Original Article

ENDOCROWNS- A NARRATIVE REVIEW

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Abstract

Grossly destructed endodontically treated teeth restoration has been a challenge for several clinicians over the years, particularly thanks to loss of strength associated to taking away of pulp and surrounding dentin tissues. This successively affects tooth's long standing prognosis. the perfect restoration of an endodontically treated tooth has been a widely discussed and much controversial topic. With the event of adhesive systems, the necessity for intra radicular anchorage and thus the post core system is greatly reduced. So, for restoring grossly destructed endodontically treated tooth endocrown may be a suitable alternative to the conventional post core restoration and full coverage restoration. The preparation consists of a circular butt-joint margin and a central retention cavity inside the pulp chamber and lacks intra radicular anchorage. It embarks the concept of minimally invasive dentistry which acquires both macro-mechanical retention from the ground and walls of the pulp chamber and also micromechanical retention from its adhesive cementation. Without the necessity of a cast metal core or reconstruction with intracanal post, this idea promotes the stability and retention of the indirect restoration hereby reducing the treatment time. Thus, endocrown has become a promising alternative within the esthetic and functional rehabilitation of an endodontically treated tooth.

Introduction

Grossly destructed endodontically treated teeth restoration has been a challenge for several clinicians over the years, particularly thanks to loss of strength associated to taking away of pulp and surrounding dentin tissues. This successively affects tooth's long standing prognosis.[1]

For events of pulpal and periapical diseases passage treatment is usually done. If coronal restoration is deficient that results in failure of root canal treatment. The contamination of the basis canal system by saliva is the major cause of endodontic failure, which is mentioned as "coronal leakage" or "coronal microleakage. passage treated tooth are more prone to fracture due to extensive loss of dental tissues that has occurred because of deep caries, abrasion, or trauma. Rootcanal treated teeth are restored using many methods like composite resin direct filling, inlay restoration, onlay restoration, full crown restoration, and post-core crown restoration .[2]

There is much discussion and disagreement in the literature about the ideal restorative treatment. the first focus is on the need to preserve healthy dental tissue, perform less invasive restorative procedures supported by adhesive procedures that permits stabilizing the tooth / restoration complex. Post-core crown restoration may present additional risks, like root canal perforation and even root fracture. to beat these drawbacks, Endocrown emerged as an alternate restorative option for endodontically treated teeth. Endocrowns were first developed by Pissis in 1995.

History of endocrowns:

The term “endocrown” was first employed by Bindl and Mormann in 1999 which is described as a monolithic (one-piece) full-composite or full ceramic crowns which restore partially or totally the coronal part of a endodontically treated tooth. The supracervical butt , preserves maximum enamel to enhance adhesion and extended inside the pulp chamber could represent an alternative to classical treatments to restore endodontically treated teeth. They bond by two mechanism: one is macromechanical retention by being anchored to the interior portion of the pulp chamber and to the cavity margins and second one is microretention by adhesive cementation.[3]

Endocrown may be a new type of onlay with a retainer in the pulp cavity which consists of a cervical margin in the form of a butt joint and a preparation of the pulp chamber. the steadiness of the restoration derive from the adhesion of cementation and increased stress sharing as well as the interface provided by the pulp cavity retainer. This restoration method is suitable for severely damaged molars or premolars after dental pulp treatment . Compared with post and core crown techniques, endocrown restoration is easier because of the core-crown integrity; furthermore, no post is required , reducing the danger of root fracture. Full crown restoration is additionally widely performed. In onlay restoration, one or more cusps of tooth are covered. Onlay provides a positive distribution of stress, reducing the fracture risk of tooth or restoration or both[4]

On contrast to standard crowns , endocrowns are stress free procedure, requires short clinical time ,low cost, simple application, and more of aesthetic properties. Endocrowns have the advantage of removing lower amounts of sound tissue compared to other technique. When endocrowns are given the masticatory stresses received at the tooth/restoration interface are properly dissipated along the general restored tooth structure.[5]

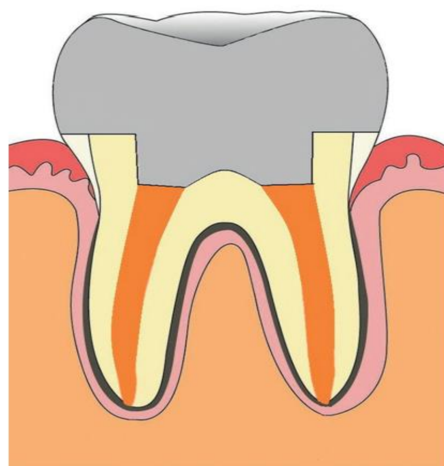
Finite element analysis and static loading tests suggest that molar teeth restored by endocrowns could withstand physiological chewing forces without fracture or debonding and under simulated masticatory function endocrown had lower dentin stress concentration than traditional post and core[6]

Fracture resistance values are higher for endocrowns in comparison to conventional crowns. just in case of compromised tooth integrity of endodontically treated molars, this restorative method provides adequate function and aesthetics. The results of static analysis like finite element (FE) cannot predict the danger of failure and longevity of dental restorations. to guage the probability of fracture in brittle materials, weibull analysis is usually used. For calculating the strain levels at selected levels and for predicting cumulative failure probablity, this method are often used with greater sucess[7]

Using numerical and acoustic emission analysis, the danger of endodontically treated teeth was evaluated. The initiation of fracture during this restoration depends on lots of physiological factors, especially changes of base geometry under load ,its biological condition and other physiological features [8]

Endocrown preparation:

Several studies suggest a 2 mm central retentive feature to afford the simplest possible retention and resistance features. Certain parameters are recommended which comprises cuspal reduction of 2-3 mm,90 degree butt margin, smooth internal preparation ,six occlusal cervical internal taper of pulp chamber, flat pulpal floor, supragingival enamel margins when possible. Increased fracture resistance has been reported thanks to incorporation of ferrule features with preparation. no matter kind of crown used, the importance of ferrule is being questioned.



Importance of ferrule:

Ferrule limits the bending of coronal structure in response to axial masticatory loads and it assists in transmission of those forces was considered critical to the mechanical properties of a restored endodontically treated teeth. Thus, ferrule effect improves stress distribution during bending and allows repairable restoration failures. Ferrule should be made consistent with available tissue, but with a minimal height of 1.5-2 mm. [9]

A ferrule effect is defined as a ‘‘360 degree metal collar of the crown surrounding the parallel walls of the dentine extending coronal to the shoulder of the preparation. The result's an elevation in resistance form of the crown from the extension of dentinal tooth structure. [10]

The composition of the bonding surface also as the residual amount of dental tissue, varies consistent with the preparation of the different marginal forms of endocrowns. A chamfer finishing line or butt joint of 90 degree are the different marginal forms of endocrowns. These are the 2 major margin preparations for endocrowns. A flat endocrown shows more residual tooth tissue and fewer bonding area, whereas a 90-degree shoulder endocrown results in a larger bonding area and less residual tooth tissue. Presence of ferrule effect and adhesion are considered the most effective conditions for long term success of post-endodontic restorations. However, just in case of severely damaged teeth there is little remaining tooth structure for the ferrule to be established and therefore the clinical serviceability of such teeth may be compromised. In such cases like crown lengthening and orthodontic extrusion have been suggested to provide additional coronal dentin[11]

The endocrown restorations reported a clinical success rate of 94–100% and demonstrated that the retention effect of endocrown restoration was superior thereto of traditional full crown restoration. Compared to other restoration methods these can preserve residual tooth tissue to a greater extent. sort of marginal form has a significant effect on the prognosis of prostheses after RCT and restoration with full crowns . to beat this, adding a 1-mm finishing line can increase the fracture resistance of endocrowns. The restoration ability of endocrowns is suffering from the bonding surface and the amount of residual tooth tissue. The factors affecting the longevity of endodontic treatment are the sort of restorative materials used and an appropriate restoration such that it conserves tooth structure.[6]

Materials used for endocrown fabrication:

All ceramic and ceramic-like restorative materials are often categorized into three groups. Glass-matrix ceramics are non-metallic inorganic ceramic materials that contain a glass phase and a dispersed crystalline phase (crystals) which incorporates feldspathic ceramics, synthetic ceramics, and glass-infiltrated ceramics. Synthetic ceramics can effectively prevent the expansion of cracks and improve the strength and cutting performance of the materials due to the greater presence of the crystalline phase than of the glass phase. Leucite-reinforced lithium disilicate and zirconia-reinforced lithium silicate ceramics are representatives of synthetic glass ceramics. Lithium disilicate

ceramic consists of about 70 vol.% of crystalline phase incorporated in the glassy matrix. it's widely used in clinical practice because of its good flexural strength and shade; however, it's also disadvantageous because the 15–20% contraction of the material after polymerization may lead to a reduction in the density between the onlay and teeth during the second sintering process. Zirconia-enhanced lithium silicate glass contains lithia and zirconia about 10 times more zirconium oxide than in traditional CAD/CAM glass ceramic. Its flexural strength can reach 450 MPa after glazing.[12]

Monolithic endocrowns are fabricated with different systems, including CAD and computer-aided manufacturing (CAD-CAM). CAD/CAM may be a type of computer-aided design and manufacturing software. The dental CAD/CAM system is employed to collect imaging data of digital impressions through a built-in camera and does not require the intermediate links of traditional restoration systems, like preparing molds and fillings. Therefore, this technique can avoid possible errors during milling with numerical control machine tools. due to its advantages in precision and clinical restoration, it's increasingly favored by patients and dentists. In recent studies, the system was wont to successfully prepare complex prostheses that cannot be produced by traditional methods and was found to significantly shorten the production time of restorations. together with the rapid innovations in digital dentistry, additional chair-side CAD/CAM materials are developed. [13]

Virtual impression technique system either uses direct digitalisation technique through intraoral scanners or indirect digitalisation technique represented by extraoral scanners. Intraoral scanners eliminate the necessity for conventional impression and its possible inaccuracies. Intraoral scanners (IOSs) became popular in dentistry, and therefore the number of commercially available IOS systems with enhanced speed, accuracy, improved patient comfort, and therefore the advantage of real time visualization has increased rapidly in the last decade. the info obtained are processed by the software program of the system to reconstruct a 3D representation of the desired object, allowing the dentist to capture 3D images of teeth, implant scan bodies, and soft tissues. Using extraoral scanners in dental labs become routine work nowadays, normally a master cast is poured from the impression then scanned, but with the advance in extraoral scanners technology it's now possible to scan the impression directly.

The bending moments on the restoration in incisors are above molars bonding surface of endocrowns in anterior tooth is an average of 30 mm^2 and is two times smaller than in molars 60 mm^2 .[14]

Retention of endocrown largely depends on adhesive cementation; therefore obtaining adequate bond strength employing a suitable adhesive method is essential. The immediate dentin sealing technique, seals the exposed dentin surface by placing a dentin bonding agent before impression taking since DBA appears to possess a superior potential for adhesion, its application is suggested immediately after completion of tooth preparation.[15]

Criteria for evaluating endocrown:

So far, only some studies on clinical reliability have been conducted, perhaps due to the lack of available evaluation tools. Until recently, the foremost commonly used evaluation criteria, like the USPHS or Ryge criteria, were incomplete concerning the carious process and therefore the new material used. The USPHS criteria lack sensitivity; for instance, the evaluation for the anatomic form criterion is predicated only on the continuity between the restoration and the tooth. The aesthetic and functional items weren't assessed. To avoid this problem, many authors used its own modified Ryge criteria, which created a body of literature extremely difficult to match. Despite this, new clinical evaluation criteria, better adapted to current objectives, for direct and indirect restorations are available since 2007, namely FDI World Dental Federation criteria. These criteria are divided into 3 groups (aesthetic, functional and biological parameters) and permit employing a range of selected items for a specific study. Differences in restoration quality are often easier to establish by increasing the number of scores available for each criterion. Moreover, a web based training and calibration tool (e-calib) for FDI criteria is out there to investigators, resulting in more homogeneous and consistent results [16]

Despite increasing popularity of endocrowns, whether this will replace the conventional restorative treatment associated with intraradicular retainer in endodontically treated teeth remains doubtful.[17]

Recent advancements:

A high -performance polymer, polyethertherketone (PEEK) has been recently introduced in dentistry. it's been used for fabrication of implant fixtures, fixed and removable dental prosthesis. the main advantage of this modified PEEK material is a elastic as bone and allowing it to act as a stressbreaker and reduce the forces transferred to the restoration and tooth root accordingly. PEEK blocks containing 20% ceramic fillers (bio HPP) has suitable biomechanical characteristics and exceptional biological compatibility benefits are removal of hypersensitive response,suitable surface finishing and tiny plaque attraction. Main improvement is 4 GPa modulus of flexibility creating it as flexible as bone and permitting to figure as a stress breaker. this will render the usage of peek a feasible alternate for the rebuilding of endodontically restored tooth [18]

Risk of debonding has been shown to be greater than risk of fracture,materials with greater adhesion values like lithium disilicate , are the simplest choice. Lithium di silicate glass could also be the best desirable materials for the construction of endocrowns due to the formation of greater bond between resin cement and tooth tissue. PEEK could be believed another structure material for endocrown restoration, the extra long term clinical proof is needed to determine the use of this material as an alternate for the usual ceramic.[19,20]

RATIONALE FOR USING ENDOCROWNS:

Since there's increased risk of root fracture and tooth fracture and need for removal of more sound tissue in post and core Pissis developed an adhesive endodontic restoration- a ceramic monoblock technique for extensive tooth structure loss cases in 1995.Endocrowns strictly follow the rationale of minimally invasive preparation due to decay-oriented concept.[21]

Bindl and Mormann gave the term " endocrowns" in 1999, defined it as a monolithic full- composite or full ceramic crowns which restore partially or totally the coronal a part of endodontically treated teeth. Being anchored to the interior portion of pulp chamber and cavity margins, and adhesive cementation these restorations acquires both mechanical and micromechanical retention. Endocrown may be a monolithic ceramic bonded restoration with supragingival margin keeping as much possible enamel for improved adhesion.

Indications:

Endocrowns are indicated if there's extensive loss to crown, and if there's limited occluso gingival space present. particularly , just in case of short, obliterated or fragile roots endocrowns are indicated.

Contraindications:

Contraindicated just in case of parafunctional habits like bruxism

In cases if adhesion can't be reassured.[22]

Advantages:

Easier to perform,

Requires low cost ,

Minimal tooth preparation,

Good biocompatibility,

Allows sealing of access to the basis canal,

Prevents bacterial microleakage that would possibly compromise the long term prognosis of endodontically treated tooth,

simple application,

More of aesthetic properties,

Better mechanical performance,

Reinterventions also can be done in this type of restoration23

Disadvantages:

Debonding

Risk of root fracture

The mean survival rate of conventional fixed partial dentures clearly exceeds the mean survival rate of adhesive fixed partial dentures but there are biological risks. Loss of vitality of the abutment teeth and therefore the occurrence of caries are more prominent with conventional fixed partial dentures than with adhesive fixed partial dentures.[24]Compared to standard crowns, endocrowns are stress free procedure, requires short clinical time ,low cost. Another advantage is that lower amounts of sound tissue is removed compared to other technique. When endocrowns are given the masticatory stresses received at the tooth/restoration interface are properly dissipated along the general restored tooth structure.[25]

Several finite element analysis and static loading tests suggest that molar teeth restored by endocrowns could withstand physiological chewing forces without fracture or debonding and under simulated masticatory function endocrown had lower dentin stress concentration than traditional post and core.[26]

Because of lesser tooth surface area in premolars, premolar endocrowns are less successful than molar endocrowns. Adhesion is affected in these cases thanks to their increased crown height. Endocrowns should be limited to posterior teeth [27]. The concept of endocrowns are extended to involve premolars and even incisors despite the debate regarding their biomechanical behaviour and long-term serviceability. There are not any definite preparation guidelines in literature to guarantee the best biomechanical behavior. Many preparation attempts are suggested especially concerning the occlusal surface to insure cuspal coverage and maximum fracture resistance of the restoration[28]

Diago Pedrollo Lise et al reported that this restorative approach was successful for 61 of the 70 restored molars (12% failure), while endocrowns on premolars underwent a better failure incidence of 31% (5 out of 16 restorations). Loss of adhesion was the sole failure reason for the premolars, thus indicating that the surface available for adhesive bonding might not have been large enough. Moreover, the unfavorable ratio between crown basis and crown height might cause a flash of force.[29]

The success rate and longevity and sturdiness of the endocrowns are unswervingly related to preparations of endocrowns, the restorative material, and punctiliously selection of bonding material. Since adhesive cementation is unconditionally required for the success of this restorative treatment[30,31]

Conclusion:

Correct treatment starts with correct diagnosis and treatment planning. Perfect treatment plan helps in fabricating an appropriate prosthesis. Better rehabilitation of restoration of severely damaged tooth is feasible with use of

endocrowns. More research in field of post endodontic restorations will end in better materials and viable option for making endocrowns more long lasting, easier and more aesthetically acceptable to patient. However results should be interpretated with caution since most of the studies are invitro and there's a need for further invivo studies. The endocrown restorations reported a clinical success rate of 94–100% and demonstrated that the retention effect of endocrown restoration was superior thereto of traditional full crown restoration.[30] Finally its important to note that proper case selection and vigorous extension of adhesive procedure is extremely essential for success of the treatment.

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