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Comparing Endocrown as Restoration of Root Canal Treated Molars and Premolars: A Review Article

Maha Mezied[1*], Ahmed Alharbi[2], Renad Alsihani[3], Alaa Alluqmani[4] and Sana Alkhamis[3]

[1]Prosthodontic Department, Riyadh Elm University, Prince Abdulaziz bin Musaed bin Jalawy, Riyadh, KSA, Saudi Arabia

[2]College of Dentistry, King Saud bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia

[3]Dental Education Department, Majmaah University, Alzulfi, Saudi Arabia

[4]General Dentist, Ministry of Health, Saudi Arabia

[*]Corresponding e-mail: Maha.s.s.mezied@hotmail.com

ABSTRACT

At the end to provide a comparative review of endocrown restorations for endodontically treated molars and premolars. Endocrowns are one of the treatment options for endodontically treated teeth which is more conservative than a post-core retained crown. Endocrowns can be a reliable option for premolars as in molars. The restorative dentist might be hesitant to use endocrowns for molars and premolars in their clinical practice because they are unconventional fixed restorations. This article aims to provide a review of a comparative review of endocrown restorations for endodontically treated molars and premolars. Enodcrowns are more practical, conservative, and less technique sensitive. It's indicated in posterior teeth and showed better performance in molars than premolars.

Keywords: Endocrowns, Molars, Premolars, Endodontically treated teeth, Crowns

INTRODUCTION

Root canal-treated teeth are more brittle than natural teeth [1]. Due to different reasons for this increased fragility, after root canal treatment tooth will lose the nutritional support of the pulp, loss of structural integrity, decrease in strength of dentin with ageing, loss of proprioception, which lead to tooth fracture [2-5]. Posterior teeth are subjected to higher occlusal load which prone them to fracture [6]. The usual approach for restoring endodontically treated teeth is post and core-supported crown [7]. The removal of the healthy dental structure during post preparation will weaken the tooth structure [8,9]. A ferrule of 1.5 mm to 2 mm is needed and in some circumstances, additional treatments such as crown lengthening methods are recommended which may compromise the periodontal condition of the tooth [10]. Furthermore, removing enamel during preparing a ferrule is unfavourable as it is important for adhesive restoration techniques [11]. Endocrown is one of the options which is more conservative than posts and cores retained crowns. Endocrowns were first developed by Pissis in 1995 which consists of monoblock restoration which restores partially or the coronal part of root canal treated teeth, indicated in cases like missing two or more axial walls of the endodontically treated tooth [12,13]. A commonly used two-step suggested treatment option of placing a conventional post and core followed by a full converge crown [14]. The main disadvantage is time-consuming and it can be reduced with a one-step procedure using endocrowns that are more applicable in terms of time and costs [15,16]. Endocrown is indicated for the endodontic restoration of severely damaged posterior teeth especially these cases with low interocclusal space, calcified root canals, or very slender roots [17,18]. A systematic review and meta-analysis by Thomas, et al. showed no difference in the failure rate of endocrown between molars and premolars [19]. Marwa EI Elagra, demonstrated that due to the different mechanical and aesthetic advantages of endocrown it is a strongly recommended treatment choice for restoring endodontically treated posterior teeth with higher advantages for molars than premolars [20]. This study is motivated by the fact that, to date, the only limited study provides a comparative review of endocrown restorations for endodontically treated molars and premolars.

LITERATURE REVIEW

Preparation Technique

Endocrown is an adhesive restoration that will invade the pulp chamber only to give stability and retention with a supragingival butt joint and preserve as much enamel to enhance adhesion [17]. Several studies describe endocrown tooth preparation following Bindle and Mormann technique. Some studies mention some modifications to the original preparation [21]. Regarding the finish line, some studies used butt and chamfer finish lines [22-24]. However, in absence of ferrule, a concave bevel on the enamel margin can increase adhesion and improve the biomechanical characteristic of the endocrown [25]. The occlusal preparation of endocrown molar and premolar is the same in occlusal surface but the difference is in-depth dimensions measurements which are 3 mm diameter cylindrical pivot and 5 mm depth for the first maxillary premolars and 5 mm diameter and 5 mm depth for molars [17]. The occlusal table of premolar should be flat to reduce the crown hight and shallower fissure to reduce cuspal deflection during mastication [26]. The thickness of the endocrown occlusal portion is usually 3 mm-7 mm. Mormann, et al. showed that endocrown with 5.5 mm thickness occlusal thickness fracture resistance is greater than endocrown with 1.5 mm occlusal thickness [27]. Another in vitro study by Tsai, et al. showed that increases fracture resistance with a greater occlusal thickness [28]. However, axial surface preparation should be parallel to the long access of the tooth with an occlusal taper of 7 degrees [17,29].

Indication and Contraindication

The indications of endocrowns include extensive tooth defects, cases where the intermaxillary space is inadequate, if the available thickness is not sufficient for ceramic material, when post and core are contraindicated, and in teeth where the use of conventional crown is not possible due to anatomical variation of the posterior root [30]. Also, it is used in cases with well endodontically treated teeth, where Supra-gingival interproximal margins are available and if there is sufficient height and thickness of the buccal and palatal cusp [31]. For molars, the endocrown is suitable in most cases especially those with very slender roots or classified canals and low clinical crowns [32]. Endocrowns is a reliable option in a patient with extensive occlusal loss and those who have occlusal risk factors, such as unfavourable occlusal relationships and bruxism [24]. The main difference between molar and premolar is the pulp chamber diameter and the recommended diameter measurement is 3 mm cylindrical pivot for the first maxillary premolars and 5 mm diameter for molars. The depth of the pulp chamber is the same, it is 5 mm for the first maxillary premolars and molars [30]. The greater the pulp chamber extension the better the mechanical property [33]. Endocrown is contraindicated if the pulp chamber is less than 3 mm and if most of the cervical margin circumference is less than 2 mm. Also, it is contraindicated if isolation is not sufficient, and adhesion cannot be assured [32]. Endodontically treated premolars with complete crown loss should be restored with a post-build-up instead of endocrown [21].

Material Preference

Most of the studies of endocrown usually talk about glass-ceramic material especially feldspathic ceramic or CAD-CAM material, but in Bindl's study, he used Ceram alumina and Ceram spinell [21,34-37]. Nowadays, many materials available can be used in the fabrication of endocrown restoration such as feldspathic and glass-ceramic, hybrid resin composite, the recent material CAD/CAM ceramic, and resin composite blocks like hybrid nanocomposite ceramic [38,39]. In Otto and Mormann's study, they utilize the machinable composite material, which is close to dentin in elasticity that makes it a good option as an alternative treatment for ceramic endocrown [36]. An *in vitro* study showed that CAD/CAM composite performed better than all-ceramic crowns and endocrowns, using a Scanning Electron Microscope (SEM) showed dentine microcracks caused by a load of material of the restoration, which ceramic show dentine cracks, but composite didn't cause dentine crack and composite can be repaired and adjusted chairside and save appointment time [40]. However, through all the available material this study compares the success rate, stability, and fewer laboratory steps of all the material ceramics available, Starting from porcelain such as IPS e.max Ceram also, glass-ceramic such as leucite and lithium disilicate, alumina such as in-Ceram Alumni, zirconia [41]. In addition, another study used a monolithic feldspathic block without any framework or reinforcement [21]. Also, lithium-disilicate reinforced glass-ceramics are excellent material and have higher flexural strength than feldspathic ceramic [42,43]. Ceramic is stiff material but has less elasticity, which can cause fracture for the restoration [44]. Toman and Toksvul suggest restoring molars using stronger material like lithium dislocate [45]. An endocrown restoration is a reliable option for endodontically treated teeth due to fabrication using CAD/CAM and Nano resin ceramic

blocks which give advantages like mechanical performance, less cost, short appointment time. The new nanoceramic resin restoration materials have benefits of having high elastic modulus like dentin, with less spread defect, high fracture resistance but it showed high microleakage, and nanoceramic is not strong compared to lithium disilicate ceramics under lateral forces, but the nanoceramic show higher survival rate than translucent zirconia in endocrowns [46]. In addition, hybrid resin nanoceramic is used as a material option for endocrowns [47]. The previous study advises avoiding using IPS-empress ceramic crown until more long-term evidence are available [48]. A clinical study evaluated the performance of monolithic zirconia endocrowns with extensive coronal loss molars, the results showed that monolithic zirconia restoration can be used to restore posterior teeth especially molars with an extensive coronal loss after root canal treatment [49].

Cementation

The dentin bonding system used dual-cured luting composite, in which after insertion of restoration moderate pressure was applied and cured the restoration by light-emitting diode system 1100 mW/cm^2 for 40 seconds for each margin [50]. Moreover, the main reason for failure in dual-cure luting cement or glass-ionomer is the fracture of the restoration [51]. In addition, both bonded resin composite and self-adhesive resin cement, have no impact on marginal integrity between the restoration and tooth, the adhesive and luting resin was cured and polymerized by the light cure unit with 800 mW/cm^2 for 4 minutes for each tooth, and the result concluded that self-adhesive resin cement was not recommended [52]. However, after enamel was etched with orthophosphoric acid the bonding was used in self-adhesive cement and light-cured following the manufacture instructions [23]. Furthermore, all endocrowns were using self-adhesive cement luting and the mode of application by following manufacture instruction which is the application of pressure on the restoration and remove the excess materials then light curing for 200 sec in total and 40 sec for each surface [44]. On other hand, Bindl's study is the only study that used light-cured resin composite. Self-etching primer, adhesive, and bonding brushed on dentin for 20 seconds, after preventing the pooling of bonding by air spray. Then light-cured used for 60 seconds at 750 mW/cm^2 [53]. The adhesive failure can be due to light cure and resin-based composite, and this can result due to lack of curing time or penetration which is can lead to lack of polymerization of the cement, which leads to reducing the strength of bonding [54,55]. Moreover, in endocrown this issue can be critical due to the increased thickness of ceramic compared to other restorations, thus thickness affects the polymerization of light-cured and dual-cured cement [56]. However, in vitro studies have shown that increasing light-curing time using halogen lamps over 1200 mW/cm^2, or high-irradiance LED (1200 mW/cm^2) can result in adequate polymerization in both dual-cure and light cure cement [57,58]. Furthermore, the dual-cure cement provides chemical and micromechanical bonding to the tooth structure [59]. In combination of total-etch and self-adhesive increase the retention and bonding strength [60,61].

Mechanical Properties

A systematic review of clinical studies examined the success rate of endocrown on both molars and premolars and found them to be similar: premolar success rate was about 68.75% to 100% and molar success rate diversified from 72.73% to 99.57% [19,22,23,53,62].

A meta-analysis of four studies concluded that there is no statistically significant variance in the failure rate of endocrown between molars and premolars [22,24,36,53]. The main finding of the review is that regardless of prior evidence, endocrown on premolar can be as reliable as on molars [53]. The available evidence proposed that endocrowns on premolars and molars have a similarly high rate of longevity and premolar may be considered as candidates for endocrown [19]. The most common mode of failure of endocrown was an adhesive failure or debonding in both molars and premolars. Another cause for failure was the fracture of the restoration [19]. In another systematic review, Three of the studies showed bulk fractures, of which five were in molars and two in premolars [24,36,63]. In which the fracture can occur due to the material used or to insufficient management of occlusal stress [64]. An elevated failure rate of restorations in patients with parafunctional habits and determined the risk to be 2.3 times higher in patients with bruxism than in those without bruxism [65]. Bindl reported that the failure rate of endocrown on Premolar was higher than molar, this could be due to the fact of increasing the available surface for adhesive bonding on molars more than on premolars, while the ratio between crown basis and crown height may lead to higher leverage for premolar than for molar endocrowns. Survival rates of endocrown were also considerably lower than those obtained for molars or premolars restored with crowns [53]. Also Derleme, et al. suggested that loss of adhesion of endocrowns on premolars is attributed to decreasing surface of adhesive bonding in premolar more than in molar [66]. Elagra, justified the same

mode of failure in premolar endocrowns mentioning that bonding failure may occur due to the reduced premolar surface of adhesive bonding in contrast to molars, and the increased ratio of the prepared tooth structure to the overall crown leading to elevated leverage for premolars than molars [20].

Fages, et al. observed after up to seven years of clinical service for the chairside CAD/CAM restorations with reinforced feldspathic ceramic that the survival rate of endocrown is a probability of 98.66%, which is a very respectable clinical outcome, and the findings are acceptable in private practice. The success of endocrown can reach 100% and is considered effective for restoring the molar sector [23].

CONCLUSION

Enodcrowns are more practical, conservative, and less technique sensitive. It's indicated in posterior teeth and showed better performance in molars than premolars. The results from the individual studies showed no statistically significant difference in the success rate of endocrowns between molars and premolars but the failure rate of endocrowns was higher in premolar than molar. Need more studies directly comparing the clinical performance of endocrowns on molars and premolars to confirm the findings.

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Conflicts of Interest

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