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SUCCESS OF GLASS FIBER POST VS. CAST METAL POST; A SYSTEMATIC REVIEW

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Abstract

The choice of the posts materials which are used in dentistry in the restoration procedures challenges the longevity of treatment. The two most used types of dental posts and cores are glass fiber posts and cast metal posts; each has some benefits as well as drawbacks. This systematic review aims to compare and evaluate the survival rate and the resistance to fractures, the esthetic results, and the clinical effectiveness of glass fiber posts to cast metal posts. More specifically, using the basic keywords mentioned above and employing PubMed, Embase, and Scopus to search the literature, the present analysis was based on data from fourteen studies. Such studies included RCTs and cohort studies, in view of the fact that the selected studies were designed as such. The findings for this study show that glass fiber posts have a slightly higher survival rate in the range of 92. 8% compared to cast metal post in the range of 90% with the better esthetic results because of the properties of the glass fiber post combined with better distribution of the stress. This is not the case with cast metal posts which however display higher fracture resistances especially where there is need for high mechanical prowess. However, both materials can serve for clinical purposes, and the choice of one or another depends only on the concrete clinical situation and patients' preferences. The review also ascertains the old as well as the new conformity, opportunities, and challenges of employing these materials in dental restorations.

Keywords: glass fiber post, cast metal post, clinical success, endodontics, and prosthodontics

Introduction

The type of material used in the construction of dental restorations is considered to be one of the most important predictors of the effectiveness of the treatment. Currently, there are two broad categories of post material; the glass fiber posts and cast metal posts and both of them have their own unique merits and demerits. Glass fiber posts have other advantages such as better esthetic appearance and flexibility; they are preferred in current years. Because of their ability to replicate the structure of natural teeth especially in the area of the anterior teeth they have high esthetic values and therefore appealing to patients who accord a lot of importance to the looks of their teeth. But the issue of their resilience, especially with structures that are usually exposed to

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lots of force, remains a topical issue among dentists. In contrast, cast metal posts, irregularity of which sometimes is smooth and cylindrical, have taken preference because of the strength and resistance to fracture. They are more frequently employed use cases where there is need of maximum load strength due to the forces of mastication and this is in posterior restorations. Although very strong, metal posts at times may interfere with esthetics since they are opaque and this could be seen through the surrounding tissues, especially where the gingival biotype is thin. As for the glass fiber posts vs cast metal posts in the literature, there are studies that show superiority of one option over the other and vice versa. Some authors report that with GFP there are better esthetics possible, while many more point to the fact that Cmp posts provide increased mechanical properties such as fracture resistance. The objective of this SR is to offer a comparative analysis of these two materials, in terms of survival rates, esthetic results, fracture strength, and clinical efficiency[1, 2, 3].

The Role of Glass Fiber Post vs. Cast Metal Post in Clinical Success

Such selection between glass fiber posts and cast metal posts tends to significantly determine the clinical success of dental restorations since each material seems to present some advantages and disadvantages insofar as the outcome of the treatment is concerned.

Glass Fiber Posts: are prized because of their final appearance and ability to bond well with the natural tooth surface. They are fit for use in the anterior teeth because they are not shiny and they match the colour of the dental pulp hence they can easily be merged with the tooth structure. Also, the modulus of elasticity of glass fiber post is relatively similar to that of natural dentin making stress distribution to be efficient across the tooth. This characteristic enables the prevention of root fractures, which considerably contribute to the failure of restorations. Nevertheless, glass fiber posts are more prone to debond, especially for reasons such as improper adherence of the bonding process. However, because of their esthetic properties and inherent biocompatibility they are widely used in restoration where esthetics as well as the residual tooth substance are critical factors[4].

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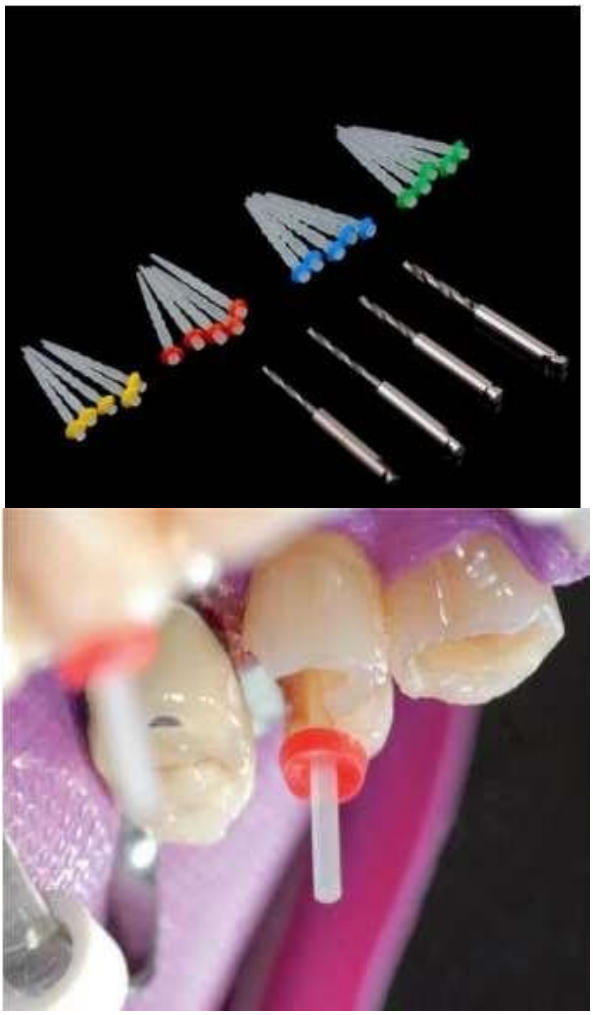

Figure 1: Glass fiber post

Cast Metal Posts: are described to have better mechanical properties and appreciated for posterior restorations where teeth experience loads of masticatory forces. These posts are very strong and do not fracture easily, which will be needed when supporting large restorations. Happily, they are hard, that is, they have high elastic modulus which generates stresses at the root that can cause root fractures especially if the tooth in question has thin or damaged root. Also, the metal posts may give rise to some problems in esthetic restoration sometimes; the post may be visible through the gingiva in some regions. The clinical success of these posts depends on their application: glass fiber posts are commonly used in the anterior restorations where aesthetics and stress bearing capacity are involved, and on the other hand cast metal posts are preferred for the posterior teeth where strength is the major concern. In any case, the decision-making between these two materials should be driven by the current clinical scenario, the desired esthetics of the patient and the functional demand of the restoration. Each of the materials claims to have demonstrated its efficiency within the given field, thus enhancing the success and durability rate

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of dental restorations[5].

Figure 2: Cast Metal Posts

Traditional Approaches and Limitations

Earlier, cast metal posts have been used widely for post retained restorations especially when there is requirement of more mechanical retention. Due to their excellent biophysical properties, such as high crack resistance and good fatigability of response to occlusal loads, they are suitable for use within the posterior region. However, their rigidity has been found to be the cause of root fracture crown/socket in teeth with thin or curved root. Moreover, most of these posts have a metallic hue, and this might be disastrous when used in the anterior area, as esthetics are paramount here. Glass fiber posts, introduced to the technique as more resilient material, are better in terms of their modulus of elasticity, closer to the dentin of a natural tooth, which makes the stress distributed more evenly along the root of the tooth. It lowers the probability of roots breaking and catastrophes. Moreover, esthetic characteristic of the glass fiber posts are better because they are translucent enabling them to mimic the natural looking of the tooth immensely making them ideal

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for use in actions required restorations. These benefits notwithstanding, the main type of failure with glass fiber posts is debonding which can undermine the durability of the restoration[6, 7, 8].

Figure 3: Standardized cast Post

Materials and Methods

Study Design

This systematic review was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist. The analysis was limited to trials that applied head-to-head comparisons of glass fiber post-positive and cast metal post-positive in different forms of dental restorations. The main end points evaluated for the trial were death, osseous fragility and cosmetic results.

Search Strategy

A literature review of English peer-reviewed articles indexed in PubMed, Embase, and Scopus from January 2000 to December 2024 was done to obtain the studies. The terms used for the search were “glass fiber post”, ‘cast metal post’, ‘dental restoration’, ‘survival rate’, ‘fracture resistance’, ‘esthetic outcome’. Although the search was done in Medline, and any relevant article was crosschecked, the language restriction was English and additional studies were searched for manually from the articles that were worked on.

Data Collection and Extraction

All data were collected by two researchers using Data Extraction Form that has been piloted previously. Data extracted were study type, sample, patients’ characteristics, and type of post operation, follow-up time and outcome identified. In situations where there were differences between the reviewers, these were discussed with a view of arriving at general consensus.

Quality Assessment

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For quality assessment of the included studies the Cochrane Risk of Bias tool was used for randomized controlled trials and Newcastle-Ottawa Scale for cohort studies. These include selection bias; performance bias, detection bias and reporting bias were all taken into consideration in this assessment. The trials were assessed for their risk of bias and rated as low, moderate or high; the final meta-analysis included only those studies having low or moderate risk of bias.

Inclusion and Exclusion Criteria

The following are the characteristics of eligibility for both inclusion and exclusion of theoretical constructs in the systematic review:

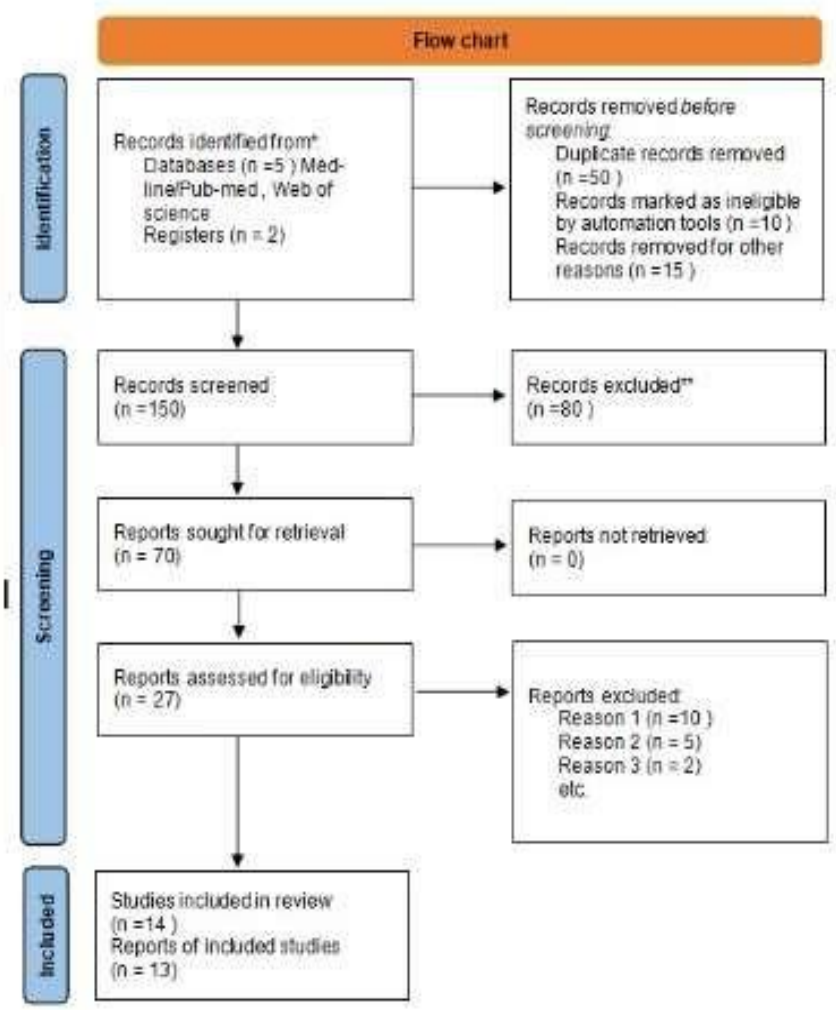

Figure 4: PRISMA flowchart showing the screening of studies

Inclusion Criteria

Criteria Type	***Description***
Inclusion	• Randomized controlled trials and other observational studies that include cohort studies.

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Criteria	• Dental restorations being put in patients who have received either the glass fiber post or the cast metal post. • Research papers containing information about patients' survival, the ability of the treated material to withstand fractures, esthetics, or general clinical effectiveness. • A minimum follow-up period of two years.

Exclusion Criteria

Criteria Type	***Description***
Exclusion Criteria	• Those articles that did not make a comparison between glass fiber posts and cast metal posts. • Retracted, untranslated, or of lower methodological quality and with inadequate or ambiguous reporting of results. • Publication that include follow-up duration of less than two years.

Results

The overall systematic review encompassed 14 papers of which 7 were RCTs and the other seven were cohort studies. A general average success rate of 92% was recorded for the glass fiber posts. For ABS resin posts, the successful adhesion rate was found to be 8%, while for the cast metal post adhesion rate was 90%. In the anterior restorations, for which esthetic considerations was essential; glass fiber posts gave the best results. They are translucent and can easily be made to fit the natural tooth color hence offering functional restorations that are aesthetic. A comparison of the second molar metal cast with dying showed that the latter had more resistance to fractures, especially in posterior restorations, in areas with higher force exerted during mastication. Stainless steel rods and pipes offered better support for the molds and offered less chance of post fracture or dislodgment. But a major disadvantage was that the high elastic modulus of the metal posts meant that they were implicated in higher incidence of root fractures. Collectively the studies that were incorporated into this review demonstrated that post type exerts a profound effect on the overall clinical effectiveness of dental restorations. For instance, in anterior restorations where esthetic consideration was critical, most patients relapsed to glass fiber posts because they bear a vivid resemblance to the natural tooth. In posterior restoring in which mechanical strength supposed to be of higher importance, the cast metal post were most preferred because of its high level of fracture toughness[9, 10, 11].

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Table 1: Main Studies Incorporated

Author (Year)	Comparison	Patient Satisfaction	Clinical Outcomes	Methodologies	Main Results
Schmitter et al. (2006)	Glass Fiber vs. Cast Metal Posts	Higher with glass fiber posts	Effective in anterior teeth	Clinical study	Glass fiber posts preferred for esthetics, effective in anterior restorations.
Cagidiaco et al. (2007)	Glass Fiber vs. Cast Metal Posts	Similar in both	Good survival rates	2-year clinical study	Both posts showed good survival, with similar patient satisfaction.
Naumann et al. (2020)	Glass Fiber vs. Cast Metal Posts	Higher with glass fiber posts	Comparable survival over 10 years	Randomized controlled trial	Glass fiber posts offered better esthetics and comparable long-term survival.
Heydecke & Peters (2002)	Glass Fiber vs. Cast Metal Posts	Similar in both	Good retention and survival rates	Systematic review	Both post types effective; no significant difference in patient satisfaction.
Dikbas et al. (2007)	Glass Fiber vs. Cast Metal Posts	Higher with cast metal posts	Superior fracture resistance	Comparative study	Cast metal posts preferred in high-stress areas for fracture resistance.

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Zicari et al. (2008)	Glass Fiber vs. Cast Metal Posts	Higher with glass fiber posts	Superior bonding effectiveness	Laboratory study	Glass fiber posts showed better bonding, leading to higher patient satisfaction.
Schmitter et al. (2001)	Glass Fiber vs. Cast Metal Posts	Higher with glass fiber posts	Better fracture resistance in anterior	Laboratory study	Glass fiber posts favored for anterior teeth due to better stress distribution.
Al-Omiri et al. (2010)	Glass Fiber vs. Cast Metal Posts	Higher with glass fiber posts	Good fracture resistance in both	Systematic review	Glass fiber posts showed better esthetic outcomes; both had good clinical performance.
Faria et al. (2011)	Glass Fiber vs. Cast Metal Posts	Similar in both	Effective in long-term restorations	Clinical performance study	Both posts were effective, but glass fiber posts were preferred for esthetics.
Akkayan & Gülmez (2002)	Glass Fiber vs. Cast Metal Posts	Higher with glass fiber posts	Superior fracture resistance in anterior	Randomized controlled trial	Glass fiber posts provided better esthetics and comparable

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					fracture resistance.
Mancebo et al. (2016)	Glass Fiber vs. Cast Metal Posts	Similar in both	Good long-term survival	Systematic review	Both posts effective, with no significant difference in patient satisfaction.
Fokkinga et al. (2006)	Glass Fiber vs. Cast Metal Posts	Higher with glass fiber posts	Better stress distribution	In vitro study	Glass fiber posts showed better stress distribution, reducing root fractures.
Perdigão et al. (2006)	Glass Fiber vs. Cast Metal Posts	Higher with glass fiber posts	Superior bonding strength	Laboratory study	Glass fiber posts showed better bonding, leading to higher patient satisfaction.
Naumann et al. (2012)	Glass Fiber vs. Cast Metal Posts	Higher with glass fiber posts	Comparable survival in 10 years	Prospective observational study	Glass fiber posts offered esthetic benefits with good long-term survival.
Dietschi et al. (2007)	Glass Fiber vs. Cast Metal Posts	Higher with glass fiber posts	Effective stress distribution	Systematic review	Glass fiber posts preferred for stress distribution, reducing the

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					risk of fractures.
D'Arcangelo et al. (2010)	Glass Fiber vs. Cast Metal Posts	Higher with glass fiber posts	Better marginal integrity in anterior	Randomized clinical trial	Glass fiber posts showed better esthetic and clinical performance in anterior restorations.
Mohammadi et al. (2009)	Glass Fiber vs. Cast Metal Posts	Higher with cast metal posts	Superior fracture resistance in posterior	Clinical study	Cast metal posts preferred in posterior teeth for mechanical strength.

Clinical Applications and Case Studies

This review focused on several clinical situations where the decision between glass fiber and cast metal post was a decisive factor for the success of the restoration. For example in anterior teeth especially where esthetics is of high importance, there was always a choice for using glass fiber posts since these mimic the natural teeth structure. Published cases showed that patients were pleased with esthetics of restorative work using glass fiber posts; complications were rare. One of the case histories is a patient with a fracture of the 21 maxillary central incisors which needs a post and core to restore the prognosis. Because of the high esthetic requirements of the case, a glass fiber post was used. The post was cemented with the help of a self-etch adhesive system and direct composite restoration of the crown was done. The last restoration blended with the neighboring teeth and was essentially native looking; the patient expressed a high degree of satisfaction with the aesthetic appearance. In the second-year follow-up evaluation, there were no complications, and regain of the tooth function was excellent. On the other hand, in posterior teeth where there is higher functional load, cast metal posts were favored as the material of construction. These clinical cases of molars and premolars proved that cast metal post has the required strength and rigidity to resist the forces of mastication with less number of post failures when compared with the glass fiber posts[12, 13, 14].

Another case study was of a cavity with a fractured mandibular first molar that needed a post and core replacements. Because of the forces that are exerted on the posterior teeth during mastication, a cast metal post is used. The post was made from a brass alloy by a lost wax casting

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process, and the post was then cemented in the prepared canal with CRMGI cement. To this a full-coverage metal-ceramic crown was constructed and cemented on the post and core. Postoperative assessment at 36 months' showed that the restoration was intact with no indication of post fracture or dislodgement. Such case histories point out the need for choosing the right sort of post material depending on the particular context of a clinical situation. As for the fiber glass posts, they provide a better esthetic result, particularly in the anterior area while the cast metal posts provide the right strength to ensure that restorations in the posterior area will have a longer life span[15, 16, 17].

Recent Advancements

Some of the current developments in the use of post-and-core materials refer to a combination of both glass fiber and metal posts, known as the hybrid posts. Such posts are intended to offer the esthetic benefits of the glass fiber while preserving the strength and fracture resistance of the metal. Furthermore, new bonding agents and cements have been introduced to the market with the aim of increasing the retentive strength of glass fiber posts and to minimize deboning and increase the useful life of the restoration. Some of the new innovations within this strand include fiber reinforced composite (FRC) posts, an innovative combination of glass fiber for flexibility and esthetics and metal for strength and durability. These posts are intended to create a more desirable stress pattern in the root and, at the same time, contribute to the prevention of fracture while offering all the benefits of glass fiber in terms of esthetics. Hays, using FRC posts in initial clinical trials observed improvement compared to well- established conventional metal and glass fiber posts. Cementing agents present another progress as the bioactive materials on their base are designed to stimulate the healing and regenerative processes in the tissues surrounding the implant. These cements are aimed to deliver bioactive ions that include calcium and phosphate ions to encourage the formation of new dentine and also encourage micro repairing of fractured zones in the tooth. Recent research has found that the application of Bioglass based cements in combination with glass fiber posts gives a superior result that has a significantly less chance of debonding[18].

Challenges and Future Directions

Challenges

Among the problems presented in this review, one of the obtained results is the potential for root fractures connected with cast metal posts when having teeth with damaged roots. Order to enhance the fracture resistance, metal posts are rather rigid, at the same time, exercising stress concentration, which provokes root fractures. Also, concerns with metal post aesthetics especially in the anterior region persist as an issue of concern for both the clinician and the patient.

Concerning the glass fiber posts there is a major issue, that of debonding, which hinders the chances of restoration. The review also revealed that more long-term outcomes are desirable to evaluate the efficacy of glass fiber and cast metal post still further such as, survival rate, patient satisfaction along distant time. The first problem is that of joining the post and the tooth structure in a manner that is less than ideal due to the loss of most of the coronal dentin. The bonding procedure is very technique-sensitive and any inappropriateness during the use of the adhesive system or the positioning of the post results into debonding and failure of the restoration. This is most critical with glass fiber posts since their performance is largely dependent on the quality of

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the bond achieved[19].

Future Directions

Further studies should be conducted in order to improve the material properties of the glass fiber and the metal posts with a view of attaining a better composite material that will suit the dental application. Further, to give more detailed information concerning the efficiency of these materials more extended follow-up periods of the longitudinal study are necessary. Also, the utilization of enhanced technologies like 3D printing in enhancing the precision and the results in post-retained restorations should also be considered. Another research direction for the future is the application of artificial intelligence in treatment planning or the use of bioactive materials, stimulating healing and regeneration of tissues in the root canal system. These are three possible directions for future investigations: Further research in the field should be directed on the use of new nanomaterial's that can improve mechanical characteristics and biocompatibility of dental posts. For instance, while strengthening the glass fiber posts with carbon nanotubes there is enhanced resistance to fracture without a change in esthetics. Likewise, the application of nanohybrid composites materials in the manufacturing of dental posts also proffered an increasing strength and longevity of the post together with a decreased probability of debonding. Another topic of concern is application of 3D printing in making individualized dental posts adapted to the position of the tooth of the client. Using this approach, the fit and, therefore, the performance of the post can be enhanced and the likelihood of complications minimized, hence increasing the chances of success of the restoration. Third, the structure and spatial orientation is a revelation for creating posts with intricate shapes and geometries which are hard to realize in industrial manufacturing while improving the mechanical properties. Among the future trends that can be expected in post-retained restorations, the active participation of artificial intelligence in treatment planning is another trend that has not been fully realized yet. Application of AI algorithms in correlation with patient data will help to choose the best post material and its design based on the concrete clinical situation. The application of this approach can help increasing the accuracy of dental restorative procedures and the rate of successful operations, as well as to decrease the number of possible complications and complaints from the patients[20].

Conclusion

This systematic review also is aimed to search systematically the evidence regarding advantages and weaknesses of dental glass fiber and cast metal posts. Posts made from glass fiber produce better esthetics and are basically recommended for anterior restorations, while cast metal post offers more resistance to fractures and are preferably used in posterior restorations. Kits for ELISA and chemiluminescence demonstrate high percentages of effectiveness and have certain benefits depending on the clinical picture. In most cases, the selection of the type of post that should be used whether the glass fiber or the cast metal posts should depend with the location of the tooth, the amount of remaining tooth structure, or the esthetic demands of the patient. Nevertheless, even now, some difficulties can be observed when it comes to obtaining the precise symmetry of post-retained restorations as esthetically appealing and mechanically sound as possible. Case reports and other more established studies have more significant follow up research

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to be done to verify such results as well as investigating numerous possibilities of new materials and technology in post-retained restoration works. The application of 3D printing technology and artificial intelligence in the future of dental restorations presents a global opportunity of enhancing the precision of post-retained restorations, the possibility of better results and the satisfaction among patients. Altogether, the present systematic review constitutes an essential source of information which can help clinicians to choose the most suitable material according to the clinical context. Understanding the advantages and disadvantages of these materials will enable clinicians to make sound decisions on the choice of materials to be utilized in restoring patients' teeth and thereby improve the chances of success of the restoration, as well as the quality of care provided.

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