ECRONICON OPEN ACCESS

EC DENTAL SCIENCE
Research Article

A Systematic Review and Meta-Analysis on the Fracture Strength, Survival, and Success Rates of Endocrown Versus Conventional Restorations of Endodontically-Treated Teeth

Salah A Yousief[1,2]*, Saad Mohamednagib Alfergani[3], Yazeed Saeed Khalofa[4], Ibraheem Abdulrahman Aljomai[5], Abdullah Hassen Jameel[6], Raed Ahmed Alzahrani[7] and Ashraf Saleh Baboor[8]

[1]*Department of Restorative and Prosthetic Dental Sciences, College of Dentistry, Dar Al Uloom University, Riyadh, Saudi Arabia*

[2]*Department of Crown and Bridge, Faculty of Oral and Dental Medicine, Al Azhar University, Assiut, Egypt*

[3]*MDSc in Endodontics, Ministry of Health, KSA*

[4]*Saudi Board in Restorative Dentistry, Ministry of Health, KSA*

[5]*Saudi Board in Family Dentistry, Ministry of Health, KSA*

[6]*Saudi Board in Periodontics, Ministry of Health, KSA*

[7]*MSc in Endodontics, Ministry of Health, KSA*

[8]*Saudi Board in Periodontics, Ministry of Health, KSA*

***Corresponding Author:** Salah A Yousief, Department of Restorative and Prosthetic Dental Sciences, College of Dentistry, Dar Al Uloom University, Riyadh, Saudi Arabia and Department of Crown and Bridge, Faculty of Oral and Dental Medicine, Al Azhar University, Assiut, Egypt.

Received: October 20, 2023; **Published:** November 07, 2023

Abstract

Objectives: Rehabilitation of endodontically treated teeth with extensive coronal damage is nevertheless difficult due in part to the weakening of the dentin tissues that surround pulp removal. There is a lack of data on the long-term survival and success of endocrowns in comparison to conventional crowns. To compare the fracture strength, survival rate, and success rate of endocrowns to those of conventional restoration is the aim of this systematic review and meta-analysis.

Data: We included all studies comparing endocrowns and conventional restoration in endodontically treated teeth whether premolar or molar ones. We included *invitro* studies, randomized controlled trials (RCTs), case-control, and cohort studies. We excluded studies that don't compare endocrowns to conventional restorations, in addition to reviews, case reports, and case series. We also excluded finite element analysis studies.

Sources: We searched the three databases (PubMed, Web of Science, and Scopus) for articles investigating our aim.

Study Selection: Two authors working independently carried out the process of title-abstract screening followed by full-text screening to include the eligible articles. Any difference was resolved between them and if the conflict persists, a senior author was in charge of it.

Results: Endocrown group was associated with a higher fracture strength compared to the conventional restoration group with a mean difference of 145.7 Newton, 95%CI: (23.86, 267.54, p = 0.02). The overall survival rate for endocrowns was 83.6% (88% for molars, and 75% for molars), while that of the conventional restoration was 80% (87% for molars, and 71.4% for premolars). However, no significant difference was obtained between both groups with an overall OR of 1.39, 95%CI: (0.76, 2.55, p = 0.29). The overall success rate for endocrowns was 81.4% (82.2% for molars, and 75% for premolars), while that of conventional restorations was 86% (83.2% for molars, and 95% for premolars) with no statistically significant difference between both groups with overall OR of 0.8, 95%CI: (0.43, 1.48, p = 0.48).

Conclusion: Endocrowns are associated with better fracture strength when compared to conventional restorations in endodontically treated molar and premolar teeth. No difference between both methods regarding survival and success rates. However, more prospective RCTs with large sample sizes validate the current findings.

Keywords: *Conventional; Endocrown; Endodontics; Survival; Fracture*

Introduction

Rehabilitation of endodontically treated teeth with extensive coronal damage is nevertheless difficult due in part to the weakening of the dentin tissues that surround pulp removal [1]. Whether or not they are mixed with core materials, the restoration's coronal retention is typically compromised, necessitating the use of intraradicular posts [2]. The extra sound tissue that needs to be removed in order to accommodate the post into the root canal is a disadvantage of the intraradicular post system, despite the fact that it has been successfully employed in the clinic [3]. Additionally, it was discovered that this process modifies the recovered teeth's general biomechanical function. Other restorative methods, including the well-known endocrown restorations, have been suggested as an alternative [4].

Endocrowns, which are conservative coronal restorations, are used to restore teeth that have received endodontic therapy but still have significant coronal tooth loss. These monoblock coronal restorations are held in place by the pulp chamber and are glued to the remaining coronal tooth structure. Bindl and Mormann initially used the term "endocrown" in 1999, and Pissis 10 first proposed the concept in 1995.

Endocrowns are monoblock restorations because they consist of a single piece that includes the intraradicular post, core, and crown [5,6]. The borders of the cavity and the inside of the pulp chamber are where endocrown restorations are affixed, as opposed to conventional techniques that use intraradicular posts. As a result, the pulpal walls and adhesive cementation, respectively, give both the larger and micro-mechanical retention [7-9]. Endocrowns also have the advantage of requiring much less chair time and less sound tissue removal than other treatments. Endocrowns also help to evenly distribute the masticatory forces felt at the tooth/restoration interface along the whole restored tooth structure [10].

The system could grow stiffer compared to the tooth architecture (in the case of ceramics) or more mechanically identical to the tooth (in the case of resin composites), based on the substance used. As a result, the choice of material may affect how effectively endocrowns function [11].

However, there is a scarcity of evidence comparing the long-term survival and success of endocrowns to traditional crowns. The goal of this systematic review and meta-analysis is to evaluate the fracture strength, survival rate, and success rate of endocrowns to those of conventional restoration.

Methods

We conducted this study based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines [12].

Search strategy

We searched the three databases (PubMed, Web of Science, and Scopus) for articles investigating our aim using the following keywords: "Endocrown" OR "Endocrowns" OR "no build-up crown" OR "no-post build-up" OR "endodontic crown"" OR "adhesive endodontic crown" AND "Fracture strength" OR "survival" OR "Success" or "Failure" from inception till September 2023.

Eligibility criteria and screening

We included all studies comparing endocrowns and conventional restoration in endodontically treated teeth whether premolar or molar ones. We included *invitro* studies, randomized controlled trials (RCTs), case-control, and cohort studies. We excluded studies which aren't comparing endocrowns to conventional restorations, in addition to reviews, case reports, and case series. We also excluded finite element analysis studies. Two authors working independently carried out the process of title-abstract screening followed by full-text screening to include the eligible articles. Any difference was resolved between them and if the conflict persists, a senior author was in charge of it. We conducted a risk of bias assessment on the eligible studies using the risk of bias-2 (rob2) tool for clinical trials [13]. Although the possibility of approaches bias *in vitro* experiments was assessed using a modification of previously used variables [14], which included using healthy teeth for evaluation, morphologically comparable evaluated teeth, sample size the computation, group randomization, the inclusion of an acceptable control group, the consumption of substances in accordance with the instructions provided by the manufacturer, getting cavities ready carried out by the same operator (standardization), and the operator's blinding. Only studies with a low probability of bias were included after full-text screening.

Data extraction

Microsoft Excel spreadsheets were used by two authors working independently to extract the data from the included studies. This includes study ID, study design, type of conventional restoration, materials of endocrowns and conventional restorations, type of tooth whether premolar or molar, sample size, age, and sex of the included participants in clinical studies.

Table 1: The baseline and summary of the included studies. (click to view)

Statistical analysis

Using Review Manager version 5.4 software, we conducted the meta-analysis using mean difference for continuous variables, and odds ratio (OR) and rates for dichotomous variables. The results were pooled at a 95% confidence level and 0.05 p-value. The heterogeneity was assessed using I^2 and a p-value of 0.05. For significant heterogeneity ($p < 0.05$) or high heterogeneity ($I^2 > 50\%$), we used a random effect model to account for the heterogeneity. For non-significant or low to moderate heterogeneity, we used a fixed effect model.

Results

Search strategy and screening

The results of the search strategy were 512 articles in total which became 342 after duplicate removal. Title and abstract screening resulted in a total of 82 articles which decreased to 25 [7,10,11,15-36] articles to enter the systematic review and meta-analysis after full-text screening as shown in figure 1.

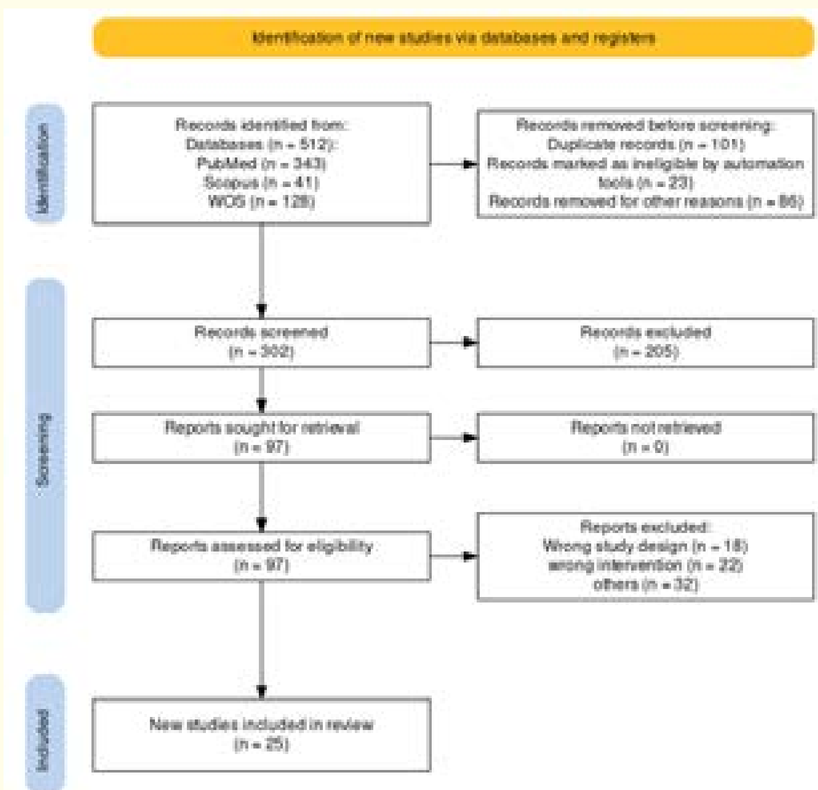

Figure 1: *The PRISMA flow chart of the selection process.*

Baseline characteristics

Statistical analysis

As shown in figure 2, 15 *in-vitro* studies were analyzed to compare the fracture strength between endocrown group and the conventional restoration group which resulted in a mean difference of 145.7 Newton, 95%CI: (23.86, 267.54, p = 0.02).

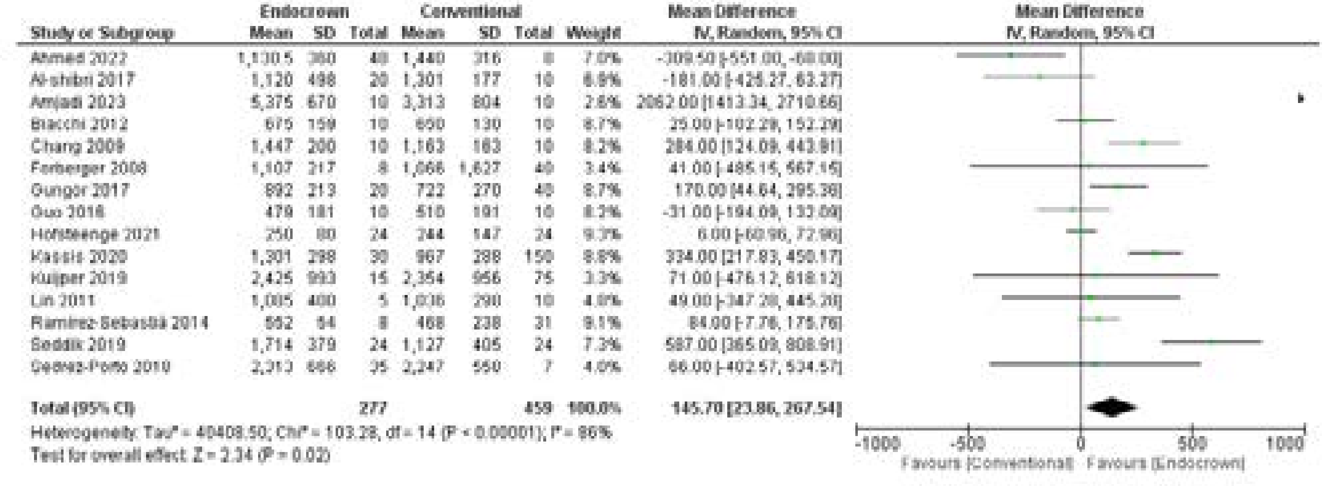

***Figure 2:** Comparison between endocrown and conventional restoration in fracture strength.*

The present analysis of six studies showed that the overall survival rate for endocrowns was 83.6% (88% for molars, and 75% for molars), while that of the conventional restoration was 80% (87% for molar, and 71.4% for premolars). However, no significant difference was obtained between both groups with an overall OR of 1.39, 95%CI: (0.76, 2.55, p = 0.29) (Figure 3).

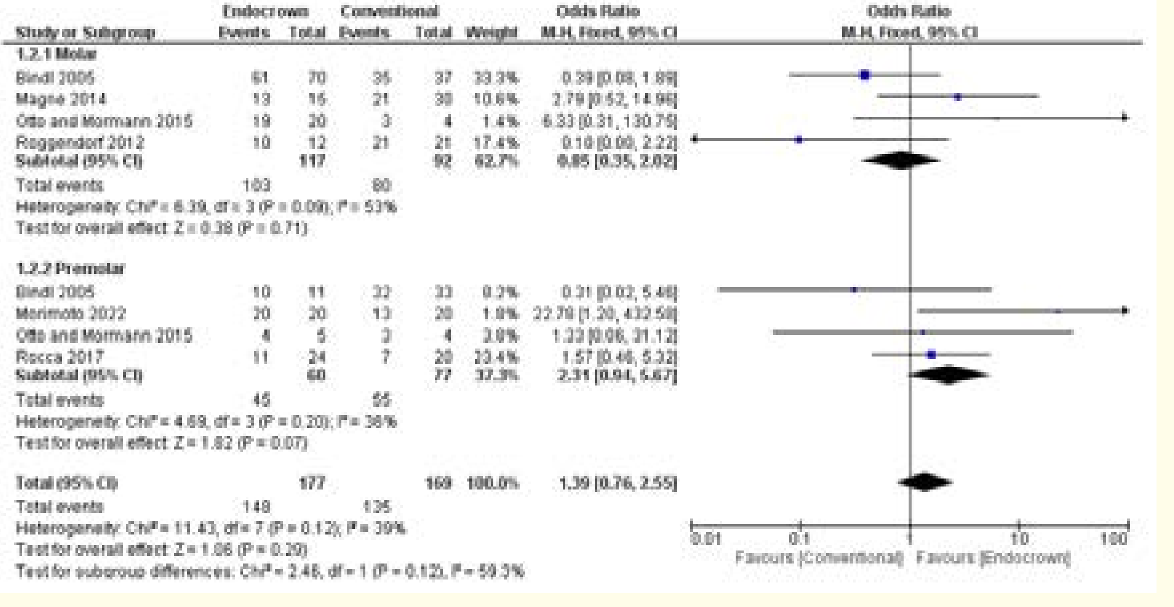

***Figure 3:** Comparison between survival rates of endocrown and conventional restorations sub-grouped by tooth type.*

The overall success rate for endocrowns was 81.4% (82.2% for molars, and 75% for premolars), while that of conventional restorations was 86% (83.2% for molars, and 95% for premolars) with no statistically significant difference between both groups with overall OR of 0.8, 95%CI: (0.43, 1.48, p = 0.48).

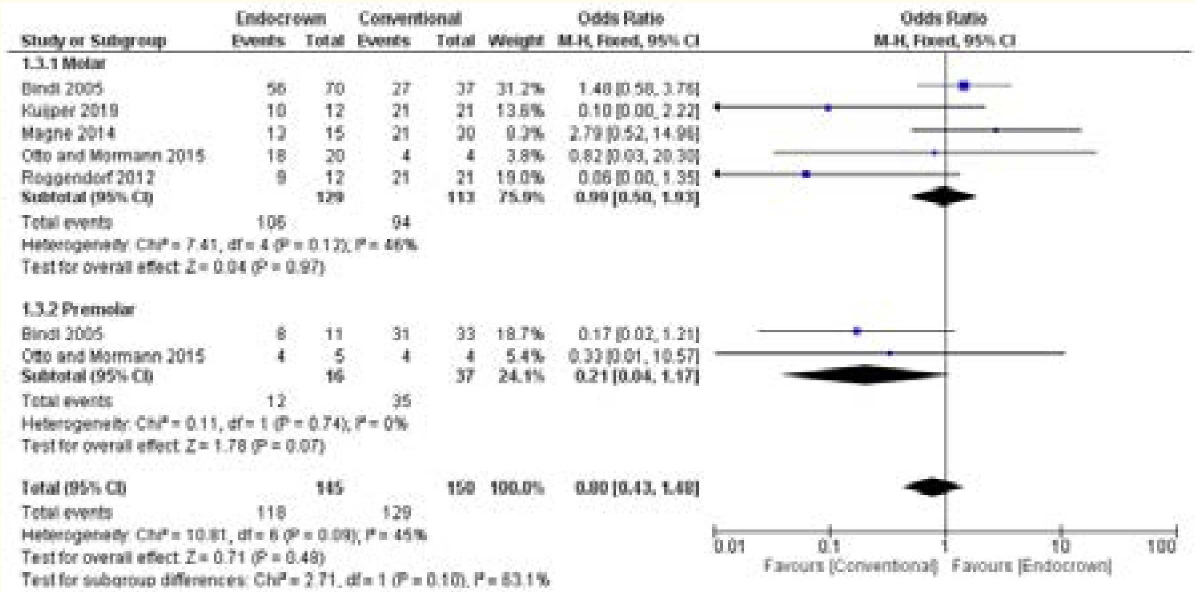

Figure 4: *Comparison between success rates of endocrown and conventional restorations sub-grouped by tooth type.*

Discussion

Our study aimed to compare the use of endocrowns and conventional treatment regarding the restoration of molars and premolars. The main findings of our study are summarized as follows: the fracture strength of endocrowns was observed to be statistically significantly higher than that of conventional restoration as observed by a pooled analysis of *in vitro* studies. However, no statistically significant difference was demonstrated between endocrowns and conventional restorations regarding survival rates and success rates whether in molars or premolars.

Similar findings were observed by Sedrez-Porto., *et al.* [20] who conducted a systematic review and meta-analysis in 2016 aiming to assess the success rate and fracture strength of endocrowns compared to conventional restoration. This study has shown that fracture strength is much more linked with endocrowns than with traditional restorations based on a meta-analysis of only five *invitro* trials. Premolars made up over 58% of the total number of teeth samples evaluated here, and four of the included studies focused on posterior teeth, which is an essential point to keep in mind. Premolars may be simpler to obtain and restore than molars, which may account for their preferred use in *in vitro* studies, but a clinical trial [8], indicated that when endocrowns were fastened on premolars, they failed more frequently. This is most likely due to premolars having a smaller adhesive area and a larger crown height than molars. Furthermore, premolars encounter higher horizontally (non-axial) directed forces, which may affect fracture resistance [37]. Only one study [11] on anterior teeth was included in the review, which emphasizes the need for additional research on how well endocrowns function in anterior teeth.

These findings showed that endocrown restorations only seemed to outperform traditional restorations when the data from all five investigations was combined. The most likely explanations are, as previously mentioned, the atypical configuration/design, thickness, and elastic moduli characteristics of endocrowns in comparison to normal systems. However, when sub-analyses were undertaken without considering the study by Ramrez-Sebastià., *et al.* endocrowns displayed fracture strength that was comparable to that of conventional crowns [11] which was the only study examining anterior teeth. It is crucial to note that the lack of more studies evaluating anterior teeth makes it difficult to explain this dual outcome, even though some inherent features specific to posterior teeth may be to blame for the data acquired.

This favorable result could be attributed to several variables, among them but not restricted to variations in thickness, elastic moduli, and configuration/design between endocrowns and conventional systems. First, the ferrule, a "bracing mechanism" of the restoration around the cervical tooth's framework that is frequently present in traditional crowns [38] may cause the loss of normal enamel and dentin tissues, which are essential for the restoration's successful bonding [37]. In contrast, endocrowns are typically prepared without a ferrule. Second, endocrowns have occlusal portions that range in thickness from 3 to 7 mm, as opposed to conventional crowns, which only have occlusal portions that range in thickness from 1.5 to 2 mm [39]. Because the larger the occlusal thickness of the restoration, the stronger the system's fracture resistance, endocrowns can bear occlusal loading better than normal crowns. Finally, traditional restorations are typically made of materials with different elastic moduli, such as metals or glass-reinforced fibers for the post section and resin composites or ceramics for the core/crown piece. Because dentin, luting cement, and restorative system stiffness mismatches can affect stress distribution, and pressure distribution is inversely related to the total number of connections between various components, the monoblock framework of endocrowns can withstand higher stress loading when compared to the multi-interfacial structure of conventional restorations [40].

The present study showed that the overall survival rate for endocrowns was 83.6% (88% for molars, and 75% for molars), while that of the conventional restoration was 80% (87% for molars, and 71.4% for premolars). In addition, the overall success rate for endocrowns was 81.4% (82.2% for molars, and 75% for premolars), while that of conventional restorations was 86% (83.2% for molars, and 95% for premolars). However, no significant difference was observed between the comparison groups regarding success or survival rates.

Similar findings were obtained by Al-Dabbagh., *et al*. [41]. They discovered that when used to replace endodontically treated molars and premolars, endocrowns and conventional crowns had comparable clinical survival and success rates.

Many of the publications that have been written about endodontically treated molars and premolars use endocrowns [15-18]. Endocrowns, however, have been demonstrated to function better when affixed to posterior teeth [19]. The bigger pulp chamber in premolars and molars as well as their axial loading during function may be the reason for this. Endocrowns were mostly employed in clinical research on teeth with little surviving coronal tooth structure because forming a ferrule would be challenging and because the margins were typically equigingiva [16,42]. Crown lengthening might be avoided in these teeth because it could further damage the tooth and make it impossible to restore.

Endodontically treated teeth ought to be repaired with a coronal restoration to minimize fragmentation and biomechanical collapse [43,44]. the perfect substance for an endocrown would include a low modulus of elasticity, identical to the structure of teeth, robust mechanical strength, and sufficient binding strength to preserve the tooth structure below it [45]. A dentin-like elastic modulus helps disperse occlusal stress along the attached surface and may boost fracture opposition, while high toughness aids in resisting occlusal load and reducing material rupture [45].

In recently published prospective and retrospective clinical investigations on the clinical efficacy and long-term survival of endocrowns [16,19,46], feldspathic CAD-CAM ceramic endocrowns were used. However, either resin ceramic or lithium disilicate ceramics were used to make the endocrowns for many of the *in vitro* investigations [15,17,18,42]. These *in vitro* studies discovered that compared to their lithium disilicate ceramic equivalents, resin ceramic endocrowns used to replace premolars had better fracturing strengths and reduced rates of severe damage. The fact that the resin ceramic's modulus of elasticity is comparable to that of dentin may help distribute occlusal stresses along the premolars' bonded surface, increasing fracture resistance and decreasing the likelihood of catastrophic failure [45].

The lack of RCTs, clinical studies with insufficient test and control restorations, and clinical studies without long-term survival analyses longer than three years were among the issues that were discovered after a review of the scientific literature. The results are not statistically significant in large part because of the few participants and the range of materials used.

It is crucial to conduct more research, particularly long-term clinical trials, to better understand how endodontic crown restorations can be used to restore severely damaged teeth. It is also necessary to undertake studies examining the impact of endocrowns in anterior teeth. Endocrowns could also be used for oral rehabilitation due to their potential for being more affordable than other therapy modalities (e.g. quicker, simpler, and less expensive to produce).

Conclusion

Endocrowns are associated with better fracture strength when compared to conventional restorations in endodontically treated molar and premolar teeth. No difference between methods regarding survival and success rates. However, more prospective RCTs with large sample sizes validate the current findings.

Statement of Ethics

An ethics statement is not applicable because this study is based on published literature.

Funding Source

No funds were received.

Data Statement

All data generated during this study are included in this article.

Declaration of Competing Interest

No conflict to declare.

Author Contribution

SY: Contributed to the design, search and selection, analysis, and interpretation.

SA, YK, IA, AJ, RA, AB: Contributed to conception and design, analysis, and interpretation, and revised the manuscript.

HE, AK: Contributed to conception and design, search and selection, analysis, and interpretation, and revised the manuscript.

Bibliography

1. Zhu Z., *et al*. "Effect of Post Placement on the Restoration of Endodontically Treated Teeth: A Systematic Review". *The International Journal of Prosthodontics* 28.5 (2015): 475-483.

2. Sarkis-Onofre R., *et al*. "Cast metal vs. glass fibre posts: a randomized controlled trial with up to 3 years of follow up". *Journal of Dentistry* 42.5 (2014): 582-587.

3. Lazari PC., *et al*. "Stress distribution on dentin-cement-post interface varying root canal and glass fiber post diameters. A three-dimensional finite element analysis based on micro-CT data". *Journal of Applied Oral Science* 21.6 (2013): 511-517.

4. Roscoe MG., *et al*. "Influence of alveolar bone loss, post type, and ferrule presence on the biomechanical behavior of endodontically treated maxillary canines: strain measurement and stress distribution". *Journal of Prosthetic Dentistry* 110.2 (2013): 116-126.

5. Otto T. "Computer-aided direct all-ceramic crowns: preliminary 1-year results of a prospective clinical study". *International Journal of Periodontics and Restorative Dentistry* 24.5 (2004): 446-455.

6. Zarone F., *et al*. "Evaluation of the biomechanical behavior of maxillary central incisors restored by means of endocrowns compared to a natural tooth: a 3D static linear finite elements analysis". *Dental Materials* 22.11 (2006): 1035-1044.

7. Biacchi GR., *et al*. "The endocrown: an alternative approach for restoring extensively damaged molars". *Journal of Esthetic and Restorative Dentistry* 25.6 (2013): 383-390.

8. Bindl A and Mörmann WH. "Clinical evaluation of adhesively placed Cerec endo-crowns after 2 years--preliminary results". *The Journal of Adhesive Dentistry* 1.3 (1999): 255-265.

9. El-Damanhoury HM., *et al*. "Fracture resistance and microleakage of endocrowns utilizing three CAD-CAM blocks". *Operative Dentistry* 40.2 (2015): 201-210.

10. Chang C-Y., *et al*. "Fracture resistance and failure modes of CEREC endo-crowns and conventional post and core-supported CEREC crowns". *Journal of Dental Sciences* 4.3 (2009): 110-117.

11. Ramírez-Sebastià A., *et al*. "Adhesive restoration of anterior endodontically treated teeth: influence of post length on fracture strength". *Clinical Oral Investigations* 18.2 (2014): 545-554.

12. Moher D., *et al*. "Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement". *PLOS Medicine* 6.7 (2009): e1000097.

13. Sterne JAC., *et al*. "RoB 2: a revised tool for assessing risk of bias in randomised trials". *British Medical Journal* 366 (2019): l4898.

14. Sarkis-Onofre R., *et al*. "The role of resin cement on bond strength of glass-fiber posts luted into root canals: a systematic review and meta-analysis of *in vitro* studies". *Operative Dentistry* 39.1 (2014): E31-E44.

15. Alshibri S and Elguindy J. "Fracture Resistance of Endodontically Treated Teeth Restored with Lithium Disilicate Crowns Retained with Fiber Posts Compared to Lithium Disilicate and Cerasmart Endocrowns: *In Vitro* Study". *Dentistry* (2017): 7.

16. Bindl A., *et al*. "Survival of ceramic computer-aided design/manufacturing crowns bonded to preparations with reduced macroretention geometry". *The International Journal of Prosthodontics* 18.3 (2005): 219-224.

17. El Ghoul W., *et al*. "Fracture resistance and failure modes of endocrowns manufactured with different CAD/CAM materials under axial and lateral loading". *Journal of Esthetic and Restorative Dentistry* 31.4 (2019): 378-387.

18. Rocca GT., *et al*. "Restoration of severely damaged endodontically treated premolars: The influence of the endo-core length on marginal integrity and fatigue resistance of lithium disilicate CAD-CAM ceramic endocrowns". *Journal of Dentistry* 68 (2018): 41-50.

19. Roggendorf MJ., *et al*. "Seven-year clinical performance of CEREC-2 all-ceramic CAD/CAM restorations placed within deeply destroyed teeth". *Clinical Oral Investigations* 16.5 (2012): 1413-1424.

20. Sedrez-Porto JA., *et al*. "Endocrown restorations: A systematic review and meta-analysis". *Journal of Dentistry* 52 (2016): 8-14.

21. Morimoto S., *et al*. "Two-Year Survival of Ceramic Endocrowns and Partial Coverage Ceramic Restorations with Fiber Post: A 2-Year Double-Blind Randomized Clinical Trial". *European Journal of Prosthodontics and Restorative Dentistry* 30.4 (2022): 252-261.

22. Seddik T and Derelioglu S. "Effect of Endocrowns on Fracture Strength and Microleakage of Endodontically Treated Primary Molar Teeth". *Journal of Advanced Oral Research* 10.2 (2019): 113-119.

23. Fildisi MA and Eliguzeloglu Dalkilic E. "The effect of fiber insertion on fracture strength and fracture modes in endocrown and overlay restorations". *Microscopy Research and Technique* 85.5 (2022): 1799-1807.

24. Belleflamme MM., *et al*. "No post-no core approach to restore severely damaged posterior teeth: An up to 10-year retrospective study of documented endocrown cases". *Journal of Dentistry* 63 (2017): 1-7.

25. De Kuijper M., *et al*. "Fracture Strength of Various Types of Large Direct Composite and Indirect Glass Ceramic Restorations". *Operative Dentistry* 44.4 (2019): 433-442.

26. Krance A., *et al*. "Fracture resistance of all-ceramic crowns based on different preparation designs for restoring endodontically treated molars". *Journal of Esthetic and Restorative Dentistry* 31.1 (2019): 72-79.

27. Hofsteenge JW and Gresnigt M. "The Influence of Dentin Wall Thickness and Adhesive Surface in Post and Core Crown and Endocrown Restorations on Central and Lateral Incisors". *Operative Dentistry* 46.1 (2021): 75-86.

28. Amjadi M., *et al*. "Comparative evaluation of fracture resistance and failure modes in endodontically treated molars restored with zirconia endocrown and onlays". *Folia Medica* 65.2 (2023): 260-268.

29. Bozkurt DA., *et al*. "Comparison of the pull-out bond strength of endodontically treated anterior teeth with monolithic zirconia endocrown and post-and-core crown restorations". *Journal of Oral Science* 65.1 (2023): 1-5.

30. Ahmed MAA., *et al*. "Fracture resistance of maxillary premolars restored with different endocrown designs and materials after artificial ageing". *Journal of Prosthodontic Research* 66.1 (2022): 141-150.

31. Magne P., *et al*. "Influence of no-ferrule and no-post buildup design on the fatigue resistance of endodontically treated molars restored with resin nanoceramic CAD/CAM crowns". O*perative Dentistry* 39.6 (2014): 595-602.

32. Guo J., *et al*. "A comparison of the fracture resistances of endodontically treated mandibular premolars restored with endocrowns and glass fiber post-core retained conventional crowns". *Journal of Advanced Prosthodontics* 8.6 (2016): 489-493.

33. Bankoğlu Güngör M., *et al*. "Fracture strength of CAD/CAM fabricated lithium disilicate and resin nano ceramic restorations used for endodontically treated teeth". *Dental Materials Journal* 36.2 (2017): 135-141.

34. Forberger N and Göhring TN. "Influence of the type of post and core on *in vitro* marginal continuity, fracture resistance, and fracture mode of lithia disilicate-based all-ceramic crowns". *Journal of Prosthetic Dentistry* 100.4 (2008): 264-273.

35. Kassis C., *et al*. "Effect of Inlays, Onlays and Endocrown Cavity Design Preparation on Fracture Resistance and Fracture Mode of Endodontically Treated Teeth: An *In Vitro* Study". *Journal of Prosthodontics* 30.7 (2021): 625-631.

36. Lin CL., *et al*. "Evaluation of failure risks in ceramic restorations for endodontically treated premolar with MOD preparation". *Dental Materials* 27.5 (2011): 431-438.

37. Skupien JA., *et al*. "Ferrule Effect: A Meta-analysis". *JDR Clinical and Translational Research* 1.1 (2016): 31-39.

38. Jotkowitz A and Samet N. "Rethinking ferrule--a new approach to an old dilemma". *British Dental Journal* 209.1 (2010): 25-33.

39. Motta AB., *et al*. "Influence of substructure design and occlusal reduction on the stress distribution in metal ceramic complete crowns: 3D finite element analysis". *Journal of Prosthodontics* 23.5 (2014): 381-389.

40. Tay FR and Pashley DH. "Monoblocks in root canals: a hypothetical or a tangible goal". *The Journal of Endodontics* 33.4 (2007): 391-398.

41. Al-Dabbagh RA. "Survival and success of endocrowns: A systematic review and meta-analysis". *The Journal of Prosthetic Dentistry* 125.3 (2021): 415.e1-.e9.

42. Abdel-Aziz MS and Abo-Elmagd AAA. Effect Of Endocrowns and Glass Fiber Post-Retained Crowns on The Fracture Resistance of Endodontically Treated Premolars (2015).

43. Suksaphar W., *et al*. "Survival rates against fracture of endodontically treated posterior teeth restored with full-coverage crowns or resin composite restorations: a systematic review". *Restorative Dentistry and Endodontics* 42.3 (2017): 157-167.

44. Tang W., *et al*. "Identifying and reducing risks for potential fractures in endodontically treated teeth". *The Journal of Endodontics* 36.4 (2010): 609-617.

45. Zhu J., *et al*. "Influence of remaining tooth structure and restorative material type on stress distribution in endodontically treated maxillary premolars: A finite element analysis". *Journal of Prosthetic Dentistry* 117.5 (2017): 646-655.

46. Otto T and Mörmann WH. "Clinical performance of chairside CAD/CAM feldspathic ceramic posterior shoulder crowns and endocrowns up to 12 years". *International Journal of Computerized Dentistry* 18.2 (2015): 147-161.

Volume 22 Issue 11 November 2023