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CASE REPORT

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Evaluation of ceramic veneer adaptation by optical coherence tomography: a clinical report

Avaliação da adaptação de laminado cerâmico por tomografia de coerência óptica: relato de caso

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ABSTRACT

Introduction: Ceramic veneers represent a treatment approach in aesthetic dentistry. They are indicated in cases of alterations in size, contour, form and color of the teeth. The clinical and radiographic examinations may not allow the correct identification of failures in the treatment with ceramic veneers. **Objective:** To report the use of Optical Coherence Tomography (OCT) for the evaluation and repair of an aesthetic oral rehabilitation involving ceramic veneers. **Case report:** A 24-year-old female patient complained of unsatisfied color change in the ceramic veneer placed on the right maxillary central incisor. The clinical examination showed color changes between the middle and incisal thirds of mesial surface of the tooth crown. The OCT sagittal images evidenced the presence of bubbles or gaps in the adhesive interface. The treatment consisted of repair of the restoration by infiltration of a composite resin. **Conclusion:** The OCT was found to be valid tool to evaluate the adaptation of the ceramic veneer placed on the maxillary central incisor.

KEYWORDS

Esthetics, Dental; Dental Veneers; Tomography, Optical Coherence.

RESUMO

Introdução: Laminados cerâmicos representam uma abordagem de tratamento em Odontologia. São indicados em casos de alterações no tamanho, contorno, forma e cor dos dentes. O exame clínico e o emprego de radiografias convencionais podem não permitir a correta identificação de falhas no tratamento com laminados cerâmicos. **Objetivo:** Relatamos o uso da tomografia de coerência óptica (TCO) para avaliação da adaptação e reparo de uma reabilitação oral estética com laminados cerâmicos. **Relato de caso:** Paciente do sexo feminino, 24 anos, queixou-se de alteração de cor em laminado cerâmica cimentado no incisivo central superior direito. O exame clínico evidenciou alterações de cor entre os terços médio e incisal da superfície mesial do dente. As imagens obtidas por TCO mostraram a presença de bolhas ou gaps na interface adesiva da região. O plano de tratamento consistiu no reparo mediante infiltração de uma resina composta no local indicado pela TCO. **Conclusão:** A tomografia de coerência óptica se mostrou um método auxiliar eficaz para análise da adaptação do laminado cerâmico no incisivo superior direito.

PALAVRAS-CHAVE

Estética Dentária; Facetas Dentárias; Tomografia de Coerência Óptica.

INTRODUCTION

The advent of the adhesive systems in dentistry made possible to preserve even more tooth structure while satisfying the patient's restorative needs and aesthetic desires [1]. Nowadays, many restorative options such as composite resins and ceramic veneers are available and dentists and patients must choose the best alternative to improve the oral condition and achieve functional and aesthetic results [2].

Contemporary dentistry experiences an increase in the use of ceramic veneers due to their esthetic appeal, biocompatibility and adherence to the principles of minimal-invasive dentistry [1,3-6]. They have become a restoration of choice to correct tooth forms, tooth position, close diastemas, restore tooth fracture or mask tooth discolorations [1-4,6,7].

Ceramics veneers have high compressive strength, surface smoothness, gloss and presents low plaque accumulation [2-4,6,8]. In addition, they foster greater preservation of tooth structure, produce predictable results, having low failure rates compared with other available options [3,8-14]. The most frequent failures reported in ceramic veneers are marginal discoloration, debonding, fracture/chipping and secondary caries [15].

The follow-up is an important aspect for the longevity of treatment with ceramic veneers [16]. Currently, the available methods for the evaluation of failures in ceramic veneers are limited to clinical and radiographic inspection, which in most cases may not allow their correct identification [17]. The optical coherence tomography (OCT) has been widely used in several in vitro in in vivo applications and is becoming popular as a promising approach in dentistry [17-34].

Optical coherence tomography is an imaging method in which is possible to evaluate the anatomy and function of biological tissue [35]. This noninvasive diagnostic technique provides real-time images without the need for biopsies and histological procedures, or the use of radiation [36]. The technique generates cross-sectional images by measuring echoes of backscattered light [37] based on the optical differences of the tissues [18].

In dentistry, the OCT allows capturing images around 2-3 mm in teeth [22]. Thus, it can used to visualize hard and soft tissues and to detect or analyze early demineralization, remineralization, recurrent caries, tooth microleakage and debonding of restoration, tooth cracks or fractures, periodontal and periimplantar tissues, location of pulp canal [32,38]. In addition, OCT has been used to evaluate ceramic veneers [17,23].

The adaptation of ceramic veneers on teeth a key criterion for success [39]. The OCT has been seen as a promising approach in the evaluation of ceramic veneers [40] and aid in decision-making [40]. Here, we report the use of Optical Coherence Tomography (OCT) for the evaluation of the adaptation ceramic veneer by means of optical coherence tomography.

CASE REPORT

A 24-year-old female patient complained of unsatisfied color change in the ceramic veneer placed on the right maxillary central incisor. This was observed through visual inspection (Figures 1 and 2). The OCT sagittal images showed the presence of gaps or bubbles with a suggestive aspect of cooptation (Figure 3).

Figure 1 - Intraoral front view photograph of the patient's smile showing color changes in the ceramic veneer of the right maxillary central incisor.

Figure 2 - Palatal view of the right maxillary central incisor.

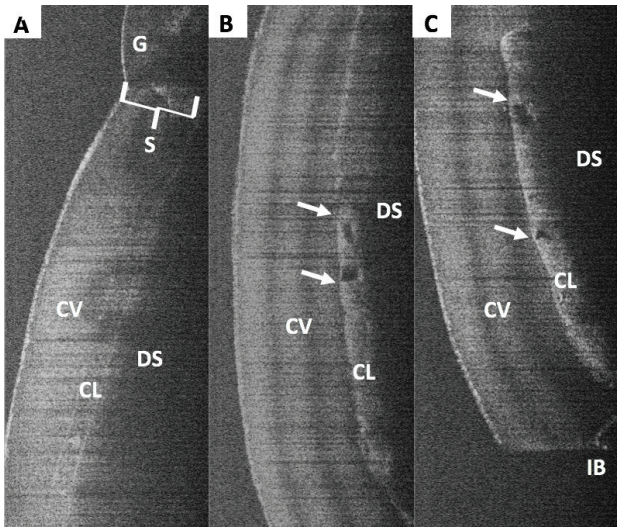

Figure 3 - Initial sagittal OCT images of the right maxillary central incisor. The cervical (a), middle (b), and incisal (c) thirds of the right maxillary central incisor shows the dental substrate (DS), gingiva(G), gingival sulcus (S) and incisal border (IB) as well as the presence of the ceramic veneer (CV) and cementation line (CL). Arrows show the presence of bubbles and gaps in cementation line.

The OCT system used was the SS-OCT 1325nm (Thorlabs, New Jersey USA), operating in Fourier Domain with a spectral bandwidth of ~100 nm, axial scan rate of 16kHz/25fps, lateral resolution ~25 μm and axial resolution of 12/9μm (air/water), spectral bandwidth of >100 nm and instantaneous bandwidth of 0.13 nm (0.5 GHz), average output power up to 10 mW, and 100 dB sensitivity. The buccal surfaces of the teeth were swept perpendicularly by a light beam and the two-dimensional (2D) images acquired. A lip retractor was used to better expose the anterior teeth. The patient remained seated, with the head resting on specific position, which perpendicular to the focus of the laser guide light emitter.

The patient signed the informed consent for the proposed treatment, which consisted of repair of the restoration by infiltration of a composite resin. With the location of the bubble, the defective tooth-restoration interface was accessed using a diamond bur with pointed cone shaped spear (#2140, KG Sorensen, Brazil) (Figure 4). Etching was carried out with 37% phosphoric acid (Super Etch, SDI, Australia) for 30s. The surfaces were washed with distilled water for 30s and dried with air. Silane (Monobond Plus, Ivoclar Vivadent, Liechtenstein) was applied on the ceramic veneer surfaces for 1 min and dried with air. An adhesive system (Stae, SDI, Australia) was applied and light-cured for 20 s (Radii Plus, SDI, Australia). A B1 flowable composite resin (Wave, SDI, Australia) was injected (Figure 5) and light-cured for 40 s (Radii Plus, SDI, Australia). The occlusion was checked and finishing and polishing procedures were carried out with Sof-Lex™ Pop-On discs (3M, Saint Paul, Minnesota, EUA). The patient was satisfied with the achieve result (Figures 6 and 7). Figure 8 shows the OCT sagittal images of the element 11 after repair.

Figure 4 - Palatal front view of the right maxillary central incisor after intervention with diamond bur.

Figure 5 - Application of a B1 flowable composite resin.

Figure 6 - Intraoral front view of the patient's smile after repair.

Figure 7 - Palatal view of the right maxillary central incisor after repair.

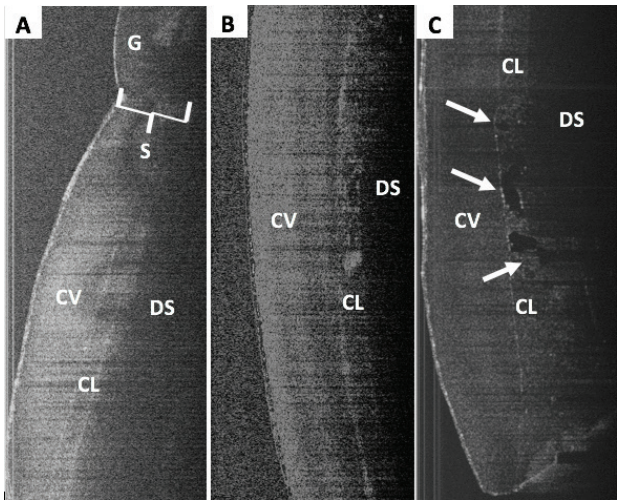

Figure 8 - Sagittal OCT images of the right maxillary central incisor after repair. The cervical (a), middle (b), and incisal (c) thirds of the right maxillary central incisor shows the dental substrate (DS), gingiva(G), gingival sulcus (S) and incisal border (IB) as well as the presence of the ceramic veneer (CV) and cementation line (CL). Arrows show the presence of bubbles and gaps in cementation line.

DISCUSSION

Ceramic veneers present excellent aesthetic results and longevity [41-43]. However, the clinical success of the treatment of teeth with ceramic veneers depends on its accurate indication, the techniques and materials used [8] as the cementation of the ceramic veneers is a crucial procedure in this aesthetic treatment approach [2,6,41,43].

Despite the high adhesive capacity provided by the current dental materials, strategies to visualize and monitor failures are of great interest [44]. Within this context, optical coherence tomography appeared as a powerful diagnostic method by providing high-resolution imaging, which favor the detection of failures in the adhesive layer, in the restorative material and even the visualization of pathologies, in a non-invasive manner [17,18,26,28,36].

A clinical case of an aesthetic oral rehabilitation with ceramic veneers performed in a 23-year-old female patient [17] was monitored for one year by means of Optical

Coherence Tomography (OCT). At that time, micrometer-sized bubbles in the cementation line were observed. As treatment was considered satisfactory, the patient was instructed about 6-month recall dental appointments to assess the health of the hard and soft tissues and the integrity of the ceramic veneers [17].

The cementation of ceramic veneers by means of hand pressure may cause the fracture of ceramic or the incorporation of bubbles or gaps in the cementation line [17,21,23,45]. For this reason, ultrasonic devices may be recommended in cementation procedures [46,47]. When compared to hand-pressure, the ultrasonic cementation did not affect the fracture strength of veneers [47]. The failure types, however, were found to be more favorable in ultrasonic cementation [46].

In aesthetic dentistry, the dental professionals used to report their best cases rather than the ones in which failures occurred and by this, lessons are lost [48]. In this clinical case, we observed the coalescence of defects reported previously at the end of the cementation procedure [17] and an attempt to repair the area with color change was performed by infiltration of a flowable composite resin. Similar type of intervention was reported in the literature [48]. The authors [48] argue that highly filled composite resins should be used in these cases due to minor capacity to discoloration. The OCT images after the repair showed that the fluidity of the composite resin incorporated a large amount of micrometric bubbles in the bonding interface.

We observed that the clear majority of changes identified in the OCT sagittal images were not clinically visible. This fact may be due to the technique's ability to acquire images with high-resolution. The Optical coherence tomography, however, is not fully used in dentistry mainly due to the low availability of customized intraoral equipment and insufficient range of OCT rays, which makes it necessary to perform hundreds or even thousands of scans to analyze the area of interest [36].

CONCLUSION

OCT was a valid tool to evaluate the adaptation of the ceramic veneer of the maxillary central incisor.

OCT represents a promising auxiliary diagnostic approach in dentistry.

CONSENT FOR PUBLICATION

Patient's consent was requested and approved.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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