

Chapter 5- Cases where special attention was paid to the prosthodontics

- Application of CAD/CAM system

1. A case in which the all-ceramics crown fabricated with CAD/CAM system was fitted

Director of Tokyo Kagawa Dental Clinic
Toshiaki Miyazawa

The construction of dental prosthesis in the recent years, not exclusive to implant prosthesis fabrication, have shifted from the casting from the mould that resulted from the bite registration techniques in the past to the construction by implementing CAD/CAM systems. The materials utilized have also been modified to metal-free materials such as zirconia that excels in estheticism, ceramics, and hybrid resins. A case where the all-ceramics crown to be fitted onto a one-piece implant was constructed using the CAD/CAM system (Advance Co., Ltd) is presented.

Patient: 74 year-old female

Main complaint: Requested implant prosthesis for the replacement of No. 13 tooth that was lost due to root fracture.

Treatment plan: The all-ceramic crown fabricated by the CAD/CAM system was adopted as the prosthesis for the implant installation.

No. 13 tooth was extracted following its root fracture, to which one-piece implant (4SS) was installed in undergoing the standard protocol, after a year and nine months. Two months later, impression and occlusion registrations were conducted (Image-1,-2). Having constructed the model, all-ceramic crown was fabricated using the CAD/CAM system, and the superstructure was mounted (Image-3,-4,-5,-6). With regards to the dimensions of the crown, its occlusal plane was fabricated to be smaller than those of the natural teeth, and as the opposing tooth was also implant prosthesis, the occlusal plane was designed with the size to match its opponent. The occlusal relationship was designed to be 30 μ m below that of the anterior natural dentures, so that it would separate with the lateral movement. The dental radiographs at the time of implant installation as well as the placement of the superstructure are featured in Images-7, -8, -9,-10, where no inflammations in the surrounding structures can be observed. Image-11 and 12 show the state, eight months after the installation, with no breakage of superstructure or presence of any other abnormalities. There are no constrictions or inflammations in the gingiva surrounding the implant prosthesis. The implant installations were conducted nine and a half years previously to the opposing teeth No. 13 to 15, and had been mounted with a metal based hybrid to the No. 13 position, and the metal crown to No. 14 and 15. But there had been neither signs of bone resorption nor gingival constriction, indicating a successful implantation case.

Observations

The field of dentistry is undergoing a significant renovation aided by the recent technological advances in computational software and hardware. The effect that implementation of CAD/CAM system has had on dentistry can be simplified to the change in the technique used in casting to cutting, but the most notable advances with this modification is in the reproducibility of the data with regards to the implant sizes, and the variety of different occlusal condition. The past techniques had been highly reliant on the level of

experience of each technician therefore reproducibility in the superstructures was not easily come by. The CAD/CAM system has enabled the information of occlusal relationships to be incorporated into construction of the prosthetics.

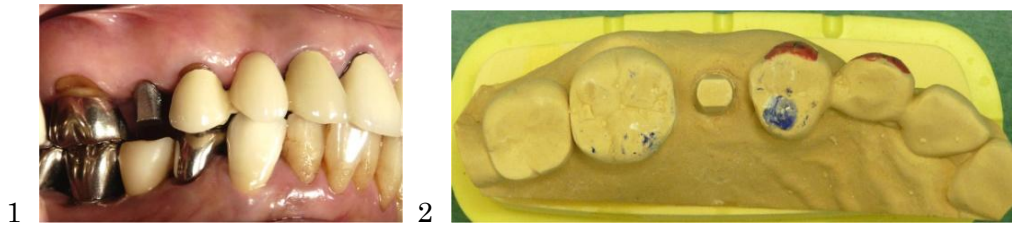


Image-1: Image of the oral cavity, two months after the installation

Image-2: Occlusal plane of the working model

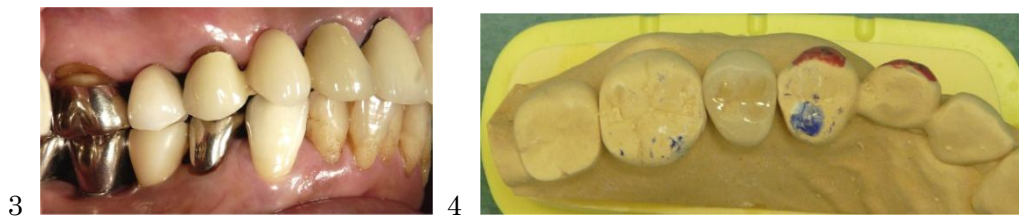


Image-3: Image of the oral cavity at the time of prosthetic placement.

Image-4: Prosthetics on the model.

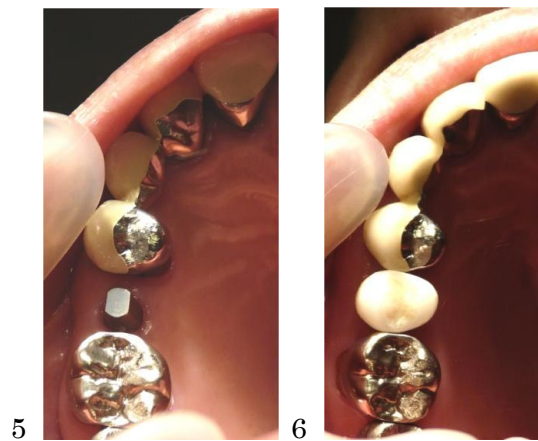


Image-5,-6: Before and after the prosthetic placement

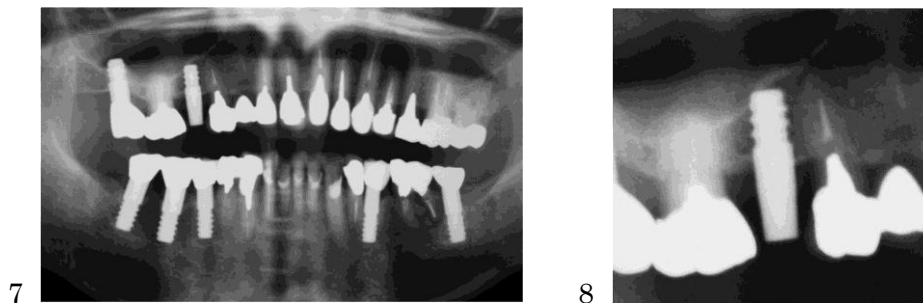


Image-7,-8: Radiograph directly after the implant installation

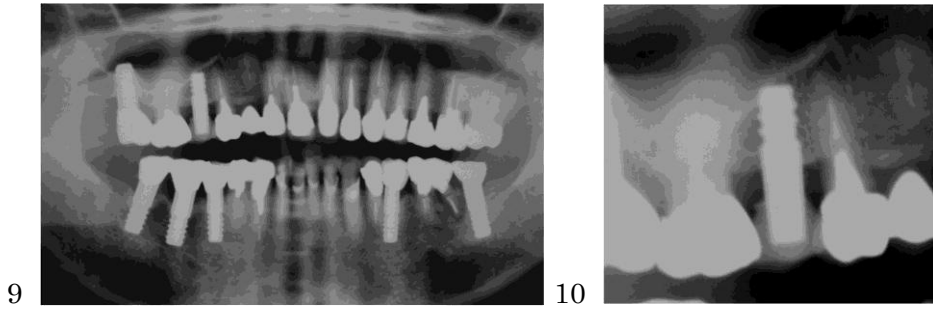


Image-9,-10: Radiograph of prosthetic placement, two months after the implant installation.

All ceramics crowns which were constructed by CAD/CAM system

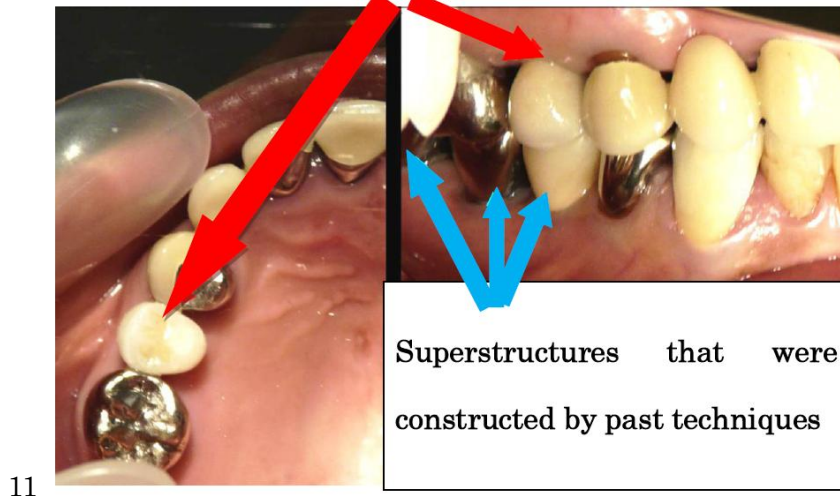


Image-11: Image of the oral cavity 8 months after the implant installation, and 6 months after the prosthetic placement. The implants of occluding teeth were installed 9½ years previously.

2. The method to mount the superstructure fabricated with CAD/CAM system to the AQB implant

Director of Nishimura Dental Clinic
Kouzo Nishimura

There are a variety of materials that are used as the superstructure with CAD/CAM including ceramics, zirconia, hybrids, and metals. For AQB implant, Kaguya-block® (Advance Co., Ltd.), made of all-ceramics, is used. As have been reported from clinical practices that the strength of the hybrid restoration material is largely influenced by the adhesive strength with the adherends. The key to avoid superstructure from its fracture is to increase the adhesive strength of the resin cement. If the adhesion between the titanium of the abutment and hybrid resin or titanium and cement are weak, the superstructure and the resin cement or the titanium do not become integrated therefore are more fragile.

Hence, explanation of a devised scheme is given to increase the adhesive strength in the placement of ceramics or hybrid superstructure to AQB implant.

Patient: 72 year-old male

Current condition: Root fracture of No. 29 tooth.

Treatment plan: Install 4LS type AQB Implant to No. 29 after its extraction. Place superstructure, two months later.

The strength of the commercially supplied resin cement when compounded as instructed by the manufacturer is relatively weak due to the absence of a bonding layer. To amplify the strength, a type of bonding resin that can be made into a thin layer of less than a few micrometers, condensed with dry-blowing. By laying the thin bonding layer onto the titanium surface prior to the application of the resin cement, it is possible to amplify the adhesive strength. As long as the layer is within few μ m, it can be fitted within the spacer at the time of superstructure fabrication, the increase in the height of the crown can be ignored.

Additionally, the metal primer treatment to polished surface of the titanium AQB abutment is insufficient to avoid the damage that occurs at the interface between the titanium surface and the resin cement, leading to integration failure between the titanium and superstructure or with composite resin. This is another possible causal factor to the damages of superstructure.

The sandblast treatment to the titanium surface acts to increase the surface area of adhesion and is effective for strengthening the mechanical fit. However, it can become the surface for plaque accumulation if applied to the gingival margin. Therefore rubber dam should be adopted to protect the margin, the neighboring teeth as well as the gingiva. The blast treatment to the crown interior should be avoided as it can create a point of fissure, and therefore the surface should be left untreated after cutting with diamond particles.

The aim of the treatment with phosphoric acid is not the etching of the internal structure but solely to clean the interior of the crown. After the silanization, under the clinical practice settings, the drying of the titanium surface should be done with devices such as dryer that would limit the increase in the temperature to reduce the difficulty in lowering the temperature since risks lie in the expansion of the crown or shortening of the working time of cementing with heat.

While the dual-cure resin cement requires photo-irradiation, with Kaguya block® due to the optical

transparency of the material used, it is thought that flowable resin can be used instead of the resin cement, provided that sufficient amount of light can be output from the photo-irradiation device.



Image-1: It is a single implantation case however, since the wearing of the incisal margin of No. 26 and 27 is significant, sufficient adhesive strength was necessary.

Image-2: The all-ceramics crown was fabricated with Kaguya block using the CAD/CAM system.

Image-3: The polished surface of the implant and the surrounding tissues in the margin were protected by a rubber-dam. The surface was washed with water and then dried after the sandblast treatment. Metal primer treatment was performed, and then dried. After the coating with the bond-force that had been condensed with air-blow, form a bonding resin polymerized layer with photo-irradiation.



Image-4: Rinse the superstructure interior with water, after a phosphoric acid treatment.

Image-5: After silane coupling treatment, undergone heat treatment with air-blow and dryer.

Image-6: Fill the internal surface with resin cement such as Clear-fill esthetic cement opaque color that can vary the color tone, and then set. Irradiate the crown interior one second at a time from the buccolingual side. After the removal of excess resin, polymerize with an irradiation device with high irradiation strength. Adjust the occlusion, and polish after it has hardened

Note of caution for titanium surface maintenance

The resistance to microorganisms with implant prosthesis is considered to be much lower than that of natural teeth due to the absence of connective tissue attachment, and its exposure to the oral cavity. The maintenance of oral hygiene with cleaning is essential for the long-term survival of the implant. However the problem lies in the relative softness of JIS Class I pure titanium and therefore the low resistance to frictional wear often are scratched with metal scalars (Fig. 1), polishing tools (Fig. 2,-3) or ruined with phosphoric acid etching or acidic sodium fluoride solutions. The scratches on these polished surfaces become a great environment for the microorganisms to breed therefore great precaution has to be taken when using phosphate etching when repairing the neighboring teeth; using concentrated acidic sodium fluorides; during professional mechanical cleaning (PMC) with coarse polishing tools; or at the time of air-powder polishing (Fig. 4). The uses of metal scalars should be avoided, and be replaced with a plastic scaler specific for implants.

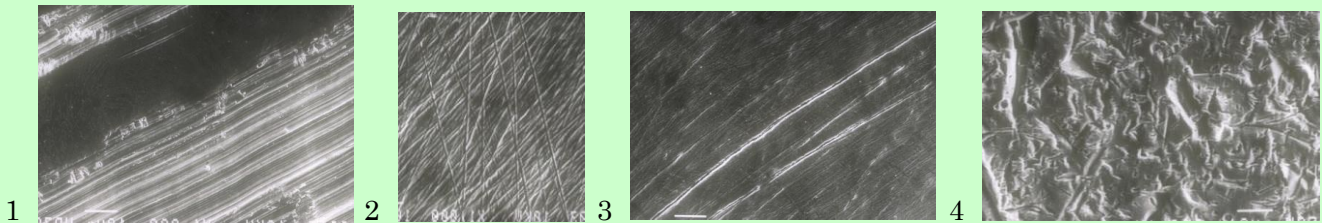


Fig. 1 Scratches made on the titanium surface with scalars (SEM image 1000× magnification)

Fig. 2 Scratches made on the titanium surface with polishing tool (Medium)

Fig. 3 Scratches made on the titanium surface with polishing tool (Fine)

Fig. 4 State of the titanium surface after air-powder polishing (for 30 seconds from 5 mm distance)

3. A method to connect the superstructure at the time of multiple implantation of one-piece implant

Director of Nishimura Dental Clinic
Kouzo Nishimura

The superstructure connection of the one-piece implant can be made difficult if the implant bodies are not installed in parallel to each other. However, there are numerous cases where this is not possible due to the state of the bone, or due to the presence of nerves and blood vessels. In the case of multiple implant installations, overloading can be prevented by connecting the superstructures. In an attempt to solve this issue, some clinical practitioners select the two-piece type implants so that suitable abutments can be chosen even though these require more complicated surgical interventions.

When using one-piece type, the superstructures have to be connected by constructing the abutments within the oral cavity or by adopting key and keyway attachments.

Here, a case is presented where the superstructure attachment was formed within the oral cavity using the one-piece type guaranteed with safety and ease in the surgical procedures, even if a sufficient taper on the abutment cannot be achieved.

Patient: 58 year-old female

Treatment: 4MS, 5MS, 5MS implants are planted to No. 13, 14 and 15.

The fixation with the bonding agent and composite resins to the natural teeth can result in fractures due to the agitation of the periosteum from incompressibility, therefore are applied as transitional fixation instead. The superstructure connections require extremely accurate craftsmanship and clinical operations as slight faults can have effects on the superstructure, abutment, implant body and the surrounding bone structures in terms of internal pressure, resulting in damages and peri-implantitis, influencing the outcomes of the treatment.

The method of superstructure attachment in the oral cavity utilizes the fact that periosteum layer is absent with implant, and the adhesion is a secure fixation technique. In other words, as the pressure to the adhesive area is small in an undisturbed implant, the connection with adhesion can be a treatment that can be guaranteed for a long time. Furthermore, the advances in the recent composite resin have enabled recovery with high stability of color tones and polish that also encompassed high tensile strength. The ease in the superstructure fabrication as well as the clinical operations of intra-oral adhesion method has advantages not only in reducing technical errors and mistakes, or in reducing patient expenditure, but also with regards to the repair of the superstructure.



Image-1: Implants were installed in parallel to No. 14 and 15, but No. 13 implants were inclined in the distal direction therefore complicating the superstructure connection.

Image-2: The one-piece implants installed to positions No. 14 and 15 were planned to be mounted with

Esthena veneer connected crown, but No. 13 implant with single Esthena crown. A 300 μ m gap between No. 13 and 14 were left and were treated with sandblast treatment.

Image-3: First the connected crown was fitted onto No. 14 and 15.

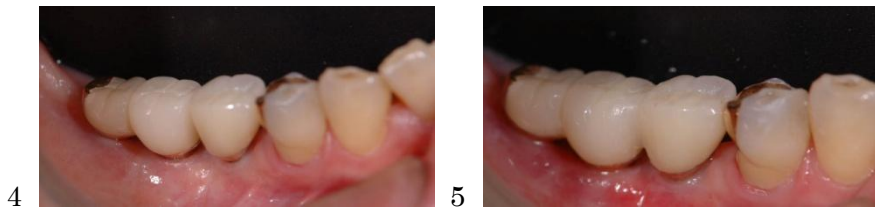


Image-4: Next the single crown to No. 13 implant.

Image-5: The gap between No. 13 and 14 were treated with phosphoric acid silanaization, and bonding application, followed by polishing after the Estelite flow quick attachment (Tokuyama Dental America Inc.).

<The treatment method for patients with strong lingual pressure and occlusal pressure>

For an osseointegration of an implant to be achieved, the micro-movement of the implant body must be restricted to a space within 50 to 100 μ m. With one-piece implant however, even if a satisfactory primary stabilization could be achieved at the time of installation, if subjected to great lingual or occlusal pressure during consolidation period can result in destabilization and inhibit osseointegration from being achieved.

In particular, with cases in which the free-distal end region had been left unfilled for a long period of time, habitual lateral protrusion of the tongue or the buccal mucosa though the missing space at the time of swallowing or occlusion have been known to develop. Prompt control of the micro-movement upon implant installation is required. To overcome this issue, the following measures were applied till achieving osseointegration depending on the extent of the lingual and occlusal pressures.

1. Interdental wire fixation (Fig. 1)

Method:

- 1) Apply sandblast treatment to the 0.9 mm stainless wire, and cut to the length that fits in between the implants for preparation
- 2) Treat the implant surface and the ends of the wire with megabond primer. Blow-dry, apply bonding, and photo-irradiate to finish.
- 3) Apply flowable resin, and fix the implant and wire.

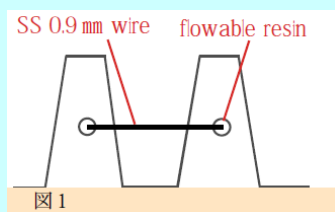


Fig. 1

2. Form a large relief around the area of implant installation, and place a splint that covers up to the alveolar ridge region (Fig. 2 to 4) for 24 hours.

3. Concomitant application of 1. and 2.

Since neither screws nor hollow structures are present in AQB one-piece type implant, main

issues usually encountered with implants such as screw loosening and fractures are absent. Even though the consolidation period of two months with AQB implant is much shorter than those implants without HA coatings, there are instances where the micro-movements resulting from habitual lingual pressure at the time of swallowing, braxism, occlusal pressure have to be

controlled. In such cases, two-piece type would usually be the first line option but by applying the splint as described above, the advantages of simple and less troublesome one-piece type implant can be exploited (Fig. 4).



Fig. 2



Fig. 3



Fig. 4