Esthetic Restoration of Infra-Occluded Retained Primary Mandibular Incisors with All-Ceramic Crowns in Adult Dentition

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The prevalence of hypodontia is reported to be between 1.5% to 10% in the permanent dentition. In the anterior teeth, maxillary lateral incisors and mandibular central incisors are the most frequently involved teeth. This causes esthetic problems for the patient. Several reports have focused on restoration of retained maxillary primary anterior teeth, but none have described restoration of retained mandibular primary incisors. This clinical report describes the restoration of infra-occluded retained primary mandibular central incisors of a 17 year-old girl diagnosed with hypodontia. All-ceramic crowns made with computer-aided design/ computer-aided manufacturing technology were used to restore the teeth incisally and interproximally. Due to a relatively short root length and inadequate crown-root ratio, the primary mandibular central incisors were splinted and adjusted to distribute the protrusive force evenly across the maxillary and mandibular incisors. Functional and esthetic results were achieved. *(Chang Gung Med J 2004;27:911-7)*

Key words: hypodontia, retained primary mandibular incisors, all-ceramic crowns.

Hypodontia is a condition in which teeth are developmentally absent. The prevalence in the permanent dentition is reported to be between 1.5% to 10.5%. The most common missing tooth is the mandibular secondary premolar. In the anterior teeth, the maxillary lateral incisor and mandibular central incisor are the most frequently involved teeth. The prevalence varies slightly by region and ethnic group.[1] Common complaints of dental patients with this problem include missing teeth, spacing in the dental arches and poor appearance.[2]

When the permanent successor is congenitally missing, a primary tooth may be retained beyond the normal time. In the absence of a proper stimulus from the eruption of a permanent tooth, the process of normal exfoliation and resorption may be slower than normal and interrupted for long intervals, during which repair of the resorbing surface occurs. The bony repair may fuse areas of the tooth to bone.[3] This may cause growth to cease in the affected portion of the alveolus while adjacent teeth continue to move occlusally. The retained primary teeth thus fail to achieve or maintain occlusal relationships with adjacent and opposing teeth and became infra-occluded.[4]

The shape and length of the root, the position and integrity of the clinical crown, the periodontal condition and the mobility of the retained tooth influence the treatment plan and choice of the restorative material and method in the adult dentition. Patient preference and specialist availability may also play a role in the choice of treatment modalities.

Many patients with retained primary teeth

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Received: Nov. 24, 2003; Accepted: Mar. 9, 2004
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choose to have the teeth removed and the space closed orthodontically. Extraction of the retained primary tooth and placement of a fixed or removable prosthesis is another treatment option. However, if a retained primary tooth is only minimally below the occlusal plane, it may be retained and restoration of the interproximal contact and occlusion is then required.[5] Full crown coverage, composite resin and porcelain veneers have all been advocated to restore retained primary maxillary anterior teeth.[6,7]

Composite resin and porcelain veneers are frequently used for retained primary anterior teeth. With experience and a proper etching technique, durable results can be achieved. However, if there is not enough enamel for bonding the restorative material to the prepared tooth because of the relatively small size of the primary teeth and the prolonged duration of function in the mouth, the following problems could be observed: (1) cohesive fracture, (2) debonding, or (3) marginal staining. In this circumstance, enamel bonded veneers are contraindicated.

Metal-ceramic crowns are the most common complete coverage system. With proper tooth preparation, the retention and strength of metal-ceramic crowns are superior to veneer restorations. There are, however, some disadvantages to metal-ceramics. Depth of translucency can be achieved only if there is significant tooth reduction. Compromised esthetics because of a gray line at the gingival margin is another problem.

The use of all-ceramic restorations has increased in recent years. The reason is that all-ceramic systems can be more esthetic than metal-ceramic systems because of the lack of a metal core. A number of all-ceramic techniques have been introduced in restorative dentistry since the early 1980s. Feldspathic porcelain and aluminous porcelain generally provide excellent esthetics and compressive strength. However, they lack tensile strength and frequently fracture when subjected to shear force. The mean flexural strength for feldspathic porcelain is 67MPa and for aluminous porcelain 91 MPa.[8] To overcome this problem, a number of unique approaches to strengthening porcelain and innovative all-ceramic fabrication methods have been developed.

The injection-molded, IPS Empress 2 (Ivoclar, Schaan, Liechtenstein) is a lithium disilicate-reinforced glass ceramic that is primarily a glass matrix with crystalline lithium disilicate that strengthens the ceramic without significantly diminishing its translucency and esthetics. This core material possesses a high flexural strength in the range of 352 to 452 MPa.[9]

Two other contemporary all-ceramic approaches have emerged with greater promise. They are Procera AllCeram (Nobelpharma AB & Sandvik Hard Materials, Stockholm, Sweden), which has a reported 96.9% success rate,[10] and In-Ceram aluminum (Vident, Baldwin Park, Calif. USA), which has a reported 98.4% success rate.[11] Procera AllCeram cores are 99.9% aluminum oxide, whereas In-Ceram aluminum copings are 70% sintered aluminum oxide saturated with lanthanum glass. The Procera AllCeram crown was found to have higher flexural strength (365 to 579 Mpa) than In-Ceram aluminum (343 to 523 Mpa).[12] Procera All Ceram cores can only be fabricated with a computer-aided design/ computer-aided manufacturing (CAD/CAM) technique, whereas In-Ceram aluminum copings can be built up on special plaster dies or milled by a CAD/CAM technique, such as the Precident DCS system (Digitizing Computer System, DCS Dental AG, Allschwil, Switzerland). Advances in dental ceramic materials and the development of CAD/CAM and milling technology have facilitated the development and application of superior dental ceramics. CAD/CAM manufacturing of all-ceramic restorations from industrially prepared ceramics blocks can yield a homogenous material structure where voids, flaws and cracks are reduced to a minimum.

Several reports have focused on restoration of retained maxillary primary anterior teeth, but none have described the restoration of retained mandibular incisors.[5-7] The purpose of this clinical report is to describe an esthetic restoration of retained primary mandibular central incisors in adult dentition by means of In-Ceram alumina crowns with the Precident DCS system.

CASE REPORT

This 17 year-old girl was referred to the prosthodontic department of Chang-Gung Memorial Hospital in 2002 with the chief complaint of short lower front teeth and poor appearance because of spacing of her front teeth. Apart from the appear-

ance, she had no other complaints. Her medical and dental histories were unremarkable. On examination, the bilateral maxillary lateral incisors and mandibular central incisors were absent, while both primary mandibular central incisors were present (Fig. 1). The retained primary incisors were infra-occluded with severe attrition and dentin exposure at the incisal edge. They were not mobile and a radiograph revealed no permanent successors (Fig. 2). Oral hygiene was good and spacings were found between the bilateral maxillary central incisors and canines, and bilateral primary mandibular incisors and lateral incisors.

The patient declined orthodontic treatment to close or redistribute the space in the upper arch and accepted any esthetic compromises produced by an asymmetric appearance. The patient was informed that the longevity of the retained primary mandibular incisors was unknown and that it was possible that they would exfoliate or become necrotic and require extraction. The patient rejected the extraction plan and opted to maintain and restore the teeth. The final decision was made to restore the retained primary incisors with In-Ceram alumina crowns and to restore the missing right maxillary lateral incisor with a resin-bonded fixed partial denture.

Tooth preparation was carried out using a taper round-ended diamond bur. Incisal reduction was not required as there was adequate interocclusal space between the infra-occluded primary incisors and maxillary permanent incisors. A circumferential chamfer preparation was used with a depth of 0.5 mm and rounded internal line angles (Fig. 3). A master impression was taken with elastomeric impression material, and a working cast with removable dies of the prepared teeth was fabricated and forward to the laboratory. Color matching and shade selection were completed using a Vita shade guide. Specific instructions for the laboratory were given in the work authorization regarding the shape, color and incisal translucency. After the tooth preparation and the position of the dies in the dental arch were scanned by the scanning instrument of the Precident DCS system, the data were transmitted to a computer to design the framework of the restoration. The splinted all-ceramic framework was milled from an In-Ceram alumina block (Vita Zahnfabrik, Bad S_ckingen, Germany) with a milling machine. The framework had a 0.5 mm default thickness and was prepared 1 mm from the actual finish line to prevent accidental damage. Afterwards, the final framework was first trimmed manually to remove any excess ceramic material from the crown margin, infiltrated with a low viscosity infiltration glass for 40 minutes, and then thinned to 0.3 mm near the margin to retain space for the veneering porcelain. The final veneer-

Fig. 1 The retained primary mandibular incisors are infra-occluded with severe attrition and mesial and distal diastemata.

Fig. 2 A periapical radiograph showing the short root length of the retained primary teeth with congenital absence of the permanent successors.

Fig. 3 A circumferential chamfer preparation is carried out on the retained primary mandibular incisors.

ing of the framework was completed using Vitadur alpha porcelain according to the manufacturer's recommendations.

The crowns were placed intraorally and the color and fit were evaluated. The occlusion was checked in centric and eccentric movements to eliminate any functional interference. The occlusal contacts during protrusive movement were adjusted to distribute the protrusive force evenly across the maxillary and mandibular incisors. Before cementation, the internal aspects of the crowns were subjected to airborne particle abrasion with 50 μm alumina. A small amount of dual-polymerized resin cement (Panavia F, Kuraray, Osaka, Japan) was applied to the inner surface of the crowns. The excess resin was removed with a brush before the resin was light cured for 20 seconds buccally and lingually. Finally the margin was checked for remaining cement and the occlusion was checked again. The patient was pleased with the esthetic outcome (Fig. 4A). Home care instructions of the splinted mandibular primary central incisors were emphasized and periodic maintenance care was scheduled. After 14 months of clinical service, the crowns were still functioning satisfactorily and there have been no clinical or technical problems (Fig. 4B). A periapical radiograph was taken and no periodontal breakdown or root resorption was found (Fig. 5).

DISCUSSION

When permanent successors are missing, retained primary teeth may provide useful functional units for years with or without the addition of restorations. Case reports that demonstrate more than 50 years of deciduous tooth retention and service are available, but some degree of root resorption may still take place.[13] The speed of root resorption varies and is influenced by the severity of the occlusal stresses imposed upon the immature supporting periodontium.[13] Accordingly, when we restore retained primary teeth, major considerations should be the occlusion and the occlusal force on the teeth. In our patient, because of the relatively short root length and inadequate crown-root ratio, splinting the bilateral primary mandibular central incisors and distributing the protrusive force evenly to the splinted

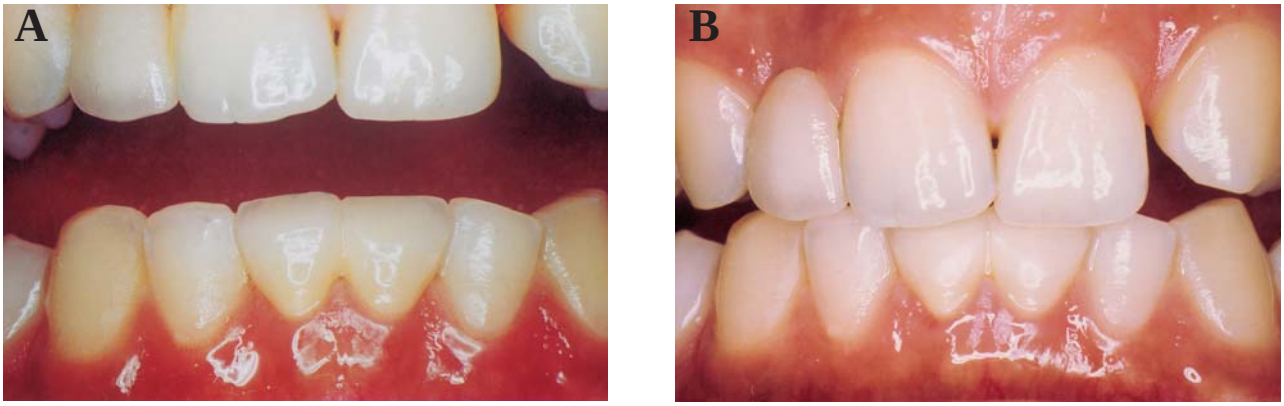

Fig. 4 (A) Splinted In-Ceram Alumina crowns on the retained primary mandibular incisors after cementation. (B) Splinted In-Ceram Alumina crowns after 14 months of clinical use.

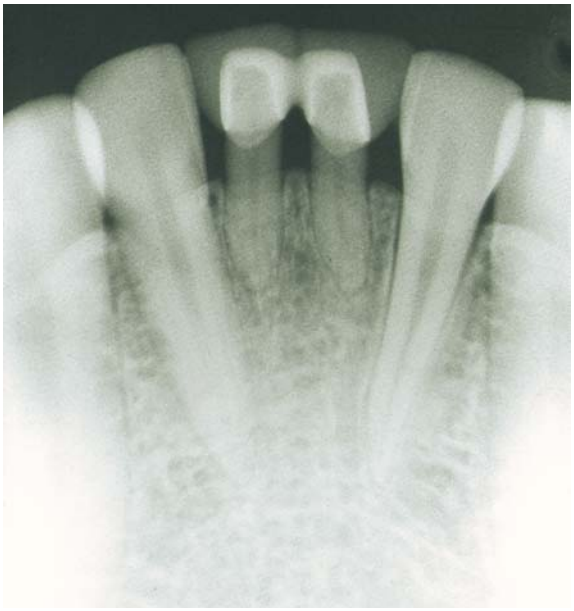

Fig. 5 A periapical radiograph showing no periodontal breakdown or root resorption after 14 months of clinical use.

crowns and the adjacent mandibular incisors avoided inadequate occlusal stresses on the retained primary teeth. The splinted primary incisors were recontoured both incisally and interproximally, and thus, there was an increase in incisal length and also improvement in cutting function and esthetics. The use of all-ceramic crowns has many advantages. Compared with porcelain or composite veneers, resin-bonding all-ceramic crowns have superior core strength and retention, especially if there is not enough enamel for proper bonding of veneers. It has been reported that 11% of veneers debond or are removed after a period up to 63 months, mostly because of bonding problems.[14] Compared with metal-ceramic crowns, all-ceramic crowns are more esthetic and biocompatible.

Many factors influence the choice of all-ceramic systems for retained primary mandibular incisors. Strength, fit, and esthetics are traditionally considered in the selection of material for full coverage restorations. Anterior crowns can be fixed to the tooth by traditional cements or resin cements. Traditional cements occupy the space between the restoration and the tooth surfaces but do not provide adhesion between them. Resin cements provide adhesion to both surfaces and can act to transfer force from the restoration to the underlying tooth and strengthen all-ceramic restorations. Except for the IPS Empress 2 system, the flexural strength of glass ceramics ranges from 90~180 MPa,[15] which is relatively weak for anterior teeth if there is no proper bonding between the surfaces. A high failure rate has been recorded for glass ceramic restorations luted with traditional cements.[16] It has been shown that the maximal biting force in the incisal region, which ranges from 108 to 229 N,[17] is smaller than the fracture load of any of the contemporary all-ceramic systems. These new core ceramics with flexural strengths higher than 300MPa, such as Empress 2, In-Ceram aluminum and Procera, are strong enough for use in anterior teeth even when luted with traditional cements. Because our patient's clinical crown was not long enough, a resin cement was used to provide additional bonding strength to increase the retention of the restorations. However, the recommended minimal coping thickness of the Empress 2 all-ceramic system is 0.8 mm, which is not possible in tooth reduction of retained primary incisors. Therefore, it is best to select all-ceramic systems with higher mechanical properties to preserve more tooth structure. Procera AllCeram and In-Ceram alumina core materials are both alumina-based all-ceramic systems. Their mechanical properties have proven to be good when compared with glass ceramics.[12] Their recommended coping thickness is 0.5 mm, which can be as low as 0.3 mm for low stress areas.[18]

To fabricate a Procera ceramic core, a dense aluminum oxide powder is compacted onto the refractory die. The core is then sintered at 1550˚C for 1 hour. The amount of shrinkage of the aluminum oxide powder is compensated by an enlarged refractory die. A mistake in compensating the amount of shrinkage would result in poor adaptation of the core onto the stone die and thus compromises its marginal fit. Instead, the Precident DCS system mills copings directly from the ceramic block to the same size as the stone die, and therefore has potential to have a better fit than the Procera system. However it has been reported that the mean marginal discrepancy of the Precident DCS system is 45.0±19.2 μm, which is comparable with the Procera system (83±41 μm).[19,20] Both meet the criteria for an acceptable marginal discrepancy of 120 μm.

Due to the need for splinting of the adjacent teeth, only In-Ceram alumina crowns could be used

in our patient. The Procera Allceram system was precluded because of limitations in coping design and soldering problems. Conventionally, the In-Ceram system requires an alumina slip to be loaded onto a refractory die using a brush, followed by brushing, sintering the die, and then glass infiltrating it. In contrast, the Precident DCS system, which mills a core from a sintered alumina block, does not require a refractory die and thus simplifies the laboratory work. In addition, the length of time necessary for glass infiltration is shortened from 10 hours to 40 minutes. This is a big advantage over the conventional In-Ceram system. Another advantage of the Precident DCS system is that completed crowns have less variation in strength because this system uses industrially sintered alumina blocks subjected to stringent quality control by the supplier.

Even though the translucency of In-Ceram Alumina is not as high as that of glass ceramics, the coping does have some light transmission and can achieve a more esthetic result than the metal-ceramic system.

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成人齒列中之下顎低位咬合滯留乳門齒之美觀贋復

徐光蔚 沈裕福

缺齒畸形在成人齒列的發生率大約在1.5% to 10.5%之間，若發生在前牙區，將會造成美觀的困擾。上顎側門齒及下顎正中門齒爲前牙區最常發生缺齒的部位，過去的文獻只提及應用於上顎前牙區滯留乳齒的贋復方式，但對於下顎前牙區的贋復方式卻很少提到。本文報告爲一位17歲女性病患，其齒列經診斷爲缺齒畸形。利用電腦輔助設計及製造(CAD/CAM)技術所做出的全瓷冠，將原本低位咬合的滯留乳門齒恢復到具有功能及美麗的外觀。因爲有較短的牙根及不良的冠根比，故將此兩顆牙齒相連，並於前突運動時與下顎兩側側門齒同時與對側牙齒接觸，以分散前突力量。(長庚醫誌2004;27:911-7)

關鍵字：缺齒畸形，滯留乳門齒，全瓷冠。

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受文日期：民國92年11月24日；接受刊載：民國93年3月9日
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