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Review Article

ENDOCROWNS : A REVIEW

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Abstract

The ideal restoration of endodontically treated teeth (ETT) has been extensively debated in the literature and controversially. Prevention of healthy dental structure is essential to help mechanical stabilization of tooth-restoration integrity, increase the amount of suitable surfaces for adhesion and thus positively affect the long-term success. The risk of biomechanical failure of ETTs is greater than that of vital teeth. The need for post-core restorations is decreased with the advancement of adhesive systems. Endocrowns have been used as an alternative to traditional post-core and fixed partial dentures, especially for the restoration of excessively damaged ETT. Endocrowns are a reliable alternative to molar restorations that are post-retained and seem promising for premolars. It is important to respect a certain preparation design and a rigorous adhesion protocol. Glass-ceramic lithium disilicate and nanofilled composite resin stand out among the available materials.

Keywords: Damaged endodontically treated teeth and Endocrown restoration

INTRODUCTION

It remains a challenge to restore extensively damaged endodontically treated teeth (ETT). Their biomechanical degradation affects the long-term prognosis of the tooth. The risk of biomechanical failure of ETT is higher than that of vital teeth and is a common problem in restorative dentistry due to fractures in such teeth. Loss of structural integrity associated with carries, trauma and extensive cavity preparation, rather than dehydration or physical changes in dentin, is the key explanation for reducing ETT's stiffness and fracture resistance. Biomechanical concepts say that a tooth's structural strength depends on the quantity and intrinsic strength of the hard tissues and the anatomical form's integrity. Studies are available that indicate the loss of the marginal ridges is the main reason for the decrease in durability (Suksaphar *et al.,* 2017). Some studies have stated that the preparation of the endodontic access cavity and root canal resulting in loss of tooth tissue enhances the brittleness of teeth rather than dentine changes (Suksaphar *et al.,* 2017; Tang and Smales, 2010). A research comparing the impact of endodontic and restorative procedures on cusp longevity has shown that endodontic procedures, occlusal cavity preparations, and MOD cavity preparations decrease strength by 5%, 20%, and 63%, respectively (Reeh *et al.,* 1989). The residual structure of the coronal tooth and the functional requirement are essential considerations to be observed for a treatment planning decision. Improved survival of endodontically treated teeth with adequate coronal cuspal coverage has been due to a decrease in microleakage and to the maintenance and protection of the remaining tooth. To reduce microleakage and consequently reduce the risk of endodontic treatment failure, immediate placement of a satisfactory coronal restoration has been reported (Ferrari *et al.,* 2000), while cuspal coverage and conservation of the residual coronal tooth structure have been reported to improve fracture resistance and the outcome of ETT (Dietschi *et al.,* 2008).

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MATERIALS AND METHODS

An electronic search in PubMed, Scopus, and the Cochrane Library of articles were conducted for last 10 years to identify all peer- reviewed English language papers using the terms ‘damaged endodontically treated teeth’ and ‘endocrown restoration’ as well as combinations of these and related terms. The following criteria were imposed for inclusion in the review: 1- studies evaluating endocrowns ,2- studies in English , 3- clinical and in vitro studies , 4- molar, premolar, and incisor restorations , and 5- materials used: ceramic and composite resin . Animal teeth, case reports, and full text not available in English were excluded from consideration. The studies judged to be relevant were criticallyreviewed, in addition to papers found during an additional manual search of reference lists within selected article.

RESULTS

The electronic search produced 100 outcomes using the search criteria. An initial assessment based simply on the titles resulted in the removal of 73 papers. 27 publications were kept after reading the abstracts, and the full text was then reviewed. Typically, limited loss of coronal structure points to teeth that have had little or no restoration but need root canal treatment. The proposal of many authors is to treat such teeth with only adhesive restoration that fills the access cavity and pulpal chamber (Robbins, 2002). The only contraindication to such a conservative approach is for patients with parafunctions, group guidance and step cuspal inclination, which may require full occlusal coverage (Sevimli *et al.,* 2015). A post-core restoration is not needed for teeth with ongoing medium-sized restorations that require root canal therapy. Total occlusal coverage, such as endocrown or onlay restorations, is suggested to create an even cavity preparation and fill undercuts through the use of a composite resin liner-base (Sevimli *et al.,* 2015). Sufficient surface and coronal structure for adhesion are restricted when more tissue is lacking. In this case, to guarantee tooth-restoration continuum strength and resistance to fracture, post-core restoration is necessary (Schwartz and Robbins, 2004). The adhesive techniques for post and core fabrication are suggested by current scientific evidence and literature. With a complete crown, occlusal anatomy and function are generally restored. However, this approach poses a higher biomechanical risk of failure directly linked to the amount of tooth structure missing (Dietschi *et al.,* 2008). The key benefit of adhesive restorations is that, as long as adequate surface is available, macroretentive elements are no longer mandatory. With this method, when applying traditional restorative methods, the insertion of radicular posts has become the exception rather than the norm. In fact, minimally invasive preparations, with optimum tissue conservation, are now considered 'the gold standard' for restoring ETT (Dietschi *et al.,* 2008). Endocrowns are used as a prosthetic alternative in the reconstruction of endodontically treated incisors (Zarone *et al.,* 2006), premolars (Lin *et al.,* 2011) and molars (Biacchi and Basting, 2012; Bindl *et al.,* 2015) with excessive tissue loss, following this rationale.

The predecessor of the endocrown method was Pissis (Pissis, 1995), who described it as the 'mono-block porcelain technique. 'In 1999, Bindle and Mörmann identified the endocrown as adhesive endodontic crowns for the first time and characterized it as complete porcelain crowns fixed to endodontically treated posterior teeth. These crowns will be anchored to the inner portion of the pulp chamber and to the margins of the cavity, so that the pulp walls provide macromechanical retention, and the use of adhesive cementation obtains micromechanical retention (Bindl and Mormann, 1999). This approach is especially indicated in cases where excessive loss of crown tissue occurs, interproximal space is limited, and conventional post and crown reconstruction is not possible due to insufficient ceramic thickness (Chang *et al.,* 2009). Endocrowns are easy to apply and require a short clinical duration compared to traditional crowns. The benefits of endocrowns are low cost, short preparation time, ease of application, reduced chair time and esthetic properties. Furthermore, endocrowns are an option in teeth with short or atresic clinical crowns, calcified, curved or short root canals that make post application extremely difficult[7].

Preparation technique for endocrowns

The preparation of the endocrown consists of a circumferential butt margin of 1. 0-1. 2 mm depth and a central retention cavity within the pulp chamber, constructs both the crown and the core as a single monoblock structure unit, and does not take support from the root canals (Pissis, 1995; Bindl and Mormann, 1999). A 3 mm cylindrical pivot diameter and a 5 mm depth for the first maxillary premolars and a 5 mm diameter and a 5 mm depth for molars are the proposed measurements (Pissis, 1995). The thickness of the occlusal ceramic portion of the endocrown is typically 3-7 mm. An in vitro study revealed that ceramic crown fracture resistance increases with increasing occlusal thickness (Tsai *et al.,* 1998). Mörmann et al. (1998) observed that the fracture resistance of endocrowns with an occlusal thickness of 5. 5 mm was two times greater than that of ceramic crowns with a classical preparation and an occlusal thickness of 1. 5 mm. No substantial differences in fracture resistance between pulp-chamber extension endocrowns measuring 2, 5 or 5 mm have been identified. With increased depth, the incidence of catastrophic fracture rates increased. Putting a fiber composite on the pulp chamber floor did not impact fracture resistance (Fernandes da Cunha *et al.,* 2017) or marginal endocrown adaptation (Fages and Bennasar, 2013) with regard to the formation of a pulp chamber floor.

Survival and success of endocrowns

Data were collected for molars, premolars, and incisors. The findings of clinical and in vitro studies indicate that endocrowns are an ideal treatment solution for molars. In the short, medium and long term, excellent survival rates for molars have been recorded. Survival rates were higher than 90% between 6 months and 10 years (Sevimli *et al.,* 2015; Bindl and Mormann , 1999; Otto, 2004). These rates were comparable in studies that also examined survival rates of traditional crowns (Govare and Contrepois, 2020). Clinical performance is also satisfactory and comparable with that observed for molars restored with traditional crowns. Moreover, with 6% of root fractures for endocrowns and 29% for crowns, endocrowns had less catastrophic failures than crowns (with or without post-retained restoration). Many of the endocrown failures is attributable to loosening (71%) (Govare and Contrepois, 2020). For premolars , survival rates ranged between 68% and 75% at 55 months and 10 years (Decerle *et al.,* 2014; Otto, 2015), while survival rates were found for traditional crowns on premolars of 94% and 95%. A higher failure rate was reported by clinical trials than for molars. All failures in premolar clinical trials were due to loss of adhesion and were, thus, repairable (Govare and Contrepois, 2020). The few available trials and the conflicting results found for incisors made it difficult to draw any conclusions about the use of endocrowns as an alternative treatment for this type of tooth (Al-Dabbagh, 2020).

Restorative Material Selection

The need for using posts-cores has decreased with the advent of adhesive dentistry. In addition, the appearance of high mechanical strength ceramics capable of being acid etched (such as those reinforced with leucite or lithium disilicate), combined with adhesive systems and resinous cements, made it possible to restore posterior teeth, especially molars, without cores and intraradicular posts (Sevimli *et al.,* 2015). The alternative restoration options for large cavities in posterior teeth are the indirect composite and porcelain laboratory systems. Indirect porcelain or composite resin inlays manufactured in laboratory rehabilitate the mechanical and biological function while providing optimum esthetics with minimal tooth preparation (Govare and Contrepois, 2020). Due to their elasticity modulus, which is close to that of dentin, nanofill composite resins have some interesting characteristics for endocrown development and thus restrict irreparable fractures while maintaining a high resistance to fracture.

A decrease in the elastic modulus, however, decreases the stress of the dentin while increasing it at the interface, contributing to the possibility of debonding and prothesis detachment (Zhu *et al.,* 2017). Moreover, for the various materials considered, the fracture resistance observed was mainly greater than the masticatory forces. Since the risk of debonding has been found to be greater than the risk of fracture, the safest option is to use materials with the highest adhesion values, such as lithium disilicate. With composite resin, the esthetic properties of this material are unparalleled, which can be a benefit for some patients. Ceramics also age better and have a lower preservation of plaque than composite resins (Kamonwanon *et al.,* 2017).

Conclusion

Endocrowns appear to be a promising, conservative, and affordable restorative alternative for endodontically treated posterior teeth with appropriate long-term survival in selected patients using standardized clinical procedures.

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