

## Evaluate the Effect of Using Composite Core Materials on the in Vitro Fracture of Endodontically Treated Teeth: A Systematic Review and Meta-Analysis

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### Abstract

**Background and aim:**the aim of the present study was to evaluate the effect of using composite core materials on the in vitro fracture of endodontically treated teeth.

**Method:**Databases of PubMed, Scopus, Web of Science, EBSCO and Embase were searched for systematic literature between 2012 to August 2021. For Data extraction, two reviewers blind and independently extracted data from abstract and full text of studies that included.95% confidence interval for mean differences with fixed effect model and in-variance method were calculated. To deal with potential heterogeneity, random effects were used and  $I^2$  showed heterogeneity. Meta-analysis was performed using Stata/MP v.16 software (The fastest version of Stata).

**Result:**In the initial review, duplicate studies were eliminated and abstracts of 126 studies were reviewed, the full text of 16 studies was reviewed by two authors, finally, five studies were selected. Mean differences of Fracture strength of endodontically treated teeth between intervention and control group was 8.40 (MD, 8.40 95% CI -31.93, 48.73).

**Conclusion:** fracture resistance of the treated root teeth in composite core build-up with higher filler content tends to be much higher than the conventional composite resins.

**Key words:** composite core materials, composite resins, endodontically treated teeth

### Introduction

The next step after endodontics is tooth restoration(1).After preparing the cavity and going through the dental filling process, dentists face challenges such as changing physical properties, disrupting the mechanism of sensorineural feedback(2). Rehabilitation is therefore of great importance as a result of its aesthetic, functional, and structural aspects(3). Common methods commonly used to restore endodontically treated teeth are post and core(4). Post and core is a dental restoration procedure which is sometimes performed after a root canal, also A post and core is a restoration consisting of a post that fills a prepared root canal and a core inserted into the pulp chamber (5, 6).

Fiber-reinforced Composite (FRC) posts have been quite popular in this regard owing to better durability, high fatigue resistance, elastic(7, 8). These types of posts can minimize the possibility of root fractures and show a significantly higher survival rate(9, 10). Restorative composites are commonly used as core ingredients that allow for post-curing preparation(11). Resin composite is a popular core build-up material to be used with FRC post due to similarity to tooth structure in hardness and fracture toughness, giving the ability to perform the preparation after curing. Restorative composites can be regularly employed for core build-up material (12-14). Although the use of core build-up composite resins is simple, there is evidence that dentists choose conventional composite resins. Therefore, the aim of the present study was to evaluate the effect of using composite core materials on the in vitro fracture of endodontically treated teeth.

## **Method**

Databases of PubMed, Scopus, Web of Science, EBSCO and Embase were searched for systematic literature between 2012 to February 2022. Use the MeSH Database, to build searches in PubMed: (((("Core Paste composite resin" [Supplementary Concept]) AND "Tooth, Nonvital"[Mesh]) AND ("Dental Restoration, Temporary"[Mesh] OR "Dental Restoration Repair"[Mesh] )) AND "Composite Resins"[Mesh]) AND "Tooth Root"[Mesh].

Key considerations PRISMA was the basis of the present study(15).

## ***Selection criteria***

*Inclusion criteria: criteria:* composite core materials, conventional composite resin, endodontically treated teeth restored, in-vitro studies.

## ***Study selection, Data Extraction and method of analysis***

Studies data were reported by study, years, composite Resins, Core-Build up Composites, outcome.

The tool used in Bourgi et al., 2021 study to evaluate the quality of in-vitro studies(16), this scale measures ten dimensions with a total of 8 items. In the analysis, any studies the scores of 1- 3, 4- 6 and 7- 8 were defined as high, medium and low risk of bias, respectively.

For Data extraction, two reviewers blind and independently extracted data from abstract and full text of studies that included. Prior to the screening, kappa statistics was carried out in order to verify the agreement level between the reviewers. The kappa values were higher than 0.80.

95% confidence interval for mean differences with fixed effect model and in-variance method were calculated. To deal with potential heterogeneity, random effects were used and  $I^2$  showed heterogeneity.  $I^2$  values less than 50% indicate low heterogeneity and above 50% indicate moderate to high heterogeneity. Meta-analysis was performed using Stata/MP v.16 software (The fastest version of Stata).

## **Result**

The review of the existing literature using the studied keywords, 126 studies were found. In the initial review, duplicate studies were eliminated and abstracts of 114 studies were reviewed. At this stage, 98 studies did not meet the inclusion criteria, so they were excluded, and in the second stage, the full text of 16 studies was reviewed by two authors. At this stage, 11 studies were excluded from

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the study due to incomplete data, inconsistency of results in a study, poor studies, lack of access to full text, inconsistent data with the purpose of the study. Finally, five studies were selected (Figure1).

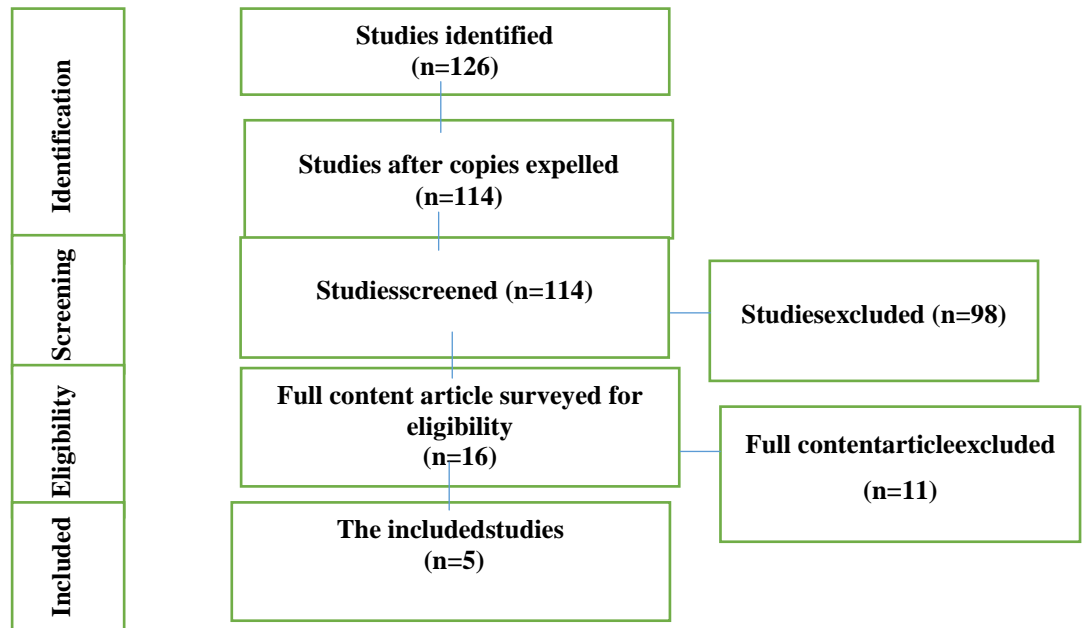


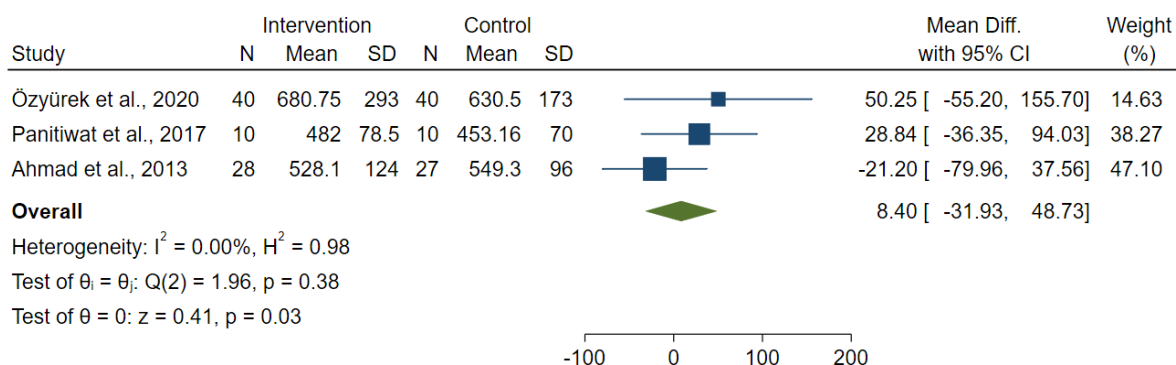
Figure 1. Study Attrition

Table 2. Studies selected for systematic review and meta-analysis.

Study. Years	composite resins	composite for core build-up material	Number endodontically treated teeth	
			core composite for core build-up	conventional or bulk-fill composite
Özyürek et al., 2020(17)	Filtek Bulk Fill Posterior	Clearfil DC Core Plus	40	40
Fráter et al., 2021 (9)	everX Posterior (GC Europe, Leuven)	Gradia Core	30	30
Fráter et al., 2020 (18)	posite resin Z1	Alpha-dent	30	30
Panitiwat et al., 2017 (12)	Tetric N-cream	Clearfil Photo Core	10	10
Ahmad et al., 2013 (19)	Composite resin Z100	Alpha-dent	28	27

**Fracture strength of endodontically treated teeth**

Mean differences of Fracture strength of endodontically treated teeth between intervention and control group was 8.40 (MD, 8.40 95% CI -31.93, 48.73) among three studies and heterogeneity found ( $I^2=0.00\%$ ;  $P =0.38$ ); there was statistically significant difference between two groups ( $p=0.03$ ); Fracture strength was higher in intervention group (Figure 2).



Fixed-effects inverse-variance model

**Discussion**

The aim of this study was to evaluate the effect of using composite core materials on the in vitro fracture of endodontically treated teeth. Based on the present meta-analysis, the core build-up composite showed better resistance than the control group. The findings indicate that there are significant differences in fracture toughness when using a variety of composite materials and should be carefully considered. Because of the stress on the core material, a higher strength material was needed to withstand the fracture load(19). Other factors can also affect the fracture toughness of composite resins, including strength, polymerization state. According to studies, other composites with higher filler content are also used to build core build-up(12, 14).Aside from the effect of fillers on the fracture resistance of a pulpless tooth, the bonding ability of composite materials plays an essential role in the strength-promotion highlighted in this meta-analysis. Since the bonding agent was applied before core build-up, according to the manufacturer’s instructions, incompatibility between materials was avoided(20). Özyürek et al., 2020 (17)reported the highest resistance to fracture was observed in the samples restored using the RelyX Fiber Post and Filtek Bulk Fill Posterior. Except for the samples restored using FiberSite posts, the fracture strength decreased after the crown replacement. Fráter et al., 2021(9)reported The restoration of immature interior teeth with the use of flowable SFRC, as post-core material displayed a promising performance in terms of fatigue resistance and survival. Panitiwat et al., 2017(12) reported the fracture resistance was higher in the groups with Clearfil Photo Core and MultiCore Flow, which presented a ranking of the highest values of the materials, showing the same tendency as fracture loads. Ahmad et al., 2013(19) showed there was no significant difference in fracture resistance between the teeth reinforced with light-polymerizing and auto-polymerizing composite resin. Studies have shown that the core material achieves better post-integration when used with less consistency(21). Dentists should also keep in mind that the performance of nuclear materials depends on their formula, and by choosing the right composite material, a successful restoration can be achieved in endodontic treatment. Therefore, it is

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better to use composite core ingredients in cases where the tooth has a crown loss. It is suggested that more RCT studies be performed in this regard to provide stronger evidence in this regard.

### Conclusion

Based on the findings of the present study and the results of studies, the evidence shows that the fracture resistance of the treated root teeth in composite core build-up with higher filler content tends to be much higher than the control group (conventional composite resins).

### References

1. Silva E, Oliveira V, Silva A, Belladonna F, Prado M, Antunes H, et al. Effect of access cavity design on gaps and void formation in resin composite restorations following root canal treatment on extracted teeth. *International Endodontic Journal*. 2020;53(11):1540-8.
2. Zheng Y, Bashandeh K, Shakil A, Jha S, Polycarpou AA. Review of dental tribology: Current status and challenges. *Tribology International*. 2022;166:107354.
3. Spear FM, Kokich VG, Mathews DP. Interdisciplinary management of anterior dental esthetics. *The Journal of the American Dental Association*. 2006;137(2):160-9.
4. Hudis SI, Goldstein GR. Restoration of endodontically treated teeth: a review of the literature. *The Journal of prosthetic dentistry*. 1986;55(1):33-8.
5. CLEEN MD. The relationship between the root canal filling and post space preparation. *International endodontic journal*. 1993;26(1):53-8.
6. Bhuva B, Giovarruscio M, Rahim N, Bitter K, Mannocci F. The restoration of root filled teeth: A review of the clinical literature. *International Endodontic Journal*. 2021;54(4):509-35.
7. Jayan JS, Appukuttan S, Wilson R, Joseph K, George G, Oksman K. An introduction to fiber reinforced composite materials. *Fiber Reinforced Composites: Elsevier*; 2021. p. 1-24.
8. Bitter K, Kielbassa AM. Post-endodontic restorations with adhesively luted fiber-reinforced composite post systems: a review. *American journal of dentistry*. 2007;20(6):353.
9. Fráter M, Sály T, Braunitzer G, Szabó PB, Lassila L, Vallittu PK, et al. Fatigue failure of anterior teeth without ferrule restored with individualized fiber-reinforced post-core foundations. *Journal of the Mechanical Behavior of Biomedical Materials*. 2021;118:104440.
10. Kharouf N, Sauro S, Jmal H, Eid A, Karrouf M, Bahlouli N, et al. Does Multi-Fiber-Reinforced Composite-Post Influence the Filling Ability and the Bond Strength in Root Canal? *Bioengineering*. 2021;8(12):195.
11. Zandinejad A, Atai M, Pahlevan A. The effect of ceramic and porous fillers on the mechanical properties of experimental dental composites. *Dental Materials*. 2006;22(4):382-7.
12. Panitiwat P, Salimee P. Effect of different composite core materials on fracture resistance of endodontically treated teeth restored with FRC posts. *Journal of Applied Oral Science*. 2017;25:203-10.
13. Lassila L, Oksanen V, Frater M, Vallittu PK, Garoushi S. The influence of resin composite with high fiber aspect ratio on fracture resistance of severely damaged bovine incisors. *Dental Materials Journal*. 2020:2019-051.
14. Zarow M, Dominiak M, Szczeklik K, Hardan L, Bourgi R, Cuevas-Suárez CE, et al. Effect of composite core materials on fracture resistance of endodontically treated teeth: A systematic review and meta-analysis of in vitro studies. *Polymers*. 2021;13(14):2251.

15. Moher D, Liberati A, Tetzlaff J, Altman DG, Altman D, Antes G, et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement (Chinese edition). *Journal of Chinese Integrative Medicine*. 2009;7(9):889-96.
16. Bourgi R, Hardan L, Rivera-Gonzaga A, Cuevas-Suárez CE. Effect of warm-air stream for solvent evaporation on bond strength of adhesive systems: A systematic review and meta-analysis of in vitro studies. *International Journal of Adhesion and Adhesives*. 2021;105:102794.
17. Özyürek T, Topkara C, Koçak İ, Yılmaz K, Gündoğar M, Uslu G. Fracture strength of endodontically treated teeth restored with different fiber post and core systems. *Odontology*. 2020;108(4):588-95.
18. Fráter M, Sáry T, Néma V, Braunitzer G, Vallittu P, Lassila L, et al. Fatigue failure load of immature anterior teeth: influence of different fiber post-core systems. *Odontology*. 2021;109(1):222-30.
19. Ahmad AM, Bakar WZW, Husein A, Alam MK. An in vitro study of fracture resistance of weakened tooth roots reinforced with two types of adhesive restorative materials. *Bangladesh Journal of Medical Science*. 2013.
20. Gundogdu M, Aladag L. Effect of adhesive resin cements on bond strength of ceramic core materials to dentin. *Niger J Clin Pract*. 2018;21(3):367-.
21. Monticelli F, Goracci C, Grandini S, García-Godoy F, Ferrari M. Scanning electron microscopic evaluation of fiber post-resin core units built up with different resin composites. *American journal of dentistry*. 2005;18(1):61-5.