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Survival Rate Of Endodontically Treated Teeth With Custom Made Cast Post - A Systematic Review

Research Article

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Abstract

Objective: This review was performed to answer the controversial clinical situation of post endodontic restoration of severely mutilated teeth with a high degree of evidence. The review helps evaluate the type of post (custom made cast post) that demonstrates superior clinical performance in endodontically treated teeth.
Data Sources: Electronic databases (MEDLINE, CENTRAL, SCIENCE DIRECT, GOOGLE SCHOLAR AND LILAC) were screened upto April 2021. Only randomised controlled trials with at least a follow up of one year were included in this review.

Keywords: Annual Failure Rate (AFR); Custom Made Cast Post; Endodontically Treated Teeth (ETT); Survival Rate.

Introduction

Endodontically treated teeth may exhibit pronounced coronal destruction [1] and the amount of residual coronal dentine, restorative procedure and material selection can influence the clinical survival of posts and restorations [2]. The preservation of at least one coronal wall is amongst the most critical factors that ensure the success of endodontically treated and restored teeth. Thus, the absence of coronal walls is the worst-case scenario for restoration, and the use of intraradicular posts remains the best method for retaining coronal restorative material [3-5]. The retention of severely mutilated teeth is hence,controversial, especially when the value of endodontic treatment is limited due to a questionable prognosis.

The restoration of the endodontically treated tooth (ETT) represents a key factor during treatment planning because of its impact on the long-term survival and prognosis of the tooth in the oral cavity [6]. The pulpless tooth is usually associated with substantial loss of coronal and radicular tooth structure caused from pre-existing restorations, dental caries, trauma, endodontic access preparation and overzealous preparation of the root canal space [7]. It is generally assumed that this loss of hard tissue leads to reduced load carrying capacity of ETT [8]. Hence, posts are indicated for ETT that are highly susceptible to fracture because of their insufficient coronal tooth structure [8-11]. Traditionally, prefabricated posts were made with metal, which are at times visible through the structure of ETT especially in the anterior region [12]. Having high rigidity, metal posts appear to vibrate at high frequencies when loaded with lateral forces [13]. The focusing of

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these forces in unpredictable "critical points" which may determine longitudinal fractures of the root or metal corrosion [8, 14, 15] and consequently lead to loss of the tooth.

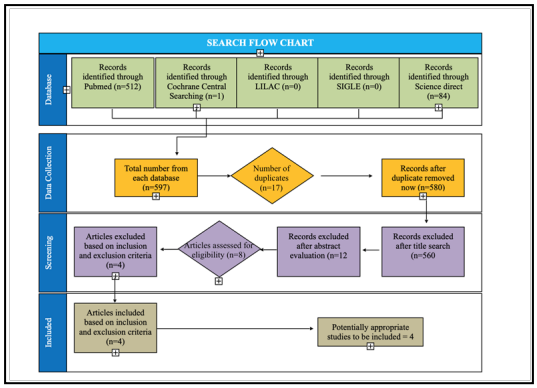
Some researchers [16-18] have suggested that as these metallic materials have much higher moduli of elasticity than that of the supporting dentin, this mismatch in the moduli could lead to stress concentrating in the interface at the level of luting cement and cause its failure. This has led to a search for a plastic-based material that has a modulus closer to that of dentin. The employment of posts with an elastic modulus similar to that of dentin led to better stress distribution in comparison to cast post in contrast to post with an elastic modulus greater than dentin which can lead to catastrophic failure.

Another factor which plays an important role in survival of endodontically treated teeth is ferrule effect. Even in cases where clinical crown is lost, ferrule of 1.5-2 mm increases survival of endodontically treated teeth by 5-10% [19, 20].

Table 1. Characteristics of included studies.

TOPIC	AUTHOR	Study design	FOLLOW UP	REGION	CORONAL WALL	RESTORATIONS	POST CEMENT	POST	NO
Randomized controlled trial comparing glass fiber posts and cast metal posts	Rafael Sarkis-Onofre -2020	RCT	5Y	upper incisors (n=75) Posteriors (n=108)	teeth without ferrule.	single metal-ceramic crowns	selfadhesive resin cement (RelyX U100 or U200, 3 M, ESPE).	183 posts (72 cast metal posts and 111 glass fiber posts)	183
Controlled Clinical Trial on the Outcome of Glass Fiber Composite Cores Versus Wrought Posts and Cast Cores for the Restoration of Endodontically Treated Teeth: a 5-Year Follow-up Study	E Cloet et al -2017	RCT	5Y	68 anterior(28 fibre, 40 metal) 123 posterior (63 fibre, 60 metal)	fewer than 2 dentine walls(>2mm) with wide pulp chambers	single crowns	dual curing adhesive cement (Panavia F 2.0)	65 prefabricated fibre posts (parapets fibre Lux) 26 custom made glass fibre posts (EVER STICK)	91
Cast metal vs. glass fibre posts: A randomized controlled trial with up to 3 years of follow up	Rafael Sarkis-Onofre	RCT	3Y	40 anterior (21 fibre, 19 metal) 32 posterior (16 fibre, 16 metal)	no remaining coronal wall , or the enamel portion of one wall with no dentine support (ferrule height, 0-0.5)	Metal ceramic single crown	Regular resin cement (RelyX ARC) or self adhesive resin cement(Rely X U 100)	Glass fibre post (White post DC)	37
Clinical evaluation of carbon fiber reinforced carbon endodontic post, glass fiber reinforced post with cast post and core: A one year comparative clinical study	GA Preethi, M Kala	Comparative clinical study	1 yr	30 root canal treated, single rooted maxillary anterior teeth	fractured maxillary anterior teeth	porcelain-fused to-metal crowns	Scotch bond multipurpose plus bonding agent and RelyX adhesive resin cement The Cast post and cores were cemented with Zinc Phosphate	Group I consisted of ten cases restored with cast posts and cores. • Group II consisted of ten cases restored with carbon fiber-reinforced posts and composite resin cores. • Group III consisted of ten cases restored with glass fiber-reinforced posts and composite resin cores	30

Figure 1. Search strategy.



Many rigid materials with varied mechanical properties such as cast gold [21], stainless steel [19, 20], titanium and composite [22], zirconia [23] have been tried. But selection of post depends on the clinical situation.

Cast metal posts were traditionally used for intraradicular retention and have shown high survival rates after 10 years [24]. As metal posts have been hypothesized to have high elastic moduli in comparison with that of dentine the risk of root fracture and catastrophic failure are at a greater extent [11]. Hence, the introduction of glass fibre posts as an alternative became the post of choice for many clinicians. The mechanical properties of these posts are similar to that of dentine, the risk of catastrophic failure is reduced drastically and most commonly reported failure involves post debonding [25]. In addition to post failure per se, the failure of intraradicular posts can be related to tooth position as failures in post-retained crowns generally occur in the maxillary anterior region, where horizontal forces are greater than in other areas [26]. However, few studies have compared the use of glass fibre and cast metal posts to restore endodontically treated teeth with no remaining coronal wall.

Previously our team has a rich experience in working on various research projects across multiple disciplines [27-41] Now the growing trend in this area motivated us to pursue this project.

Given this lack of clinical evidence regarding the best post to be put to use for the restoration of teeth without coronal walls, the aim of this study was to evaluate the survival of cast metal posts in such teeth. The hypothesis tested was that the survival of endodontically treated teeth would not differ according to the type of post used.

Table 2. Risk of Bias- Major Criteria.

Study	Randomization	Allocation Concealed	Assessor Blinding	Dropouts Described	Risk of Bias
Rafeal et al 2014	Yes	Yes	Yes	Yes	Low
Preethi et al 2008	No	No	No	Yes	High
Ellen cloet et al 2017	Yes	Unclear	No	Yes	Moderate
Rafeal et al 2020	Yes	Yes	Yes	Yes	Low

Table 3. Risk Of Bias - Minor Criteria.

Study	Sample Justified	Baseline Comparison	I/ E Criteria	Method Error
Rafeal et al 2014	Yes	Yes	Yes	No
Preethi et al 2008	No	Yes	Yes	No
Ellen cloet et al 2017	No	Yes	Yes	No
Rafeal et al 2020	Yes	Yes	Yes	No

Figure 2. Risk of bias graph: Review authors' judgements about each risk of bias item presented as percentages across all included studies.

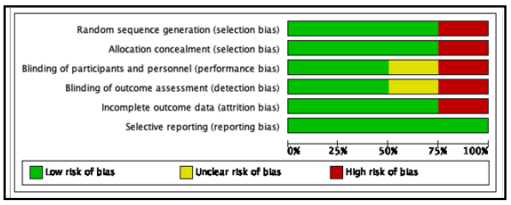
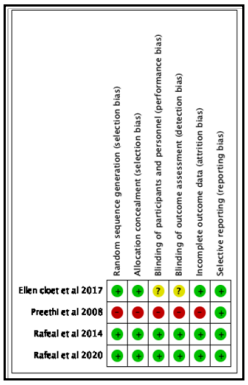


Figure 3. Risk of bias summary: Review authors' judgements about each side of bias items for each included study.



Materials and Methods

Data Sources

Literature published in English was obtained through electronic search of the following database up to April 2021: MedLine via pubmed, Central via cochrane library. The search strategy included the following keywords combination of (Mesh and free terms). Additional relevant studies were identified by hand searches of the references in retrieved articles.

Resource Selection

Initially, two reviewers independently examined the titles and abstracts according to the following inclusion criteria:

Patients (P): Patients who under went endodontic treatment in permanent teeth followed by post core and single unit crown.

Intervention (I): Endodontically treated teeth received prefabricated metal or fiber posts followed by single crown.

Comparison (C): Endodontically treated teeth received custom made cast post followed by single crown.

Outcomes (O): Survival and success rate of restored tooth (primary outcome). The survival criterion was defined as an in-situ tooth post complex without extraction. The success criterion was defined as both the restored tooth and restoration being present and clinically acceptable, with out intervention or repair needed.

Secondary outcomes included incidence of complications including root fracture and debonding of posts.

Review

Assessment of risk of bias and evidence quality.

Methodological quality of retrieved studies were evaluated independently by two reviewers according to the guidance provided by the cochrane collaboration. The following domains was assessed: sequence generation, allocation concealment, blinding, incomplete outcome data, selective outcome reporting, and other sources of bias.

Statistical Analysis

Pooled data from all outcomes were subjected to meta-analysis to estimate the risk ratio (RR) and 95% confidence interval (CI) using the review manager. For each outcome, Cochrane's test was applied for analysis of heterogeneity among included studies. To test the reliability of evidence, outcomes of fixed effects and random effects models were compared, but only random-effects estimates were reported to be more conservative. If the heterogeneity of outcomes was higher than 40%, sensitivity analysis was carried out by subgroup analysis, testing for excess studies with significant results. If heterogeneity could not be eliminated, meta-analysis was abandoned and narrative analysis was applied instead. Additionally, publication bias could not be assessed due to the limited number of studies.

Results

An electronic search identified 580 potentially relevant articles. The evaluation of titles and abstracts led to the selection of 14 articles and finally only four articles met the inclusion criteria. The search strategy is described in Fig1.

Discussion

Our institution is passionate about high quality evidence based research and has excelled in various fields [42-52].

The purpose of this review was to evaluate the survival rate of endodontically treated teeth with custom made cast posts in 4 clinical studies that fulfilled the criteria for being included in this review. In the present meta analysis, two included studies were well designed RCTs with low risk of bias, another clinical study was not well designed with high risk of bias. There was not a single systematic review comparing the survival rate of custom made cast posts with other types of posts available. Other published descriptive systematic reviews comparing fibre and metal posts did not conduct a meta-analysis of RCT's because of high heterogeneity.

Rafael Sarkis-Onofre et al 2020

A randomised controlled trial on the comparison of survival rate of a glass fibre post and custom made cast post in endodontically treated teeth was conducted. This study aimed to assess the survival and success of glass fiber posts compared to cast metal posts in teeth without ferrule. An equivalency, prospective, double-blind (patient and outcome evaluator) randomized controlled trial (RCT) with parallel groups was designed to compare the clinical performance of cast metal and glass fiber posts cemented in endodontically treated teeth without ferrule (NCT01461239). Teeth were randomly allocated to the glass fiber or cast-metal post groups. All teeth were restored with single metal-ceramic crowns. Kaplan-Meier analysis with the log-rank test was used to test the success and survival between glass fiber and cast metal posts considering a cut-off value of p =0.05. The annual failure rates were calculated considering the survival data for all restorations and separated by type of post after five years. A hundred and nineteen patients and 183 posts (72 cast metal posts and 111 glass fiber posts) were analyzed. The median follow-up was 62 months (IQR 37–81). The log-rank test for success (P=0.26) and survival (P=0.63) analyses did not present statistically significant differences. The AFR of both posts after 5 years was 1.5%. Considering the posts separately and after 5 years, cast metal posts presented an AFR of 1.2% and glass fiber posts AFR of 1.7%. Most failures were in posterior teeth (16/23), 10 failures were classified as root fractures and 5 as post debonding. The follow-up rate was 95.3%. Glass fiber and cast metal posts showed good and similar clinical performance [53].

Ellen cloet et al 2017

The aim of this study was to evaluate and compare the 5-year outcomes of glass fiber composite and cast posts and cores for the restoration of endodontically treated teeth. A total of 143 patients in need of 203 full ceramic restorations on endodontically

treated teeth were included. After primary stratification based on the need for post or no post, teeth were randomly allocated to three test groups, namely prefabricated glass fiber posts, custom-made glass fiber posts or composite cores without posts. The control group was treated with gold alloy-based wrought posts and cast cores. Success (original present) and survival (present after intervention) probability lifetime curves, corrected for clustering, were drawn over the entire data set. The mean follow-up time was 5.8 years (range: 0.5 to 7.2 years). At 5 years, the success and survival probabilities were 85.2% and 91.5%, respectively. Lifetime curves did not show any significant differences between the test and control groups for success (P = .85) or survival (P = .57). Moreover, no significant differences for success or survival could be found among the four groups (the three test groups and the control group). To conclude, after 5 years of follow-up, cast gold and composite post-and-core systems on teeth with ceramic full restorations provided with a ferrule performed equally well [54].

Rafael Sarkis-Onofre et al 2014

This randomized controlled trial compared the survival of glass fibre and cast metal dental posts used to restore endodontically treated teeth with no remaining coronal wall. Fifty-four participants (45 women) and 72 teeth were evaluated during a follow-up period of up to 3 years. Teeth were randomly allocated to the glass-fibre and cast-metal post groups. All teeth were restored with single metal-ceramic crowns. Survival probabilities were analyzed using Kaplan–Meier statistics (p 0.05). The 3-year recall rate was 92.3% and the survival rates of glass fibre and cast metal posts were similar (97.1% and 91.9%, respectively; p = 0.682). Four failures were observed: two glass fibre posts in a premolar and anterior tooth debonded, one glass fibre post in a premolar debonded in association with root fracture, and one root fracture occurred in a molar with a cast metal post. Glass fibre and cast metal posts showed similar clinical performance in teeth with no remaining coronal wall after 3 years. Posts are used to restore most endodontically treated teeth with no remaining coronal wall. This randomized controlled trial was among few to compare glass fibre and cast metal posts in teeth with compromised prognosis. The type of post used did not significantly influence the survival of restorations. These results can help dentists respond to the important question of how best to rehabilitate endodontically treated teeth with no remaining coronal wall [55].

GA Preethi et al, 2008

GA Preethi and Kala had clinically evaluated glass fiber posts, carbon post and cast post and core for one year in the age range of 18-60 years wherein they had 10 root canal treated teeth per group. Patients were recalled till 1 year and evaluated for crown margin, periapical or periodontal pathosis, fracture of restoration and root. It was reported that glass fiber reinforced post including composite core in upper anterior teeth had a higher success rate (100%) in post-endodontic restoration [18].

Report On Quality Of Evidence Looked Upon

Four trials were included in this review. Three among the 4 included studies were randomised controlled trials and one was clinical study. Three RCTs have a level of evidence 2. Thus the level of evidence is high. Risk of bias of 2 studies-Rafeal et al 2020 and Rafeal et al 2014 has low risk of bias, Ellen cloet et al 2017 had a moderate risk of bias, 1 study by Preethi et al 2008 had a moderate risk of bias.

Inference

From this systematic review a conclusion that survival of endodontically treated teeth does not depend on types of posts used can be drawn.

Implications For Practice

Custom made cast post as well as glass fibre post are equally effective in managing the endodontically treated tooth with less amount of coronal structure.

Implications For Research

Since the number of randomized controlled clinical trials included in this review is limited, more clinical trials are required to prove the survival rate of endodontically treated teeth with different types of post and core.

Report Of Outlier Data

No outlier data obtained.

Summary

The aim of this systematic review was to evaluate the survival rate of endodontically treated teeth with custom made cast post with other types of post. An electronic search was carried out on the PUBMED database for the articles which could be used for evaluating the survival rate of endodontically treated teeth restored with a custom made cast post and single crown.

Article search was narrowed down based on the pre-stated inclusion and exclusion criteria. A total of four articles were included in this systematic review for detailed evaluation.

Survival rate of endodontically treated teeth restored with custom made cast post was the primary variable of interest.

Based on the result of this systematic review, we can conclude that survival rate of endodontically treated with a custom made cast post with single crown was almost similar when compared with other types of post and core with single crown.

Conclusion

The present systematic review does not provide concrete evidence to show the survival rate of endodontically treated teeth restored using a custom made cast post with a single crown system to be better when compared to other post and core systems. One article included in this review has shown a moderate risk of bias. Further it also recommends more clinical studies to be done comparing different post and core systems to custom made cast post.

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