calibra*, a dual cure resin system (Figure 10).

Fig 9: The occlusal, distal, coronal and facial aspect of endocrown prosthesis

Fig 10: Post cementation

Discussion

The concept of endocrown follows the principle of minimal preparation. Bindl and Mormann [15], in 1999 proposed an alternative to the conventional post and core supported crown. They suggested a monolithic ceramic restoration which was developed based on the concept given by Pissis [16] who called it a 'mono-block porcelain technique'. A clinical report on endocrown was presented by Lander and Dietschi [17] in 2008 and in 2009, Magne and Knezevic [18], compared ceramics and composites as material for reconstruction of ETT with endocrown in molar.

The endocrown is applicable to most molars, particularly those with clinically low crowns, calcified root canals, or narrow canals. It is not recommended if adhesion cannot be assured, if the pulpal chamber is less than 3 mm deep, or if the cervical margin is less than 2mm wide for most of its circumference [13]. A minimum of 1.0-1.2 mm wide butt margin circumferentially and a central retention cavity inside the pulp chamber, helps construct both the crown and core as a single unit mono-block structure that does not take support from the root canals [15, 16]. The occlusal ceramic portion of the endocrowns is usually 3-7 mm. Increasing the occlusal ceramic thickness further increases the fracture resistance of the endocrown [19].

The pulpal chamber cavity provides retention and stability. This anatomy, along with the adhesive qualities of the bonding material helps to avoid including the canals in the preparation as a retentive feature. The compressive stresses are reduced as they are distributed over the cervical butt joint and the walls of the pulp chamber [13].

An in vitro study performed by Taha *et al*. showed endocrowns with axial reduction and a shoulder finish line had higher fracture resistance than those with butt margin. The butt joint being parallel to the occlusal plane, provides a stable surface that resists the compressive stresses [20]. According to Schultheis *et al*., endocrown is a better alternative for posterior teeth that are subjected to heavier occlusal forces [21].

In a study, equal stress were applied under masticatory simulation on endodontically treated molars restored with endocrowns and with post and core. The finite element analysis showed that endocrowns were more resistant to fracture than those with FRC post. Ideally placed endocrowns were neither damaged nor debond under physiological load [11]. Studies have shown fracture resistance of endocrowns are better than the conventional treatments [22, 23]. On comparing lithium disilicate ceramic and indirect resin composites, the former exhibited higher fracture strength than the indirect composite groups [24].

Zoidis *et al*. demonstrated that modulus of elasticity of the polyetheretherketone (PEEK) framework (4GPa) veneered with indirect composite resin for endocrown could dampen the occlusal forces protecting tooth structures better than ceramic materials. However further long-term clinical evidence is required [24]. According to Belleflamme *et al*., these are a reliable option in cases with parafunctional habits such [25]. The concept of endocrown has also been applied to maxillary premolars [26] and maxillary incisors [17] but the studies on these have been limited and hence these indications remain controversial [27].

Conclusion

Minimal invasion is dictating the future of dentistry and endocrown follows this principle. The preparation for endocrown is less when compared to the conventional approach for ETT. The integrity of endodontic restoration is maintained and the structure of roots are also not compromised thereby increasing the longevity of the tooth. The compressive forces are absorbed by the cervical butt joint and the shear forces are dispersed over the axial walls of the pulp chamber. The biocompatibility of ceramic restorations makes them more acceptable intraorally. The conservative approach, higher fracture resistance of the restoration, better aesthetics, low cost and reduced chair side time makes it a viable option to restore endodontically treated molars.

Conflict of interest

The authors declare that they have no conflicts of interest.

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