Esthetic Restoration of Deciduous Teeth Using Prefabricated Zirconia Crown in Children with Early Childhood Caries: A Report of Three Cases

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Early childhood caries is a widespread condition that requires attention; however, its treatment remains a challenge in terms of child behavior management. This study describes the usefulness of customized zirconia crowns for the restoration of deciduous teeth through the evaluation of some cases. Three cases are described: a 29-month-old girl who presented with severe early childhood caries affecting anterior tooth, a 50-month-old boy who presented with extensive caries of his anterior tooth, and 70-month-old girl who presented with extensive caries of his primary posterior dentition. These prefabricated, zirconium-based ceramic crowns (Nusmile™ NuSmile) are available in various sizes, shapes and colors. Before the treatment, radiographs and intraoral photographs were taken to evaluate the appropriateness of treatment. Our findings indicate that customized zirconia crowns may be appropriate for restoring the deciduous teeth. Further long-term clinical studies are required to clarify the usefulness of this restorative method.

Key Words: Deciduous tooth, Dental caries, Early childhood caries, Pediatric dentistry, Prefabricated zirconia crown

Introduction

Pediatric dentistry is an area of childhood science that involves space management, orthodontics, surgery, and management of trauma. The most serious threat to children's oral health is dental caries¹⁾. Dental caries is the most common chronic disease. It occurs when food containing high amounts of sugar or carbohydrates remain on the tooth. Bacteria living in the mouth digest these foods and turn them into acids. The acids dissolve the enamel, progressing to the pulp, and cause tooth damage leading to tooth decay²⁾. Dental caries is the most common oral disease in infancy, but its pattern of occurrence is not uniform. The pattern of caries observed on a deciduous tooth is different from that observed on a permanent tooth, and the most common pattern of dental caries is the maxillary dental caries. Dental caries of the maxillary

anterior teeth was previously known as nursing bottle caries and is now defined as a type of severe early childhood caries (ECC)³⁾.

ECC is a form of dental caries that affects the primary dentition of young children. Terms such as "nursing bottle mouth," "bottle mouth caries," or "nursing caries" are used to describe a particular pattern of dental caries in which the upper primary incisors and upper first primary molars are usually most severely affected⁴⁾. The treatment of ECC is expensive, often requiring extensive restorative treatment and extraction of teeth at an early age. The estimates of the cost of tooth restoration alone may exceed \$1,000 per child⁵⁾. The American Academy of Pediatric Dentistry defines this condition as "the presence of one or more decayed (noncavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child aged 71 months or younger⁶⁾.

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Preformed stainless steel crowns (SSCs) are the most durable and reliable restorations for severely carious (ECC) or fractured deciduous teeth⁷⁾. Croll⁸⁾ reported that SSCs were easy to cement, fracture proof, wear resistant, and firmly adherent until exfoliation. The primary disadvantage is the compromised esthetics because of the metallic silver appearance. With an increasing demand for esthetics, SSCs have become less desirable, SSCs have become less desirable. Currently, people are showing increasing interest in their appearance and want their dentist to reflect that desire. The number of parents searching for esthetic options to repair their children's teeth is also increasing. A multitude of restorations including open-faced SSCs, pre-veneered SSCs, resin (strip) crowns, and zirconia crowns are used to restore

deciduous teeth. In the field of restorative dentistry, zirconia has been used for root canal posts since 1989, for implant abutments since 1995, and for all-ceramic posterior fixed partial dentures since 1998⁹⁾.

Contemporary zirconia powder technology contributes to the fabrication of new biocompatible all-ceramic restorations with improved physical properties for use in a wide range of promising clinical applications. Prefabricated zirconia crowns are designed to restore deciduous teeth with caries or fracture. These prefabricated, zirconium-based ceramic crowns (NuSmileTM; NuSmile, Houston, TX, USA) are available in various sizes, shapes, and colors (Fig. 1). To overcome the shortcomings of the abovementioned treatment options, prefabricated zirconia crowns can be utilized as alternative treatment options for

Fig. 1. Prefabricated zirconia crowns (NuSmileTM; NuSmile).

Fig. 2. Clinical photographs and periapical radiographs of Case 1. (A, B) Before (strip crown state) treatment (September 17, 2012). (C, D) After (zirconia crown) treatment (September 18, 2012).

deciduous teeth in children with ECC or high risk of trauma. These not only provide superior esthetics but also allow for shorter treatment duration and increased hardness compared with existing restorations for deciduous teeth.

This study aimed to report zirconia restoration for deciduous teeth. The study was reviewed and approved by the Ethics Committee of the College of Dentistry of Wonkwang University, Daejeon, Korea (IRB no. 201410-04, W1410/004-01).

Case Report

1. Case 1

In April 2010, a 29-month-old girl presented at Wonkwang University Sanbon Hospital, Gunpo, with complaints of ECC. She was young and underweight (9 kg) and was extremely fearful of dental treatment. She usually underwent treatment under conscious sedation; sedative drugs had little effect on her. Although she was a

regular visitor at our institution, she was very uncooperative and fearful. In September 2012, she visited our institution for replacement of a fractured and discolored strip crown on tooth #61 (Fig. 2A, 2B).

Following pulpectomy and core buildup, teeth #51 and #61 were prepared to receive the prefabricated zirconia crowns, which were selected and adapted according to tooth size. An assistant applied the primer (Signum zirconia bond; Heraeus Kulzer, Hanau, Germany) to the inner surface of the crown, mixed a self-etching adhesive cement (RelyXTM Unicem; 3M ESPE, Seefeld, Germany) using an auto-mixer, and injected the cement into the crown. At the same time, an expert surgeon cleaned and dried the prepared tooth surfaces and applied the cement. The crowns were adapted onto the tooth surfaces and photopolymerized, and any excess cement was removed. The following day, periapical and intraoral photographs (Fig. 2C, 2D) of the restored teeth were obtained. Fig. 3 shows the findings at the 5-month and 16-month follow-up

Fig. 3. Clinical photographs and periapical radiograph of Case 1. (A) Findings at 5-month follow-up (February 22, 2013). (B) Findings at 8-month follow-up (May 13, 2013). (C, D) Findings at 16-month follow-up (January 6, 2014).

visits, respectively.

2. Case 2

In December 2015, a 50-month-old female presented at Wonkwang University Daejeon Dental Hospital, Daejeon, with complaints of severe dental caries (Fig. 4A, 4B). As she was young and feared dental treatment, her parents opted for treatment under conscious sedation.

Following single-visit pulpectomy and core buildup, teeth #51 and #61 were prepared to receive the prefabricated zirconia crowns, which were selected and adapted as described above. Panoramic and intraoral photographs of the restored teeth were obtained the following day (Fig. 4C, 4D). At the 4-month follow-up, the zirconia crowns showed superior esthetics and harmony with the surrounding tissues, and the parents were extremely satisfied with the treatment (Fig. 5A, 5B). Fig. 5 shows the findings at the 10-month (Fig. 5C, 5D) and 18-month follow-up visits (Fig. 5E ~ G), respectively.

3. Case 3

In December 2014, a 70-month-old female presented at Wonkwang University Daejeon Dental Hospital, Daejeon, with complaints of dental caries. Pulpotomy and core buildup were performed for teeth #54, #64, #74, and #84, which were then prepared to receive prefabricated zirconia crowns. The crowns were cemented as described earlier, and panoramic radiographs (Fig. 6) were obtained the following day. Fig. 7 shows the findings at 1-year and 17-month follow-up visits, respectively.

Discussion

Compared with permanent teeth, caries progresses faster in deciduous teeth and presents more serious symptoms. ECC, if not treated, leads to abscess formation, pain, and malocclusion¹⁰⁾. If dental caries develops irreversibly during childhood, it will necessitate not only restoration treatment but also dental and prosthetic treatment. Since it can cause malocclusion and temporomandibular disorder, the management of childhood dental

Fig. 4. Clinical photographs and periapical radiographs of Case 2. (A, B) First visit, panoramic view (December 4, 2015). (C, D) Intraoral photograph and panoramic view after treatment (January 14, 2016).

Fig. 5. Clinical photographs and periapical radiographs of Case 2. (A, B) Findings at the 4-month follow-up (May 10, 2016). (C, D) Findings at 10-month follow-up (November 28, 2016). (E~G) Findings at 18-month follow-up (July 28, 2017).

caries is the basis for lifelong oral health¹¹. In addition, the cost of treatment becomes a great burden in countries that enforce public health care¹¹.

In particular, the demand for esthetics, rather than function, of anterior deciduous teeth restorations is increasing. The esthetic restoration of severely mutilated deciduous teeth has been a challenge to the pediatric dentist, not only because of the available materials and techniques, but also because the children who require these restorations are usually among the youngest and least manageable group of patients. Clinicians, who treat young children, are always faced with a challenge to find the most effective material and technique to successfully restore the deciduous anterior teeth¹². Full-coverage crowns for deciduous teeth are recommended for teeth with multiple carious surfaces, incisal edge involvement,

extensive cervical decalcification, pulp therapy, hypoplasia, and poor moisture or hemorrhage control¹³. The available full-coverage restorations for deciduous teeth include preformed SSCs, open-faced SSCs, pre-veneered steel crowns, composite resin strip crowns, and polycarbonate crowns¹⁴⁻¹⁸.

In esthetic dentistry, ceramic materials are widely used for the fabrication of dental restorations. The ceramic materials of choice are glass ceramics, spinel, alumina, and zirconia. Zirconia is reported to have a higher flexural strength compared with alumina. Zirconia all-ceramic crowns have several advantages, including a high flexural strength (1,000 MPa) and desirable optical properties such as adaptation to basic shades and decreased layer thickness (compared with conventional ceramics) required to achieve the desired color^{19,20}.

Fig. 6. Clinical photographs and periapical radiographs of Case 3. (A~E) First visit radiographs (May 2, 2015). (F~I) After treatment, intraoral photograph and panoramic view (August 10, 2015).

Fig. 7. Clinical photographs and periapical radiographs of Case 3. (A~D) Findings at 1-year follow-up (August 12, 2016). (E~H) Findings at 17-month follow-up (January 9, 2017).

In the present report, we described the esthetic outcomes in three pediatric patients who received zirconium dioxide ceramic crowns to treat a variety of lesions, ECC, and fractured old crowns. All three patients showed good esthetic results over at least 1 year of follow-up. Zirconia crowns are a promising option due to their appealing esthetics, superior hardness, and fast application compared with older crown materials. They may be particularly useful in uncooperative pediatric patients or when esthetics is a concern, but there is limited clinical data on the technique. In conclusion, prefabricated zirconia crowns can be considered a good alternative to conventional metal-ceramic restorations for the restoration of deciduous teeth with ECC or a high risk of trauma.

However, further long-term clinical studies are required to clarify the usefulness of this restorative method.

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