

Survivability of endodontically treated teeth with Endocrown - Systematic review

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Abstract

Introduction: Endo crowns are formed from a mono block which are anchored to the internal portions of the pulp chamber and cavity margins, thus obtaining macro-mechanical retention by the pulpal walls and micro retention by adhesive cementation.

Aim: The purpose of the present study was to assess the survival rate of endodontically treated teeth with endo crown based on a systematic review of the literature.

Materials and method: Two review authors independently assessed the titles and abstracts of all documents. The titles and abstracts of all reports identified through the electronic searches were read.

Clinical trials that evaluated endo crown restorations with follow up were included in the study. Case reports, case series, pilot studies, reviews and in vitro studies and language other than English were excluded from the study. This report followed the PRISMA Statement. A total of 10 studies were included in this review.

Results: 10 clinical studies were included in the qualitative analysis and were published between 1999 and 2021. Follow up periods were from 6 months to 19 years, showing a success rate varying from 68.75 to 100% in premolars and 80% to 99.8% molars. Out of total 548 posterior teeth evaluated in 10 clinical studies, only 43 reported failures.

Conclusion: Endo crowns appears to have acceptable long term survival rate for endodontically treated teeth. Additional well designed clinical studies and randomized control trial with long term follow up are needed to validate the results of their use in premolars as well as in anterior teeth.

Keywords: Endo crown; survivability; lithium di silicate; endo dontically treated teeth

Introduction

Rehabilitation of endodontically treated teeth(ETT) with extensive coronal destruction pose clinical challenge since they are more prone to fracture, due to loss of strength associated with removal of pulp and surrounding dentin.¹ For posterior ETT, a post-endo dontic restoration with cuspal protection is traditionally recommended to reduce the potential of tooth fracture.^{2,3} Incidence of tooth fracture after endodontic treatment was lower in posterior teeth with cuspal protection; cuspal-coverage restoration significantly improves clinical success in posterior ETT.⁴ With the advent of adhesive dentistry and increasing emphasis on minimally invasive principles, the use of endo crown is recommended. Gulabivala and Ng (2019) defined endo crowns as monolithic composite or ceramic endo crowns which incorporate a dowel extension into the pulp chamber for retention.⁵

Objective

The purpose of the present study was to assess the survival rate of endodontically treated teeth with endo crown based on a systematic review of the literature

Materials and Methods

This study followed the PRISMA statement guidelines. The population, intervention, control, and outcome (PICO) for this systematic review were defined as follows:

- The population - participants undergoing endo dontic treatment;
- The intervention – endo crowns;
- The comparison – no comparators
- The outcome measures - survival rates

Study selection

Two review authors independently assessed the titles and abstracts of all documents. The titles and abstracts of all reports identified through the electronic searches were read.

Clinical trials that evaluated endo crown restorations with follow up were included in the study. Case reports, case series, pilot studies, reviews and in vitro studies and language other than English were excluded from the study.

Data Extraction

For each of the identified studies included, the following data were then extracted on a standard form, when available:

- year of publication
- study design
- number of patients
- type of material used
- adhesive system used
- Reason for failure
- follow-up period
- Success rate

Quality Assessment

Effective Public Health Practice Project (EPHPP) tool. This tool provides a standardized means of assessing study quality by providing overall methodological rating of strong, moderate or weak.

Results

An electronic search of articles published from January 1995 to June 2020 undertaken in September 2021, with an updated search carried out in may 2021, in the

following databases: PubMed/Medline, Web of Science, Cochrane, Scopus and Google Scholar. The search strategy in the databases resulted in 2350 papers. 1605 articles were cited in more than one database (duplicates). The independent screening of the abstracts for those articles related to the aim of the review. Of the resulting 43 studies, were excluded for not being related to the topic or not presenting clinical cases). Additional hand searching of journals and of the reference lists of selected studies, plus the updated search, yielded two additional papers. Thus, a total of 10 publications were included in the review.

Search criteria

(endo crown OR endo crowns OR endo crown OR endo-crown) AND (computer aided design OR endodontically treated teeth OR ceramic OR mono block OR CAD-CAM, OR “depulped restoration” OR “no build up crown” OR “no build-up crown” OR “no-post build up” OR “no-post build-up” OR “endo crowns” OR “endo crown” OR “endodontic crown” OR “endodontic crowns” OR “adhesive endodontic crown” OR “adhesive endodontic crowns”)

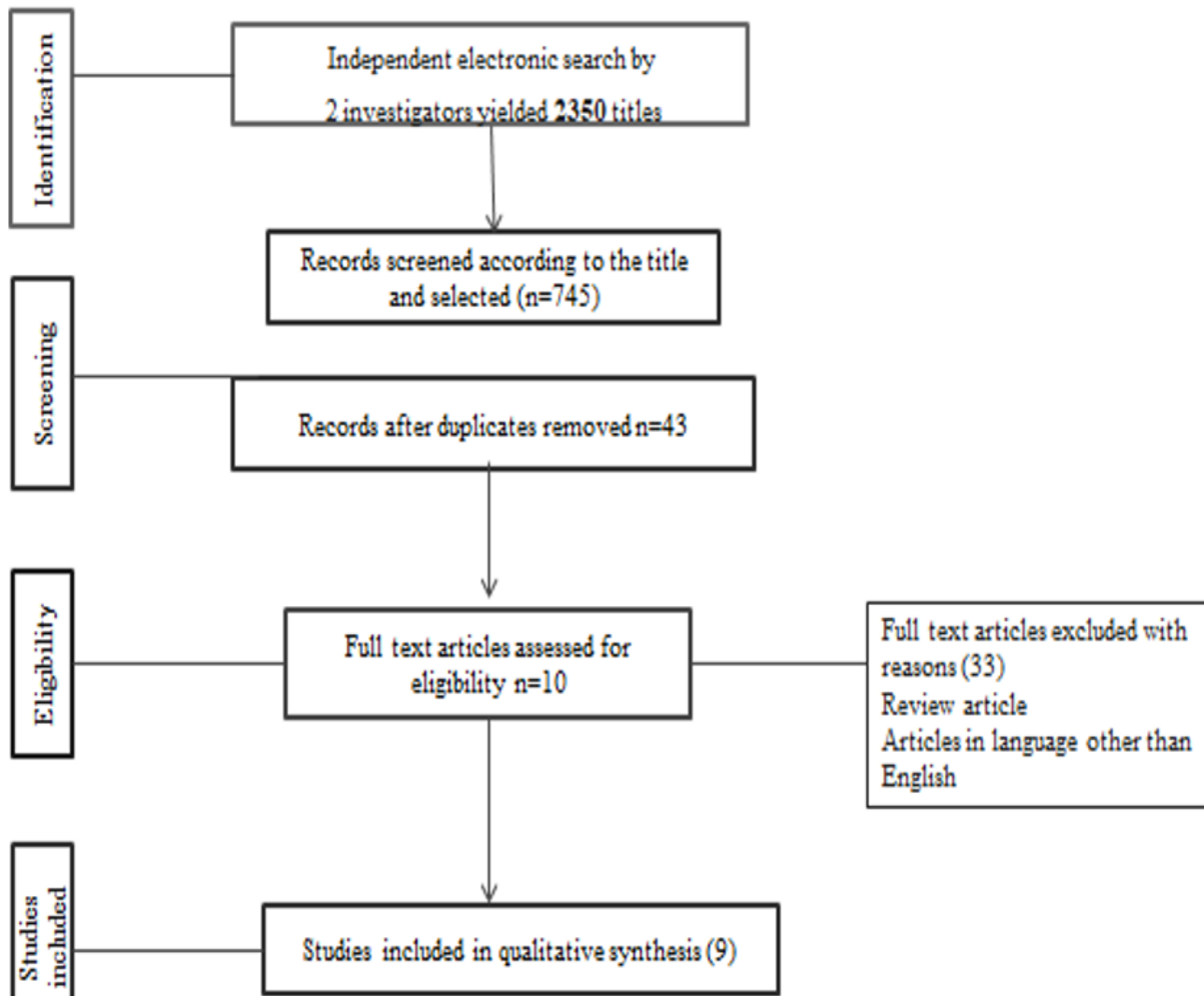


Table 1:

Author name	Published	Study design	country	Study sample	Reason for failures	Type of restoration	Luting agent used	Follow up	Failed endo crowns	Success rate	Conclusion
Bindl and momann ⁶	1999	Prospective Clinical	Switzerland	19	Debonding, secondary caries	Cerec endo crowns		26 months	1	95% - premolar and molar 93.3% - molar 100%- premolar	The overall clinical quality of the CEREC endo crowns was very good.
Bindl et al ⁷	2005	Prospective	Switzerland	86	Adhesive failure/ debond Vertical root fractures Periodontitis, Inter radicular osteitis	Feldspathic porcelain CAD-CAM (CEREC2)	Resin based posterior composite (Tetric, Ivoclar Vivadent); light cured	3 to 7 years 55 + 15 months	19	Premolar- 68.75% Molar – 87.1%	Endo preparation appeared acceptable for molar crowns but inadequate for premolar crowns
Bernhart et al ⁸	2010	Prospective study		20	Endo crown fracture, Tooth fracture	Cerec 3D	Dual curing bonding agent (Pana via, kurraray, EUROPE)	2 years	2	96% after 1year. 90% after 2 years	CAD – CAM fabricated crowns represent a very promising treatment alternative for endodontically treated molars
Roggendorf et al ⁹	2011	Prospective observational	Germany	12		Feldspathic porcelain	Vertical root fracture:	7 years		80%	adhesively luted all-ceramic CAD/CAM generated restorations
		longitudinal				CAD-CAM (CEREC2)	66.7% Caries: 33.3%				are suitable for restoration of extended coronal defects
Decerle et al ¹⁰	2014	Prospective	Britian	16	Secondary caries	Ceramic blocks - vita mark II.	Self-adhesive cement (relyx unicem 3M espe)	6 month	1	100% PM and 90.9% molar	
Otto Mormann et al ¹¹	2015	Prospective	Switzerland	25	Ceramic bulk fracture, Debond	Cerec 3 (CAD/CAM) method and Vita Mark II (feldspathic ceramic	Dual cured composite luting agent (duo cement plus coltene)	10 years and 8 months	3	Endocrowns showed 90.5% survival on molars and 75% on premolars	The longevity of Vita Mark II Cerec 3 shoulder crowns on molars and premolars, as well as of endocrowns on molars, proved to be--for private practice--a very acceptable result, while the premolar endocrowns tended to show a higher risk for failure.

Botto et al ¹²	2016	Retrospective clinical trial	Uruguay	11	Loss due to periodontal involvement after 12 years and 9 months	7 IPS Empress 1 gold alloy 1 indirect composite	Dual cure to cement	8 years to 19 years	1	90	Endo crown is a conservative and aesthetic technique-sensitive procedure used to restore posterior endodontically treated teeth, mainly molars, with a very good biomechanical and functional performance, and very acceptable longevity.
Belleflamme Et al ¹³	2017	Retrospective Clinical trial	Belgium	64	Debonding Secondary caries Periodontal disease minor chipping) and major fractures			44.7 months	10	98.8%	Endo crowns were shown to constitute a reliable approach to restore severely damaged molars and premolars, even in the presence of extensive coronal tissue loss or occlusal risk factors.
											such as bruxism or unfavourable occlusal relationships
Fages et al ¹⁴	2017	Prospective clinical trial		235	Loss of restoration; partial / total tooth or ceramic fracture, caries	CEREC unit; Dentsply Sirona	3 VITA mark 2; VITA Zahn Fabrik		1	99.78	
Ma'aita et al ¹⁵	2021	Randomized clinical trial	Jordan	60	Zirconia –lithium debonded. Hybrid ceramic Endo crowns glass-chipped/fractured	–lithium disilicate-reinforced glass-ceramic, monolithic zirconia and polymer infiltrated hybrid ceramic	dual-cured resin cement (RelyXTM Ultimate, 3M, Bracknell, UK)	2 year	Zirconia – 3. Hybrid ceramic-2	90.9%	Lithium disilicate-reinforced ceramic had fewer complications and required less intervention compared with zirconia and hybrid ceramics

Descriptive Analysis

10 clinical studies were included in the qualitative analysis and were published between 1999 and 2021. Follow up periods were from 6 months to 19 years, showing a success rate varying from 68.75 to 100% in premolars and 80% to 99.8% molars. Out of total 548 posterior teeth evaluated in 10 clinical studies, only 43 reported failures.

Discussion

According to the present systematic review endo crown seemed to have good survivability rate ranging from 68.8% to 100 %. Several factors are associated to survivability of the endo crowns, including differences in design, thickness, and elastic moduli that endo crowns have compared to conventional systems.¹⁶ Also, ferrule, usually found in conventional crowns, may cause the loss of sound enamel and dentin tissues that would be important for proper bonding, while endo crowns are generally prepared without ferrule.¹⁷ Besides, the thickness of the occlusal portion of endo crowns varies from 3 to 7 mm, in contrast with conventional ones in which it varies from 1.5 to 2 mm.¹⁸

The most used ceramic materials for endo crown restoration fabrication are leucite glass-ceramic, lithium disilicate, zirconia, polymer infiltrated hybrid ceramic and also they can be pressed or milled CAD/CAM systems in the laboratory by processing the feldspathic ceramic block.⁶⁻¹⁵

Lithium disilicate and leucite reinforced ceramics had the ability to acid-etched and had high mechanical strength, which enabled them, associated with adhesive systems, to make the posterior teeth restoration is possible without using post and cores technique.¹⁵ The main reason for failure in most of the studies was debonding of ceramic endo crowns. The adhesives used varied from dual cured luting cement^{8, 11, 12, 14}, self-

adhesive resin cement¹⁰ to light cured resin based composite material⁷. When light cured resin based composite material was used adhesive failure was seen. This may be related with inefficient curing light penetration resulting in inadequate photo polymerisation of the cement, thus decreasing bond strengths.⁷ Two molar debonds were reported by Otto & Mormann⁷ the author attributes the failure to insufficient stabilisation due to minimal pulp chamber extension of less than 2mm.

Otto and Mörmann et al used machinable composite material as alternative to ceramic which has modulus of elasticity close to that of dentin.¹¹ He explained the debonding of ceramic endo crowns to be due to the high modulus of elasticity of the ceramic which transfers the chewing force to the interface between the luting cement and dentine, resulting in stress at the interface thereby causing debonding of the endo crown restoration. Ma'aita et al reported that, the lithium disilicate group showed a 100% retention of endo crowns compared with zirconia and hybrid ceramics.¹⁵ This can be attributed to the reliable bonding technique and an elastic modulus that is similar to dentin. Bindl et al. reported that endo crowns are inadequate for premolars, having a failure incidence of 31%, which showed a strong correlation with the surface available for adhesion.⁷ However Decerle et al and Otto et al, concluded that the fabrication of endo crowns is a reliable approach for restoring both molars and premolars, even in the presence of extensive loss of tooth structure or occlusal risk factors.^{10, 11}

Clinical studies showed that the bonding system was retained on the intaglio surface of loosened endo crowns and failed at the dentine interface.^{6, 11} This could be due to the presence of sclerotic dentin in the pulp chamber which results in poor adhesion than with sound dentin.⁷

Also, when the residual height of the walls is less than 2 mm, shown to have a negative impact.¹¹

The other reason for failure was fracture of the restoration^{7,8,11,13-15}, seen in 6 studies which may be ascribed to the material used or due to insufficient management of occlusal stress. Also, the Ceramic material has been widely used with its advantage being stiffness but due to its minimal elasticity can result in catastrophic fractures. There were periodontal failures which was reported in 3 of the studies.^{7,12,13} Belleflamme et al.¹³ reported a survival rate of 98.8% even in the presence of occlusal risk factors such as bruxism and unfavourable occlusal relationships. Botto et al¹² used both butt and chamfer finish margins while Fages et al¹⁴ used butt finish margin and Belleflamme et al¹³ used chamfer finish margins.

Conclusion

Endo crowns appears to have acceptable long term survival rate for endodontically treated teeth. Additional well designed clinical studies and randomized control trial with long term follow up are needed to validate the results of their use in premolars as well as in anterior teeth.

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