Dental
Communication

Crown or Not to Crown Root Canal Treated Teeth Minireview

Abdulaziz A. Algadhi[1], Abdulrahman S. Aljuman[1], Abdulkreem M. Hummadi[2], Naif I. Alqunfuthi[2] and Mohammed M. Al Moaleem*[3]

[1]*Restorative Dental Since Department, College of Dentistry, Jazan University Jazan Saudi Arabia*
[2]*Dental Intern, College of Dentistry, Jazan University, Jazan Saudi Arabia*
[3]*Department of Prosthetic Dental Science, College of Dentistry, Jazan University, Jazan 45142, Saudi Arabia*

ABSTRACT

Root canal treatment through cleaning, shaping and apical sealing are crucial for periapical healing. Moreover, Coronal restoration of the root canal treated tooth is required to prevent coronal leakage and to provide function and aesthetic. The quality and timing of the final restoration has its effect on the survival and success rate of endodontically treated tooth. It has been found that full coverage restorations show a higher long-term survival rate than direct restorations. Direct restoration has an excellent short-term survival rate comparing to crowns or onlays. Long term survival is the main criteria of successful endodontic treatment. Full coverage restorations show a higher survival rate than direct restorations. The definitive restoration should be placed as soon as RCT completed. It has been shown that time of crown placement after endodontic treatment affect the survival rate of endodontically treated teeth. Finally, no need for a post if the remaining tooth structure can withstand the core material.

KEY WORDS: ROOT CANAL TREATMENT, CROWNING, SURVIVAL RATE.

INTRODUCTION

Endodontic therapy has a success rate up to 86-98% (Song et al., 2011; Mustafa et al., 2021). However, a successful endodontic treatment does not depend only on a good root canal therapy, but good restorative treatment is crucial (Gillen et al., 2011). Completing the root canal treatment is not the end of the story, the tooth needs to be restored back to normal function, form, and aesthetic. The quality of the final restoration has its effect on the survival and success rate of endodontically treated tooth (Mannocci and Cowie., 2014; Bhuva et al, 2020). Well-sealed coronal restoration will prevent the ingress of microorganisms (Bayram et al., 2013). Swanson and Madison highlighted that coronal leakage is a major factor leading to endodontic treatment failure (Swanson and Madison., 1987; Mustafa et al., 2021). A meta-analysis published in 2008 stated that endodontically treated teeth with adequate restorations have a higher success rate comparing to poor quality restored teeth (Ng et al., 2008).

Effect of Endodontic Treatment on Teeth: A study done in 1992 investigated the physical and mechanical properties of dentine from vital and endodontic treated teeth at different hydration level. They found that neither root canal treatment nor dehydration has an effect on the properties of dentine (Huang et al., 1992). Another study found that endodontically treated teeth are not brittle compared to vital teeth (Sedgley et al., 1992).

On the other hand, it has been shown that the medicaments and irrigants used in endodontic treatment can change the physical properties of dentine. For example, long term use of calcium hydroxide can have an effect on the dentin, making it more brittle and prone to fracture (Grigoratos et al., 2001; Andreasen et al., 2002). Furthermore, it has been studied that using calcium hydroxide ($Ca(OH)_2$) dressing for 5 weeks or more will decrease the fracture resistance of the root (Andreasen et al, 2002; Batur et al, 2013; Zarei et al., 2013). They found also that irrigation and disinfection used in root canal therapy

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can interact with organic contents on the tooth lead to decrease in the modulus of elasticity of the dentine (Andreasen et al., 2002).

No doubt that sodium hypochlorite (NaOCl) and Ca $(OH)_2$ are important for adequate and successful root canal treatment, but they affect the strength of the remaining dentine (Ng et al., 2011). It has been found that using of NaOCl with concentration over 2% has a negative effect on collagen within the dentine (Kishen 2015). Recently, Bel Haj Salah et al., (2021) have showed the contribution of Bio Root Root Canal Sealing in the healing of periapical lesions, accordingly, bioceramic-based sealers seem to optimize the prognosis of root canal treatments. There are other factors that can lead to a weakening of the remaining tooth tissue such as a change in proprioception and tooth architecture (Eliyas et al., 2015). It has been found that access cavity preparation increased deflection of cusps during function and eventually increase the micro leakage and cusp fracture (Gutmann., 1992; Pantvisai and Messer., 1995).

Literature reports a huge reduction in tooth stiffness from 14-44% following occlusal cavity preparation, and 20-63% following mesio-occlusodistal (MOD) cavity (Geistfeld 1981). It is a fact that most teeth requiring endodontic treatment have had caries, restorations, cracks, and trauma which might be the reason behind the tooth weakness (Eliyas et al., 2015). Proprioception is affected by endodontic therapy. Non-vital teeth show a higher pain threshold and thus increased occlusal loading. It has been found that proprioception is decreased by 30% after endodontic treatment (Yu and Abbott., 1994).

Timing of restoration: It has been found that well sealed coronal restoration leads to successful endodontic treatment than good quality obturation (Ray and Trope., 1995). Before thinking of the final restoration, we should consider the following: pre-endodontic status of the tooth and surrounding structure, quality of the root canal filling, location of the tooth, and types of restoration to be used. If the root canal treatment satisfactorily completed and with no symptoms, it is sensible to place the final restoration immediately especially in a case of previously uninfected and vital tooth. However, if the tooth was symptomatic with periapical pathology, postpone the final restoration until symptoms subside is wiser until there is a clinical and radiographic prove of success. If the tooth had a small periapical lesion which is about 2mm or less, final restoration can be placed. Whereas, pre-operative large periapical radiolucency needs a review term before placing the definitive restoration (Mannocci and Cowie, 2014 ; Bhuva et al., 2020; Alserhan et al., 2021).

In questionable prognosis teeth, the dentist should protect the tooth direct after the root canal treatment with a good quality plastic restoration or stabilize the tooth with orthodontic band until there is a clear clinical and radio graphical evidence of success (Mannocci and Cowie, 2014). Placing an expensive coronal restoration such as gold crown or ceramic restoration might be the wrong decision if the prognosis of the root canal treatment is guarded. Periapical pathology may take several months or years, however, good quality permanent coronal restoration should be placed in order to guard the root canal system from any leakage and bacterial contamination (Bjørndal and Kirkevang., 2018, Alaki et al, 2021).

The dentist should be aware of the factors lead to endodontic failure which needs a review appointments and regular check-up before considering extra coronal restoration. Some of these factors are large periapical lesion, persistence of bacteria, overextended root filling, and complications during instrumentation such as ledges, and perforations (Tabassum and Khan et al., 2016; Bjørndal and Kirkevang., 2018; Bhuva et al., 2020). The definitive restoration should be placed as soon as the endodontic treatment finished. Endodontically treated teeth are more susceptible to fracture because of several reasons mentioned above: loss of proprioception, altered architecture of the tooth, and altered physical properties of the dentine. It has been found that the survival rate of RCT tooth received coronal coverage within 4 months of treatment was 85%, on the other hand, the survivability of tooth received crown after 4 months was 68% (Pratt et al., 2016).

Methods of restoring root canal treated (RCT) molars: The best plan for successful restoration is by a thorough examination of the tooth for caries or fracture before starting endodontic treatment. The dentist should assess the restorability, periodontal status, occlusal function, crown-root ratio, and biological width. If these factors are satisfactory, then treatment can be initiated. Practitioners should remove all existing fillings, build-ups, or crowns, when possible, before endodontic treatment. This will lead to more accurate assessment of the remaining tooth structure (Schwartz and Jordan, 2004; Alaki et al., 2021; Alserhan et al., 2021).

Direct Restoration

Amalgam: has been used for decades with long-term success. The use of amalgam decreased because of the patient concerns about toxicity and increasing demand for more esthetic restoration. However, amalgam is a safe material, has a high compressive strength makes it a good choice as a cusp coverage restoration (AFFAIRS ACOS, 1998).

Amalgam is not an adhesive restorative material; however, it has been found that bonding the amalgam restoration to tooth structure increases the fracture resistance of the tooth. Furthermore, they found that not statistically differences between bonded amalgam group and sound teeth in fracture resistance (Sagsen and Aslan., 2006; Alaki et al., 2021; Alserhan et al., 2021).

Composite: resin restoration can be used as a definitive restoration for posterior teeth especially when the access cavity is conservative (Mannocci and Cowie, 2014; Bjørndal and Kirkevang., 2018). Composite most

commonly used as a core material before crowning procedure. Composite has a lower compressive strength than amalgam restoration.

Glass ionomer (GI): has found to be as good coronal seal as an intact crown for eight weeks testing period. It has a good antibacterial effect and it bonds chemically to tooth structure (Bobotis et al., 1989). This makes it a good interim restoration until the definitive restoration placed.

Indirect Restoration

Gold Restorations: (crowns/onlays & inlays) are biocompatible material, long lasting restoration for posterior teeth. Gold restorations consider a conservative approach comparing to ceramic or zirconium which need more tooth reduction (Felden et al, 2000; Alaki et al, 2021; Alserhan et al, 2021). It has been found that cast gold restoration has a higher survival rate in comparison to amalgam and composite (Stoll et al, 1999). If esthetic is not a major concern, gold is still the first choice in posterior teeth. Porcelain Fused to Metal: crowns are the most commonly used indirect restorations in posterior teeth. Preparing the tooth for a PFM crown needs more reduction than gold crown especially in the buccal aspect of the tooth. The non-aesthetic aspect can be finished in metal by using metal collar or even a metal occlusal coverage (Mannocci and Cowie, 2014; Al Moaleem et al, 2017a).

Ceramic crowns, inlays, and onlays: are considered the best in mimicking the natural tooth (Griggs 2007). Ceramic materials come in different composition and strength and this should be taken into consideration when restoring posterior teeth (Raptis et al, 2006; Bhuva et al 2020; Al Moaleem et al., 2017b;). Posts: posts are indicated if the amount of the remaining tooth structure is not adequate to retain a core material. Using posts should be avoided when enough tooth structure is available to retain the core material. Post's materials available are: cast post and core, fiber post, ceramic, glass, and zirconium posts (Schwartz and Jordan, 2004; Bhuva et al 2020).

To crown or not to crown: It has been extensively discussed how to restore endodontically treated teeth, however, the best type of definitive restoration is still controversial (Willershausen et al, 2005; Dias et al, 2018; Bhuva et al., 2020). Full coverage crown with or without post was found to be the best choice as it protects the tooth from fracture, but crown restoration needs a preparation which leads to decrease the strength of the remaining tooth structure (Gupta et al., 2014; Alshiddi and Aljinbaz, 2016; Wang et al, 2016; Alaki et al., 2021; Alserhan et al., 2021). The main goal of conservative dentistry is to preserve the healthy tooth structure. Some dentists prefer to use direct composite restoration especially in case of conservative access cavity. Mannocci in 2002 found that no significant difference in success rate in his 3 years clinical trial between direct and indirect post-endodontic restoration. This study considers a short term and was done on premolars only which do not have as heavy occlusal load as molars.

It has been found that coronal coverage restoration decreased the possibility of tooth fracture under occlusal load (Sjögren et al, 1990; Vire., 1991; Eckerbom et al., 1992; Caplan and Weintraub., 1997; Bhuva et al 2020). Eckerbom stated that RCT teeth have the same survival rate as vital teeth (Eckerbom et al., 1992). Furthermore, Vire found that crowned RCT teeth with crowns show an increase in longevity than uncrowned RCT teeth (Vire DE., 1991; Al Moaleem et al, 2017 b). In a retrospective study by Aquilino and Caplan (2002) it was found that crowning the endodontically treated teeth promote higher longevity for posterior teeth. They placed a crown on 129 teeth and restored 74 teeth with either amalgam or composite restoration. The survival rate after 10 years was 89% for the crowned teeth, and 62% for the direct restorations.

In another study, 24 teeth with partial coverage gold crown survived without fracture with a mean period of 8.9 years. Teeth with crowns, bridges, individual post with crown and crowns and bridges with access cavity show a high survivability (>95%) in 10 years. In the same study a total of 235 teeth restored with direct restorations (GIC, Amalgam, Composite). 29.4% (n=69) of these teeth had to be extracted due to fracture. The 70.6 % survived during the observation period. The mean survival rate of composite was higher than amalgam and GIC. Also, it has been shown that cavitated teeth with one or two surfaces missing survived more than teeth missing three or more surfaces. This concludes that teeth with missing one or two surfaces can be restored with direct composite. However, this author used a small sample of 37 composite restorations which decrease the power of this study regarding the composite (Dammaschke et al., 2013).

Pratt et al in retrospective study found that the eight years survival rate of RCT teeth restored with crowns was 84%. Whereas in teeth restored with core build-up without crown the survival rate was 71%. Moreover, RCT teeth restored with composite or amalgam build-up were 2.29 more likely to be extracted (Pratt et al, 2016). According to a recently published systematic review, indirect restorations have a higher medium (>5 – <10 years) and long-term survival (>10 years) than direct restorations. However, in short-term (<5 years) no important difference was found between direct and indirect post-endodontic treatment (Shu et al., 2018).

Placement of post after endodontic treatment is a controversial matter. It has been shown that cementing a fiber post can improve the resistance to fracture of RCT anterior teeth (Abduljawad et al, 2016). However, the preparation for post space will increase the chance of root fracture (Peters et al., 2003). Posts should be avoided when we have adequate tooth structure to retain the core. Usually, molars do not need a post because the pulp chambers and canals can retain the core restoration.

Recently, Dallak et al (2020) and Al Ariqi et al, (2021) have concluded the importance of using the cone beam computed tomography (CBCT) during diagnosis, treatments, and before crowning of most of root canal treated teeth. Similarly, Bhuva et al, (2021) found that the survival of teeth and restorations following RCTs are affected by a large number of variables which include the residual volume of tooth structure, the presence of proximal contacts, tooth location, whether a cuspal coverage restoration has been provided (for molar teeth) and the use of a post. The following points should be in mind during evaluating of the RCT of all teeth particularly the molars;

1. Root filled teeth, particularly those undergoing RCT, when the remaining tooth size is less than 30%, there is a higher risk of endodontic failure. In-addition, teeth with one or less residual walls have less survival to those with two or more walls. The possibility of long-term tooth survival is maximum for teeth with two or more proximal contacts and lowest for those with no proximal contacts. Last molar teeth should be considered as having increased risk of failure.
2. The irresistible majority of retrospective studies report superior long-term survival for root filled posterior teeth restored with indirect cuspal coverage restorations when compared with those restored with direct restorations. The performance of root filled teeth restored with direct plastic restorations, such as composite resin, has rarely been compared with indirect cuspal coverage restorations in randomized clinical trials. Although the evidence is limited, a delay of more than four months to placement of the indirect restoration appears to be associated with a lower survival rate.
3. Cracked teeth which have undergone RCT showed to have good survival rates after four years. Whilst an increased periodontal probing depth associated with a crack is a negative predictive factor, the depth of the crack itself does not appear to be as relevant. Such factors should be measured when discussing treatment options with patients.
4. All of the available evidence indicates that for the restoration of posterior teeth, contemporary techniques such as all ceramic crowns, onlays and endocrowns are as durable as MC crowns. Prospective studies with longer follow-up periods are required to validate the performance of these restorations. Cementation protocols of these restorations seems to have a high relevant to their survival rates.
5. Teeth restored with fibre-posts have comparable survival rates to those restored with direct or indirect metal posts. The use of adhesive techniques for post placement that permit the preservation of the maximum amount of dentine is recommended. Adherence to appropriate bonding protocols, including the use of appropriate luting cement applications tips, is essential for predictable post placement. Though, based on the existing data, no definitive cementation technique can be suggested.

CONCLUSION

Long term survival is the main criteria of successful endodontic treatment. Full coverage restorations show a higher survival rate than direct restorations. The definitive restoration should be placed as soon as RCT completed. It has been shown that time of crown placement after endodontic treatment affect the survival rate of endodontically treated teeth. Finally, no need for a post if the remaining tooth structure can withstand the core material.

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