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Case Report

Repair of Fractured Metal-Ceramic Restoration Using CAD/CAM Technologies. Case Report

Zlatina Tomova[1], Yanko Zhekov[1], Angelina Vlahova[1]

[1] *Department of Prosthetic Dental Medicine, Faculty of Dental Medicine, Medical University of Plovdiv, Plovdiv, Bulgaria*

Corresponding author: Zlatina Tomova, Department of Prosthetic Dental Medicine, Faculty of Dental Medicine, Medical University of Plovdiv, 3 Hristo Botev Blvd., 4000 Plovdiv, Bulgaria; Email: zlatina_tomova@abv.bg; Tel.: +359 897 515 526

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Abstract

Fractures in esthetic ceramic veneering are one of the potential failure modes during prosthetic treatment. Depending on the type of chipping fracture, there are three possible outcomes: replacement, restoration repair, or polishing of the fractured area. Computer-aided design and manufacturing (CAD/CAM) technologies provide new methods to the maintenance and repair of fixed metal-ceramic restorations. Here, we report the case of a 68-year-old patient who came to the dentist with comcerns about his appearance due to spontaneous gingival bleeding and a fracture in the ceramic veneering of a metal-ceramic restoration. The patient reported occurrences of bruxism. The proposed treatment plan included consultation with a cardiologist, periodontal treatment, polishing of the chipped areas, repair of the fractured zone with an exposed metal core, and fabrication of a mouth guard. Once the ceramic veneering on the palatal and buccal sides of the retainers had been completely removed, a digital impression was obtained and sent to the dental lab so that milled zirconium veneer could be manufactured. The veneering was cemented the next day using the standard prosthetic field preparation process and resin-modified glass ionomer cement. In conclusion, fixed metal-ceramic restorations that have fractured can be successfully repaired using CAD/CAM methods and materials.

Keywords

CAD/CAM, metal ceramic restorations, veneering repair

INTRODUCTION

Metal-ceramic restorations remain one of the most commonly employed prosthetic restorations in cases of partial edentulism and also destruction of the hard dental tissues. They provide recovery of the masticatory function, speech, and esthetics. Fracture in the esthetic ceramic veneering is one of the possible failures in the provided prosthetic treatment. The successful treatment of fixed prosthetic restorations can be achieved depending on many factors, such as the type of abutment preparation, the strict laboratory protocol, precise fit, and the presence of parafunctions. Parafunctional habits such as bruxism can cause occlusal overloading thus leading to fractures of the ceramic material.[1] Depending on the kind of chipping fracture, there are three possible outcomes: replacement, restoration repair, or polishing of the fractured region.[2] The cases of ceramic veneering fractures that could be treated by means of polishing or repair are considerably more than the cases of fractures that would require replacement of the whole restoration.[3] Repairing fixed prosthetic restorations is a time- and cost-effective way to extend the life of a prosthodontic device without removing it from the oral cavity.[4] There are numerous systems for direct chairside repairing of fractured ceramic veneering which require creation of high-strength bond between the resin-veneering material and the underlying ceramic or metal surface by applying hydrofluoric acid intraorally or using silicoating tech-

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nique.[5] With the development of CAD/CAM technologies, new approaches may be provided to repair fractures of fixed metal-ceramic restorations.

CASE REPORT

A 68-year-old patient came to the dental office with esthetic complaints because of a fracture of the ceramic veneering of a metal-ceramic restoration and spontaneous gingival bleeding. The restoration had been placed in the oral cavity 6 years ago. The patient reported suffering heart attack 5 months ago, after which surgical intervention was provided for stent placement. Cardiovascular medication therapy was prescribed including Ca-antagonists and anticoagulants. The patient reported episodes of bruxism appearing frequently within the last few months. The intraoral examination showed numerous chipping fractures without exposing the metal core of the restoration and a fracture with visible metal surface occupying the vestibular area of maxillary left lateral incisor and canine ***(Fig. 1)****. Proliferation of gingival tissues was seen. The proposed treatment plan included periodontal treatment, polishing of the chipped areas, repair of the fractured zone with exposed metal core, and fabrication of a mouth guard.*

Figure 1. Initial state of the oral cavity.

The ceramic veneering of the retainers on the lateral incisor and the canine was fully removed using high speed handpiece ***(Fig. 2A)****. During preparation, fine grid diamond burs with red ring and crystal size of 46 μm were used and polishing with rubber with diamond particles was performed. To avoid the risk of ceramic fractures, no sharp edges were left on the surfaces.*

To provide visual control of the preparation in the cervical areas, retraction cords were placed prior to and during the preparation. Astringent retraction paste (3M ESPE, USA) was also applied to control the bleeding. An intraoral scanning was performed using 3Shape TRIOS 3 Intraoral scanner (3Shape, USA). The digital impression ***(Fig. 2B)*** *was sent immediately to the dental lab for production of veneering made of ceramics based on zirconium dioxide* ***(Fig. 3)****.*

The zirconium veneering designed as crowns was fixed with resin-modified glass ionomer cement Ketac Cem Plus (3M ESPE, USA) after applying the standard protocol of cleaning with hydrogen peroxide (3%) and alcohol (70°) ***(Fig. 4)****. Occlusion was carefully checked to avoid presence of preliminary contacts in maximal intercuspation and during function.*

We found no new adverse changes at the follow-up visits 6 and 12 months after the repair.

DISCUSSION

The described CAD/CAM repair was a time- and cost-effective method that increased the longevity of the prosthetic restoration by at least a year. Compared to the conventional techniques digital workflow provides advantages in all clinical and laboratory stages.[6]

Compared to conventional impression techniques, intraoral scanning is a time-efficient impression method that is well accepted and preferred by patients.[7,8] Another advantage of the intraoral scanning is that the presence of moisture does not affect the quality of the impression because the technique allows rescanning of the areas of interest without necessity of starting from the very beginning. In the described clinical case, providing dry prosthetic field for accurate conventional impression was hard to achieve because of the condition of the gingival tissues.

Ceramics based on zirconium dioxide possesses high mechanical properties which can withstand the excessive occlusal forces because of the active crack resistance – the so-called transformation toughening.[9] Zirconium fixed prostheses are produced by milling within hours – after the CAD design, the milling process of the "green" zirconium takes about 20 minutes, and the sintering process takes about several hours.[10] The final restoration can be placed in the oral cavity the next day. The disadvantage of the described treatment was that the patient could not have an immediate repair but had to wait for the cementation performed on the next day.

The protocol for cementation is crucial for the longevity of the repair. Hydrofluoric acid and silane coupling agent provide high bond strength between the metal core and the resin or ceramic repair material.[9] In our clinical case, application of highly reactive hydrofluoric acid over the fracture zone was a matter of concern because the surface was partially covered by the gingival overgrowth. The use of zirconium veneering helps the fixation protocol and conventional cementation technique could be applied. Although the fracture was situated on the vestibular surface of the retainers, it was decided to make a repair which covers both labial and palatal area of the restoration, thus avoiding the risk of high dislodging forces and the minimal ceramic thickness in the incisal edge.

To avoid new potential fractures in the episodes of bruxism, occlusion must be checked to eliminate preliminary contacts. Typically, 12-to-40-μm-thick articulating paper

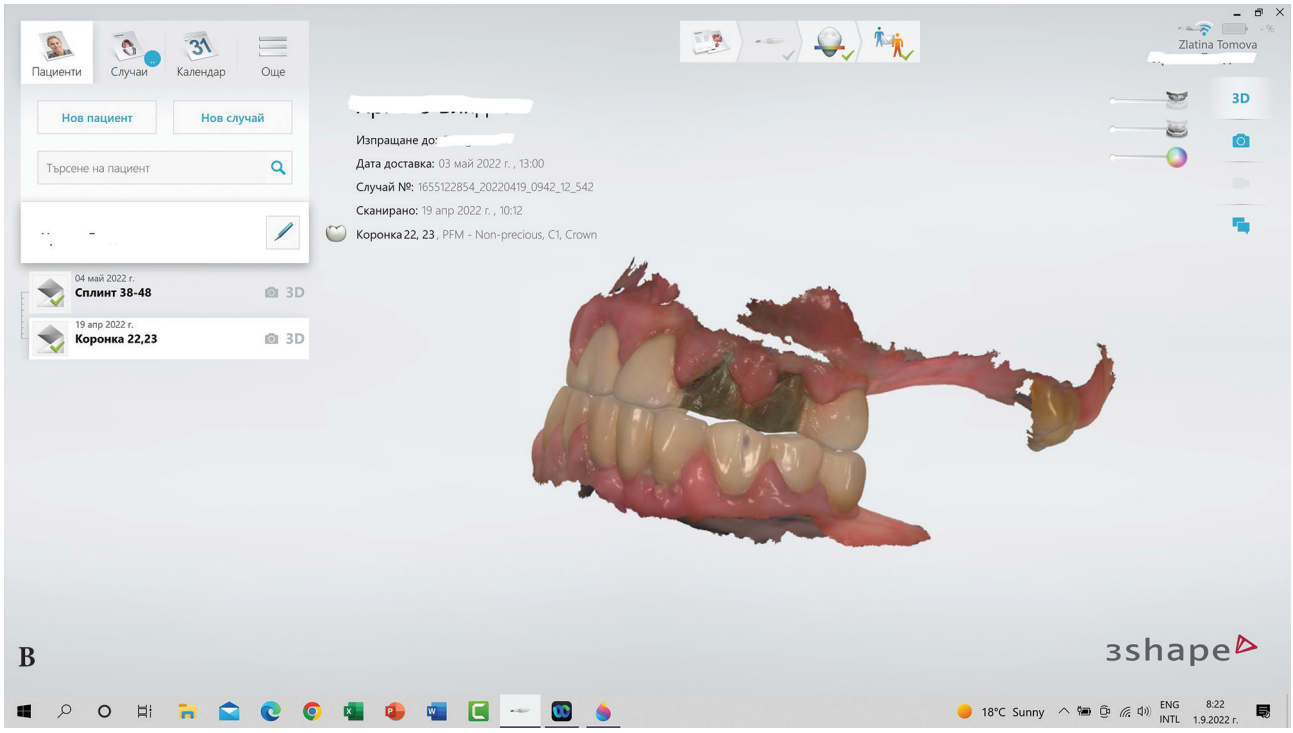

Figure 2. A. The metal-ceramic restoration after the preparation for repair; **B**. Digital impression after the preparation.

Figure 3. Milled zirconium veneering.

Figure 4. Intraoral state after the repair.

is used for occlusal checks.[11] Using CAD/CAM technologies, interocclusal space can be checked at the stage of taking the intraoral digital impression using the "Clearance" tool to determine if any additional preparation is required. The same tool can be used to register the occlusal contacts after restoration placement.

The proliferation of the gingiva is often associated with some drugs including calcium antagonists.[12,13] Nevertheless, after consultation with a cardiologist, it was decided that the medication therapy could not be changed at that time. Our findings in the described clinical case – episodes of bruxism after the heart attack, support the conclusion that there is a link between cardiovascular diseases and bruxism because of disturbances in autonomic nervous system.[14]

CONCLUSION

The CAD/CAM technologies provide new methods and materials with high mechanical properties and good esthetics for the repair of metal-ceramic restorations.

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Competing Interests

The authors have declared that no competing interests exist.

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Ремонт сломанной металлокерамической реставрации с использованием технологий CAD/CAM. Отчёт о клиническом случае

Златина Томова[1], Янко Жеков[1], Ангелина Влахова[1]

[1] *Кафедра протетической дентальной медицины, Факультет дентальной медицины, Медицинский университет – Пловдив, Пловдив, Болгария*

Адрес для корреспонденции: Златина Томова, Кафедра протетической дентальной медицины, Факультет дентальной медицины, Медицинский университет – Пловдив, бул. „Христо Ботев“ № 3, 4000 Пловдив, Болгария; Email: zlatina_tomova@abv.bg; тел.: +359 897 515 526

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Резюме

Переломы эстетических керамических виниров являются одним из потенциальных случаев неуспешного лечения во время протетической терапии. В зависимости от типа сколового перелома возможны три варианта исхода: замена, восстановительный ремонт или полировка области перелома. Технологии компьютерного проектирования и производства (CAD/CAM) открывают новые методы обслуживания и ремонта несъёмных металлокерамических реставраций. В данной статье мы сообщаем о случае пациента 68 лет, обратившегося к стоматологу с опасениями по поводу своего внешнего вида в связи со спонтанной кровоточивостью дёсен и переломом керамического винира металлокерамической реставрации. Пациент сообщил о случаях бруксизма. Предложенный план лечения включал консультацию кардиолога, пародонтологическое лечение, полировку участков сколов, восстановление зоны перелома с обнажённым металлическим стержнем и изготовление каппы. После полного удаления керамической облицовки с нёбной и щёчной сторон ретейнеров был получен цифровой слепок, который был отправлен в зуботехническую лабораторию для изготовления фрезерованного циркониевого винира. На следующий день винир был зафиксирован с использованием стандартного процесса подготовки поля протеза и модифицированного смолой стеклоиономерного цемента. В заключение, несъёмные металлокерамические реставрации, которые сломались, могут быть успешно восстановлены с использованием методов и материалов CAD/CAM.

Ключевые слова

CAD/CAM, металлокерамические реставрации, восстановление виниров