Journal of Dentistry xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

Journal of Dentistry

journal homepage: www.intl.elsevierhealth.com/journals/jden

Clinical performance of CEREC AC Bluecam conservative ceramic restorations after five years—A retrospective study

Farahnaz Nejatidanesh[a], Mehrak Amjadi[b], Mohadese Akouchekian[b], Omid Savabi[c,*]

[a] Dental Materials Research Center, School of Dentistry, Isfahan University of Medical Sciences
[b] Student's Research Committee, School of Dentistry, Isfahan University of Medical Sciences
[c] Torabinejad Dental Research Center, School of Dentistry, Isfahan University of Medical Sciences

ARTICLE INFO

Article history:
Received 15 April 2015
Received in revised form 27 June 2015
Accepted 2 July 2015
Available online xxx

Keywords:
Computer-aided design
CEREC
Dental restoration failures
Inlays
Survival analysis
Treatment outcome

ABSTRACT

Objectives: The aim of this study was to assess the clinical performance of CAD/CAM partial coverage posterior restorations made by CEREC AC Bluecam system after 5 years.
Methods: 159 ceramic partial coverage posterior restorations were placed in 109 patients in a private practice. The restorations were made using CEREC AC Bluecam with CEREC Blocs or Empress CAD blocks. The clinical performance of the restorations was evaluated with modified California Dental Association (CDA) guidelines, gingival and plaque indices, probing pocket depth, and bleeding on probing in a period of 5 years. Patients' satisfaction was assessed using visual analogue scale. The Kaplan–Meier method was used to analyze survival probability of the restorations ($\alpha = 0.05$).
Results: The restorations included 102CEREC Blocs and 57 Empress CAD. The survival rates of CEREC Blocs and Empress CAD blocks were 96.0% and 94.6%, respectively ($P = 0.67$). A total of 7 (4.5%) failures were found. The failures were not significantly influenced by restoration size, type and position of teeth. The ceramic fracture was significantly more in nonvital teeth ($P = 0.04$). The periodontal parameters were not significantly different between the restored and control teeth except plaque index. The mean score of patients' satisfaction was 94.4 ± 8.1.
Conclusions: Chair-side CEREC AC ceramic partial coverage posterior restorations were clinically successful restorations with mean survival rate of 95.5% after 5 years.
Clinical significance: Conservative chair-side CAD/CAM ceramic restorations with less reduction of tooth structure can be a successful restorative method with acceptable survival rate and patient's satisfaction.

1. Introduction

The use of ceramic restorative materials has increased significantly in the last decade due to increasing demands for esthetic and metal-free restorations [1]. While full coverage complete crown restoration requires substantial reduction of tooth structure, partial coverage preparations with reduced macro-retentive geometry, such as inlays and partial coverage ceramic crowns have been reported to remove half the amount of tooth structure compared to a complete coverage metal ceramic crown [2]. Preserving tooth structure is critical for the longevity of teeth and restorations [3]. This permits retaining more enamel and dentin and can provide better periodontal health by preservation of sound tooth structure [2].

With the development and improvement of reliable adhesive bonding techniques, minimally invasive dentistry has become a field of great interest. Bonding with resin luting agents provides a chemical bond between the cement and the tooth as well as cement and the silanized glass. This bonding can increase the strength of ceramic which results in reduced fracture rate and increased lifetime of ceramic restorations [4].

Additionally, resin cements can seal small cracks of the intaglio surface of ceramic restorations and improve ceramic strength [5]. Ceramic-resin bonding is successfully achieved through pretreatment of silica-based ceramics with acid etching followed by silanization [6,7].

The computer-aided design/computer-aided manufacturing (CAD/CAM) technology has had a significant effect on both dental laboratories and clinics. The innovations in digital optical

* Corresponding author at: #400-Sheikhsadoogh Shomali St., Sheikhsadoogh Cross Road Isfahan, Iran. Fax +98 311 6625500.
E-mail address: savabi@hotmail.com (O. Savabi).

http://dx.doi.org/10.1016/j.jdent.2015.07.006
0300-5712/

impression techniques, virtual design software and precise milling machines [8,9] are rapidly improving fabrication methods. Chair-side CAD/CAM systems can be used for fabricating ceramic inlays, onlays, veneers, crowns, and fixed dental prostheses. These systems provide design and automatic production of all-ceramic monolithic restorations in one appointment. Continual development of the hardware and software have expanded the restorative capabilities significantly [10,11]. Chair-side production of restorations eliminates the need for interim restorations and decrease the risk of tooth structure fracture [12].

The ceramic restorations can be milled from prefabricated blocks with a CAD/CAM system [13]. Two types of these ceramics are CEREC Blocs (Sirona Dental Systems) and IPS Empress CAD (Ivoclar Vivadent) glass ceramics blocks. These materials are industrially manufactured in a reproducible manner in high-quality materials [13].

CEREC Blocs are fabricated from fine-grained powders that produce relatively pore free ceramic. Improved polishability, reduced enamel wear and increased strength of these blocks are partly because of their fine crystals (4 μm). They contain SiO_2 (60–64%) and Al_2O_3 (20–23%) and can be etched with hydrofluoric acid to create micromechanical retention for adhesive bonding with resin luting agents. The flextural strength of CEREC Blocs is approximately 112 or 120 MPa when polished or glazed, respectively [14].

IPS Empress CAD blocks are similar to IPS Empress Esthetic pressable materials (Ivoclar Vivadent) in structure. IPS Empress CAD blocks are made of a leucite-reinforced glass ceramic which consists of a glass and a crystal phase. Leucite crystals (5–10 μm) evenly grow in a multi-stage process directly from the amorphous glass phase. The flextural strength of IPS Empress CAD is approximately 105–125 MPa [14].

The long term longevity of dental restorations is essential for their clinical use. Survival rates for all-ceramic restorations has been reported from 88 to 100% for 2–5 years [15–17], and 84 to 97% after 5–14 years in service [18–27]. Wittneben and her colleagues [28] have been reviewed the clinical performance of CAD/CAM restorations in a systematic review. They found a total survival rate of 92.9% (95% CI: 89.3–95.3%) after 5 years for inlay/onlay CAD/CAM restorations [28].

Most of the clinical researches have been performed on restorations made by first generations of chairside CAD/CAM systems [12,15,16,18,19,21,29–31]. Introduction of new sophisticated softwares and milling machines open new era for dentistry. On the other hand Bluecam's handheld camera optics provides greater depth of field and precision. It provides a uniform field of illumination for increased accuracy. Built-in "shake control" eliminates blurry images and produces significantly more detailed images. The primary aim of this clinical study was to compare the survival, modified California Dental Association (CDA) criteria [32], and periodontal parameters of Cerec Bloc and IPS Empress CAD partial-coverage restorations over 60 months. The secondary purpose was to determine any correlation to tooth or patient characteristics with survival of the restorations. The null hypothesis was that there would be no significant difference in the clinical performance of the restorations which were made with CEREC Blocs and IPS Empress CAD blocks.

2. Materials and methods

In this retrospective study 109 patients (74 women and 35 men) with a mean age of 45.53 ± 10.67 years (range 18–70 years) who had received CAD/CAM ceramic (CEREC) partial-coverage posterior restorations between March 2009 to September 2009 were evaluated (all the patients were included). All the patients' files were screened and patients were recalled after 1 year. This research was approved by the Ethical Committee of Isfahan University of Medical Sciences (#393400).

The studied restorations consisted of 159 inlays and onlays (Table 1). Clinical treatment was performed by one prosthodontist in a private dental clinic. All patients were in good general health. The inclusion criteria consisted of having received a CEREC posterior restoration (except full crowns) from the same private practice during the aforementioned time span.

The clinician prepared, fabricated and placed all of the restorations in one appointment. The clinician prepared the tooth for all-ceramic two surface restorations with 1.5–2.0 mm pulpal floor depth, 1.0–1.5 mm axial reduction, 2.0 mm isthmus width with rounded internal line angles. The divergence of 12° was considered for proximal walls (6° each wall). For 3 surfaces restorations, the functional cusps were reduced 2 mm and nonfunctional cusps were reduced when the remaining wall thickness was less than 1.5 mm. For 4 and more surfaces restorations, in addition to cusp reduction, a shoulder preparation was extended to buccal or lingual surfaces. The gingival margin was placed entirely in enamel whenever possible. For teeth with substantial loss of tooth structure resulting from caries or fracture, the clinician used composite cores (Build-It; Pentron LLC) to create the required retention and resistance form.

After preparation, the teeth were isolated by cotton roll and saliva ejector. Retraction cord (Ultrapak; Ultradent) or paste (Expasyl; Kerr/Sybron) were used for tissue retraction. The prepared and corresponding antagonist teeth were sprayed (Optispray; Sirona) and scanned with CEREC Bluecam (CEREC AC) from occlusal view. The buccal bite was scanned for registration of occlusal relation.

The restorations were fabricated with a CEREC AC system (Sirona). The clinician designed (Version 3.85; Sirona) and milled (MCXL; Sirona) the restoration from prefabricated block of IPS Empress CAD (Ivoclar Vivadent) or CEREC Blocs (Sirona) at standard milling speed. No randomization was used for selection of blocks. After recovering the restorations from the milling chamber, proximal contacts and surfaces were checked, corrected, and polished with polishing disk (Sof-lex; 3M ESPE). The internal surface of the restorations was adjusted by diamond bur when needed.

2.1. Luting procedures

After try in, the restorations were cleaned with 96% isopropyl alcohol and the inner surfaces were treated with 9.5% hydrofluoridric acid (Porcelain Etchant; Bisco) for 1 min and then silanated (Bis-silane; Bisco). The tooth was isolated by rubber dam (Optradam; Ivoclar Vivadent) and enamel and dentine of the prepared teeth were etched with 32% phosphoric acid gel (15 s),

Table 1
Distribution of the studied posterior restorations.

	First premolar	Second premolar	First molar	Second molar	Total
Maxillary	14	22	34	14	84
Mandibular	9	16	26	24	75
Total	23	38	57	38	159

Please cite this article in press as: F. Nejatidanesh, et al., Clinical performance of CEREC AC Bluecam conservative ceramic restorations after five years—A retrospective study, Journal of Dentistry (2015), http://dx.doi.org/10.1016/j.jdent.2015.07.006