

Clinical update quiz: your free CPD hour



Survival of pre-formed zirconia crowns in primary teeth: a prospective practice-based cohort study

Foster M, Patel J, Turlach B, Anthonappa R. Survival of pre-formed zirconia crowns in primary teeth: a prospective practice-based cohort study. *Aust Dent J.* 2024 Jun;69(2):139-145. doi: 10.1111/adj.13006. Epub 2024 Feb 1. PMID: 38299688.

Reviewed and edited by Professor Harcourt and Dr Condon. Compiled by Dr Nirav Bhatia.

This article was originally published in the Australian Dental Journal, 2024 and has been edited for brevity and clarity.

Introduction

Restorative therapy in the primary dentition is geared towards providing a child with a functional and aesthetic outcome until exfoliation. Full coverage restorations provide a superior seal and preservation of coronal integrity compared with intra-coronal restorations in the primary dentition and are commonly used in the management of high caries risk children, teeth with multiple carious lesions and developmental defects of enamel. Stainless steel crowns (SSC) have become the gold standard in restoring primary molars.

Despite their proven clinical history and longevity, the use of SSCs is limited by their metallic appearance. Pre-formed zirconia crowns (PZCs) have shown promising outcomes based on their excellent aesthetics, favourable mechanical properties, and biological compatibility. However, unlike SSCs, PZCs cannot be crimped or contoured and need to be passively cemented thus resulting in greater technique-sensitivity. A recent systematic review found only 14 clinical studies on PZCs with most studies focusing on anterior teeth with a follow-up period between 12 and 18 months, with limited literature on the longer-term success on posterior teeth. The aim of this study was therefore to investigate the (1) survival probabilities of PZCs placed on anterior or posterior primary teeth beyond 12 months and (2) identify demographics and tooth-related factors that might affect survival probability.

Methods

Study population and design

All children received care through a single private practice and were assessed for suitability and treated under general anaesthesia by a single paediatric dentist (MF). Eligibility for this study included children whose parents requested an alternative restoration to a stainless-steel crown, adequate tooth structure and a minimum of two millimetres of circumferential ferrule to place a zirconia crown, and at least 12 months of follow-up.

Zirconia crown protocol

All crowns were placed and prospectively reviewed by an experienced paediatric dentist (MF) in the same practice. EZ-Pedo crowns were used in the study. The preparation of the teeth was in accordance with the guidelines recommended by EZ-Pedo, and the manufacturer-recommended burs were used as part of this process. The initial pilot phase (first 20 patients) used EZ-Pedo version 1 crowns while the remaining patients received the newer version 2 crowns.

The decision to provide pulp therapy (in the form of pulpotomy only) was made based on clinical or radiographic signs. Where this was required, the pulpotomy technique was completed using diathermy, followed by the placement of formocresol and a resin-modified core. A core was also placed if significant undercuts remained after caries removal without pulp therapy. All of the crowns were cemented with FUJI IX Extra, with constant pressure for approximately 30 seconds until the material began to set. The excess was then removed with a probe and Superfloss prior to cleansing with a three-in-one syringe using air and water spray.

Data collection

The children in this study were reviewed one month postoperatively and then on a six-monthly schedule with data being prospectively logged. As a pragmatic prospective study, radiographs were only taken if the child was compliant and the need for a radiograph was clinically justified. All available radiographs were externally reviewed by two paediatric dentists. To assess the survival of PZCs, clinical success was established if a tooth did not require a secondary procedure from either time of placement to the last follow-up appointment, or through to natural exfoliation of the treated tooth. If a tooth with a PZC required a secondary procedure prior to natural exfoliation, this was classed as a clinical failure.

Test your knowledge with our online quiz.

Earn up to **11 free CPD hours** per year!

Released each month online.

adavb.org/clinicalupdate

Procedural complications such as clinically significant overhangs found during probing of the crown margins postoperatively and visible fracture of the crown were recorded, but these were not classified as failures if the crown was otherwise intact with no intervention being required.

Results

This study included 155 children with 319 teeth followed up for at least 12 months. The mean age of the children was 5.8 years, ranging from 2 years to 11 years. Seventy percent (70%) of teeth had received pulpotomy, with 76% of these being first primary molars. A total of 67 children (43%) had only one PZC placed, 46 (30%) had two PZCs placed, and 42 (27%) had three to five PZCs placed, with the exception of one child who had seven PZCs placed.

On average, the crowns were followed up for 38 months (ranging from 12 to 78 months). Of the 319 crowns followed, five failures requiring extraction were observed in three patients.

Kaplan–Meier Survival Analysis

When examining the survival variables in this study, the low occurrence of failures (only five failures out of 319 teeth) resulted in unstable parameter estimates when applying a Cox proportional hazard model to the survival time, particularly when gender, tooth type, or presence of a pulpotomy were used as explanatory variables.

As a result, the possible explanatory variables included age at treatment and the location of the tooth in the arch but none of the hazard ratios (HR) was statistically significant. This was expected, given that there were only five failures out of 319 teeth.

Radiographic Assessment

Postoperative radiographs were available for 30 patients involving 54 teeth treated with PZCs. Of these, radiographic signs of pathology were noted in 13 (24%) PZC-treated teeth: Five teeth (9%) presented with furcal resorption, seven teeth (13%) presented with internal resorption. While radiographic changes were evident in 13 teeth, only five of them required extraction. This suggests that some of these findings were incidentally identified on radiographs in the absence of symptoms.

The margins of the PZCs were also evaluated from the available

radiographs and were deemed satisfactory in 41 (76%) of PZC-treated teeth. However, the following issues were noted; ledges were observed in 9 (17%) of PZC-treated teeth, overhangs in 2 (4%) of cases, overpreparation in 2 (4%) of cases. Excess cement was a common radiographic finding, evident in 10 (19%) of teeth. Of the teeth with excess cement, 70% exhibited it on the distal surface.

Discussion

PZCs have seen a rise in popularity in the last decade due to a demand for more aesthetic solutions than SSCs. This study supports previous literature underlining a high success rate and retention of PZCs. Recent systematic reviews have further highlighted favourable outcomes for PZCs when assessing gingival health, parental satisfaction, colour stability, and marginal integrity. The V1™ crowns tended to be associated with more fit issues and ledges as they are morphologically taller and narrower in all dimensions. Additionally, excess cement was commonly observed during radiographic assessment of zirconia crowns placed earlier in this study, this is likely attributed to a high-viscosity glass-ionomer cement (GIC) being used rather than a luting cement. The use of a luting cement might reduce this risk as it is easier to floss and wash out. The cement used has shown to influence retention of PZCs. Previous studies investigating bioceramic cements have shown mixed results with one study reporting significantly poorer outcomes with this type of cement. Nevertheless, the majority of studies have tended to use GIC as the cement of choice with a reported success rate of 82% to 100% in the broader PZC literature.

Although this study echoes the high success rates of PZCs seen in the literature, it must be noted that the tooth preparation, cost, and technique sensitivity can limit the use of PZCs in routine practice. All children included in this study were treated under general anaesthesia; this provides a controlled environment for PZC preparation where issues such as subgingival preparation and subsequent gingival bleeding can be readily managed. The study findings need to be interpreted with caution as this methodology lacks the stringent control and comparison groups typically found in randomised clinical trials. A single operator limits the generalisability of the results; it is likely that success rates of PZCs are associated with operator experience given the technique-sensitive preparation and cementation required.

Postoperative radiographs were not obtained for all patients, and of those that were available, nearly a quarter (24%)

displayed signs of radiographic changes with internal resorption being the most common. Although this study was confined to clinical rather than radiographic success, osseous resorption warrants further discussion with the parents and clinical discretion and patient compliance will largely dictate the necessity of extracting asymptomatic teeth with an underlying radiographic pathology. Where the decision is made to monitor these teeth without surgical intervention, appropriate informed consent must be undertaken such that the parents are aware of potential consequences including pain, discomfort, swelling, abscess formation, enamel defects, and disturbances to the underlying permanent successor due to the presence of chronic infection.

In this study, it was observed that all teeth displaying radiographic signs of internal resorption had undergone a pulpotomy. While the exact cause of internal resorption is

uncertain, it is associated with odontoclastic activity and suggests that the tooth has maintained some degree of vitality. It is important to highlight that internal resorption is a common occurrence in molars that have undergone formocresol pulpotomies with studies reporting an incidence rate of approximately 20%.

Conclusion

This study found that PZCs placed on primary teeth under general anaesthesia show good clinical success and survival extending up to 78 months. The age at treatment, tooth type, and need for pulp therapy did not influence longevity in this study. However, radiographic success is likely to be significantly lower than clinical success, which might be masked by asymptomatic pathology.

Questions

Clinical Update Quiz – November 2025

YOUR FREE CPD HOUR

Complete the Clinical Update quiz online at adavb.org/clinicalupdate (member login required). Each new Clinical Update will be available online from the first business day of each month, as will correct answers from the previous quiz.

Answer at least eight out of 10 questions correctly and you will be awarded ONE FREE CPD hour. Or select your answers below, make a copy and send to CPD Coordinator. Mail: ADAVB, PO Box 9015, South Yarra, Vic 3141.
Email: cpd@adavb.org.

This is an ADAVB member-only service.

Submit your answers by 28 Nov 2025.

Name: _____

Member #: _____

1. A B C D
2. A B C D
3. A B C D
4. A B C D
5. A B C D
6. A B C D
7. A B C D
8. A B C D
9. A B C D
10. A B C D

September QUIZ 2025 answers

1. C
2. A
3. FALSE
4. D
5. B
6. D
7. TRUE
8. D
9. B
10. C

1. What was the primary aim of the study on pre-formed zirconia crowns (PZCs)?
 - A. To compare zirconia crowns with stainless-steel crowns in adults.
 - B. To investigate the survival probabilities of PZCs placed on primary teeth.
 - C. To explore the long-term aesthetic outcomes of zirconia crowns
 - D. To assess the efficacy of various pulp therapies in children.
2. What was the minimum follow-up period for patients included in the study?
 - A. 6 months
 - B. 12 months
 - C. 38 months
 - D. 78 months
3. Which of the following crowns were used in the study?
 - A. Pre-veneered stainless steel crowns
 - B. EZ-Pedo zirconia crowns
 - C. Composite resin crowns
 - D. Metal-free ceramic crowns
4. What was the most common complication observed in the study?
 - A. Crown fractures
 - B. Internal resorption
 - C. Crown dislodgement
 - D. Overhangs
5. How were the zirconia crowns cemented in the study?
 - A. Using a luting cement
 - B. Using FUJI IX Extra glass-ionomer cement
 - C. With zinc phosphate cement
 - D. With a resin-based adhesive
6. What was the average follow-up period for the crowns in this study?
 - A. 6 months
 - B. 12 months
 - C. 38 months
 - D. 78 months
7. What percentage of treated teeth showed radiographic signs of pathology, among those where radiographs were available?
 - A. 9%
 - B. 17%
 - C. 24%
 - D. 76%
8. What was one of the common radiographic findings related to the zirconia crowns?
 - A. Occlusal wear
 - B. Internal resorption
 - C. Marginal leakage
 - D. Root fractures
9. What did the study suggest about radiographic success versus clinical success?
 - A. Radiographic success was higher than clinical success
 - B. Radiographic success was significantly lower than clinical success
 - C. Clinical success was the same as radiographic success
 - D. Radiographic success was not considered in the study
10. What was the most common site for excess cement accumulation in zirconia crowns?
 - A. Buccal surface
 - B. Mesial surface
 - C. Distal surface
 - D. Occlusal surface