Case Report

A cantilever all-ceramic resin-bonded fixed dental prosthesis using digital technology for a patient with cleft lip and palate

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Abstract
The patient, an 18-year-old woman, complained of an esthetic problem due to a defect of a maxillary lateral incisor, with which cleft lip and palate coincided. A prosthodontic treatment was performed with a cantilever all-ceramic resin-bonded fixed dental prosthesis (RBFDP) using a digital impression. The fixed prosthetic treatment satisfied the patient aesthetically. Cantilever all-ceramic RBFDP using positioning splint and digital impression was effective for patients with cleft palate.

Key Words: cantilever, cleft lip, cleft palate, digital impression, positioning splint, resin-bonded fixed dental prosthesis

Introduction
The patients with cleft lip and palate, in addition to the missing teeth at the site of the cleft, dehiscence is present in the alveolar bone. When implant is performed, bone transplantation is required, not only is the surgical invasion great, but implant placement is also impossible if the bone does not settle. Therefore, a common treatment that is easily accepted by patients is fixed dental prosthesis (FDP) treatment. However, when an FDP with a two retainer is applied to a one-tooth defect in a patient with cleft lip and palate, the movement between the abutment tooth is significantly different from the usual one because both abutment tooth are not connected by bone. The stress at the time becomes complicated, and it concentrates on cement that cements the periodontal ligament and crown of the abutment tooth [1]. Therefore, considering the long-term prognosis, it is desirable to use a full coverage FDPs as abutment devices. However, in recent years, case reports of all-ceramic RBFDPS with cantilever have been accumulated [2,3], and compared with two retainers, they are not affected by the swaying of the tooth of both abutment tooth, it may be suitable for application to patients with cleft lip and palate. All-ceramic RBFDP is highly esthetical and minimally invasive because it is formed exclusively in enamel [4-6]. The purpose this clinical report is to present a case of all-ceramic cantilevered RBFDP for a patient with maxillary lateral incisor defect, cleft lip, and cleft palate, using digital impression technique.

Case Report
An 18-year-old woman visited the Fukuoka Dental College for her prosthodontic treatment after orthodontic treatment (Fig. 1). Her maxillary left lateral incisor was missing. Veau classification was Class III, and strong scarring was observed on the palate mucosa [7]. No signs or symptoms of periodontal disease were found, and the maxillary left central incisor had one degree of sway (Fig. 2). Bone defect was large with cleft lip and palate (Fig. 3).

Fig. 1
Before completion of orthodontic treatment

Fig. 2a
Frontal view after orthodontic treatment

Fig. 2b
Occlusal view after orthodontic treatment

Digital image and facial photograph of the pre-prosthetic treatment was used to digitize with intraoral scanner (TRIOS3, 3Shape, Copenhagen, Denmark). Digital impression data and facial photograph data were imported on CAD software (Dental Designer, 3Shape) to design the all-ceramic RBFDP. The simulation data were presented to the patient and used to explain the treatment contents such as the tooth preparation site and tooth preparation design (Figs. 4-6).
Provisional restoration of the cantilever was performed based on the form of the diagnostic wax pattern. Digital impression was made using an intraoral scanner. A final device was designed on dental CAD using the digital impression data of the formed abutment tooth. The all-ceramic RBFDP morphology of semi-sintered zirconia material (Katana STML, Kuraray Noritake Dental, Tokyo, Japan) was produced using a milling machine (Aadva Mill LD-1, GC, Tokyo, Japan). After the adjustment, it was completely sintered in an oven (S6 MS-3316, Motoyama, Osaka, Japan). The completely sintered body was finely adjusted on the 3D printer model, and was completed by polishing, staining and glazing. Cantilever all-ceramic RBFDP with gum was fabricated using zirconia.

The mounting guide is manufactured by fixing the all-ceramic RBFDP on a working cast manufactured by a 3D printer (Varseo 3D Printer, Bego, Bremen, Germany) and 3D measuring machine (LS3 Scanner, KaVo Dental, Bochum, Germany). The 3D data converted into standard tessellation language (STL) file. The device was designed by inputting this data into CAD software (Geomagic Freeform Plus, 3D Systems, Rock Hill, NC, USA). This designed data was modeled and manufactured by an 3D printer using 3D material (VarseoWax Surgical Guide, Bego).
Airborne-particle abrasion with 50-70 μm Al₂O₃ was used for surface treatment of the inner all-ceramic RBFDPs, and then the 10-methacryloyloxydecyl dihydrogen phosphate (MDP) primer (Clearfil Ceramic Primer Plus, Kuraray Noritake Dental) was applied. After the pretreatment for luting with a fluoride-free abutment surface abrasion, 37% phosphoric acid (K-etchant gel, Kuraray Noritake Dental) is used for etching, and the primer (ED Primer, Kuraray Noritake Dental) was applied. The final prosthesis device was trial fitted in the oral cavity. Then, on the 3D printer model, the final device was temporarily attached to the positioning splint using dental cyanoacrylate adhesive (Dental Cyanone D, High Pressure Gas Industry, Osaka, Japan) (Fig. 7). After that, the positioning splint with the prosthesis was inserted into the oral cavity and seated with a luting agent (Panavia V5, Kuraray Noritake Dental) (Fig. 8,9).

A wrap-around type retainer was fabricated and fitted to prevent the return of orthodontic treatment. At the three-months follow-up, the occlusal and the periodontal tissue and the tissue around the prosthetic device were confirmed, and brushing instruction and professional cleaning by a dental hygienist were continued.

Discussion

Chen et al. reported that the 5-year survival rate of all-ceramic RBFDPs made of glass ceramics, alumina, and zirconia was 98.1% for the cantilever, and 92.0% for the two retainers respectively [3]. The clinical success rate of all-ceramic RBFDPs varies considerably. Kern et al. reported that the 10-year survival rate of all-ceramic RBFDPs with a cantilever (alumina, zirconia) was 98.2% [8]. Sasse et al. reported that the 5-year survival rate of all-ceramic RBFDPs (zirconia) with a cantilever was 93.1% [9]. In addition, all-ceramic RBFDPs may cause early detachment and fracture if proper retainer design and occlusal relationship with opposing tooth cannot be properly inspected. It may be effective to select a cantilever in cases such as this case where the movement between the abutment tooth is different without being involved in occlusion too strongly, or in cases where there is a risk of relapse such as patients with cleft lip and palate.

It is thought that these mechanical prosthesis designs, wearing of wraparound type retainers, and continuation of maintenance have been successful for after treatment without problems. It is speculated that the lack of life-style habits such as bruxism also has a significant effect. When choosing an all-ceramic RBFDP for a patient, it may be prudent to carefully identify the indication and apply it clinically. The fixed prosthetic treatment satisfied patient aesthetically. A beforehand and precise occlusal examination is crucial to be successful for a cantilever all-ceramic RBFDPs in a case like this one.

The purpose of treatment with a prosthesis using digital impression using an intraoral scanner, it is possible to eliminate the effects of displacement of the abutment tooth, soft tissue (especially scars) and distortion of the impression material due to impression pressure. It is thought that the cantilever using digital impression led to a good fit of the final prosthetic device. In this procedure, the contents of the procedure were visualized as a three-dimensional image from the time of diagnosis by simulating based on the digital impression data.

Positioning splint is effective and successful for all-ceramic RBFDPs [9]. In this case using 3D printer and CAD software is easy, simple and reliable compare to a conventional method. In addition, an all-ceramic RBFDP for a patient might be suited due to the different movement of maxilla segments in a patient with cleft lip and palate.

It was suggested that the all-ceramic RBFDP using digital impression to cope with cleft lip and palate as in this case may be useful as a prosthetic device if the conditions are adjusted.

Conflicts of Interest

The authors declare that there are no conflicts of interest related to the manuscript.

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