

Immediate restoration with one-piece zirconia implants

Fabricating removable interim prostheses

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Introduction

Zirconia implants have been recommended as a possible alternative to traditional titanium implants.¹ Compared with titanium implants, zirconia implants show favourable results regarding biocompatibility, soft-tissue reaction and aesthetic outcomes.^{2,3} Although two-piece zirconia implants are available in the market, the long-term prognosis of this design is still unknown.^{4,5} One-piece zirconia implants have demonstrated satisfactory results;^{6,7} however, with the one-piece design, there are significant challenges for both clinicians and patients during the healing time. For clinicians, occlusal forces may be applied to the implants before they are osseointegrated. This increases the risk of failure if the forces are too great or if the initial implant stability is less than ideal.⁸ For patients, the main concerns are related to maintaining aesthetics and function during the healing time.

If the initial stability after the implant placement is ideal and there are enough adjacent teeth to prevent heavy contact, immediate placement of an interim restoration on the implant is possible.^{9,10} However, when multiple implants are placed in scattered positions or when there is a distal extension situation, the loading on the implants should be delayed to allow for better bone and soft-tissue healing. For two-piece designs, implants can be submerged and uncovered after osseointegration is achieved. For a one-piece implant, a prosthesis should

be offered to provide aesthetics and function during the healing time. In addition, this prosthesis should provide protection of the implants to avoid occlusal contact before sufficient osseointegration has occurred. In these situations, a removable interim dental prosthesis (IDP) could be suitable. Compared with a fixed IDP, a removable one may be less stable and comfortable; however, for one-piece dental implants, this prosthesis meets the needs mentioned and offers ease of adjustment and removal for cleaning by patients.

The fabrication of a removable prosthesis supported on one-piece implants is different from the conventional technique. The replacement of the missing teeth must meet the traditional tooth arrangement requirements; in addition, any occlusal contact on the implants should be avoided to protect the implants from loading before osseointegration. A space between the intaglio surface of the removable IDP and the implants is necessary for this purpose. This prosthesis also must be fabricated in a short period, preferably in the dental office immediately after surgery. This article presents a case report with a technique for fabricating a removable IDP supported on one-piece zirconia implants immediately after surgery.

Case report

A 65-year-old female patient presented with a fractured tooth under an existing metal framework removable par-

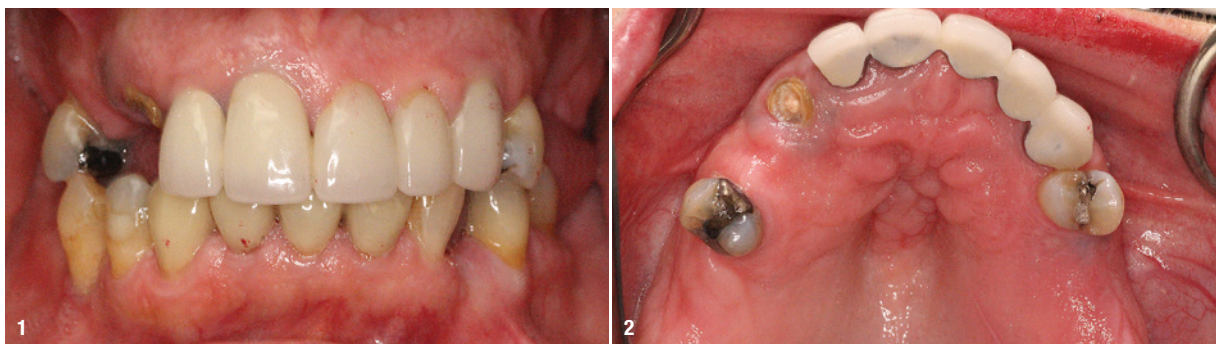


Fig. 1: Frontal view, before surgery. Fig. 2: Maxillary arch, occlusal view.

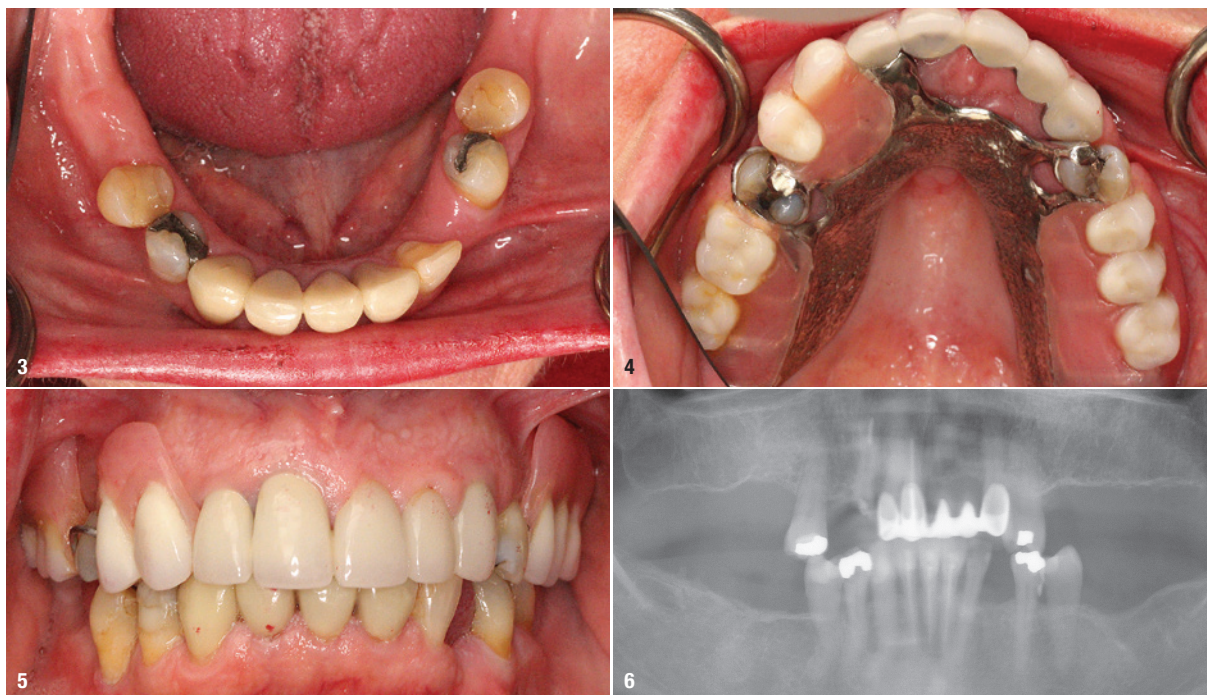


Fig. 3: Mandibular arch, occlusal view. **Fig. 4:** Maxillary arch with the removable partial denture. **Fig. 5:** Frontal view with the partial denture in position. **Fig. 6:** Panoramic radiograph, before surgery.

tial dental prosthesis and requested that it be examined for implant treatment. Her chief complaints were that, in the past, the teeth that had had contact with the hooks from the denture had become loose and needed to be extracted, and she wanted to do something to avoid becoming edentulous. Intra-oral examination revealed a remaining maxillary right second premolar and a left first premolar. An existing fixed metal–ceramic dental prosthesis using the right lateral and central incisors and left canine as abutments to replace the missing left central and lateral incisors was observed (Figs. 1–6). The patient was not interested in any treatment on the mandibular arch although there were several missing teeth. After evaluation with CBCT and discussion with the patient, a decision was made that the non-restorable canine root would be removed and zirconia implants would be placed in the edentulous areas and the extraction site immediately.

An impression was taken with the existing removable partial dental prosthesis in position. Two holes were created on the impression tray to stabilise the partial dental prosthesis when taking the impression.¹¹ The partial dental prosthesis was removed from the impression, and the impression material was trimmed with scissors to remove the thin and unsupported parts (Fig. 7). The impression was poured with a Type IV dental stone (Silky-Rock, Whip Mix), and a vacuum-formed matrix was made with a clear plastic material (thermoforming material, 0.020 in.; Henry Schein; Fig. 8).¹²

Local infiltrations with 2% lidocaine with 1:100,000 adrenaline were given, and the retained canine root was removed. The zirconia implants (ZiBone, COHO Biomedical Technology) were placed with a flapped procedure using a surgical kit provided by the implant manufacturer.

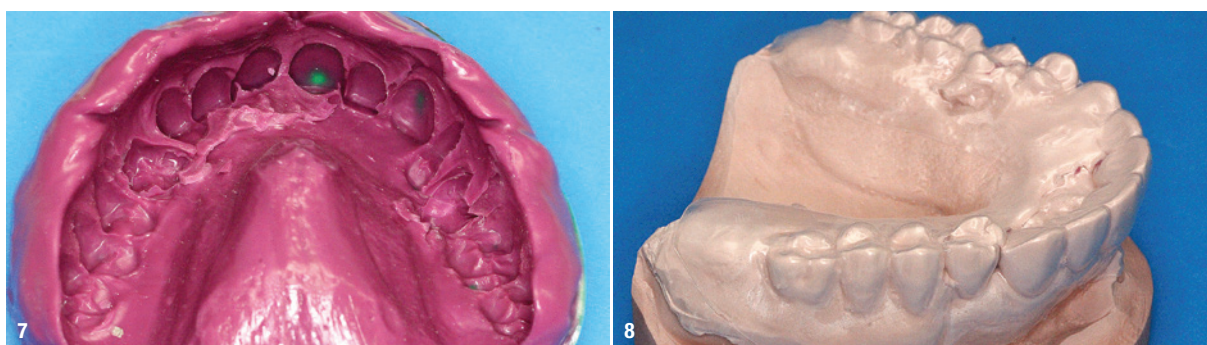


Fig. 7: Impression of the upper arch with the partial denture in position. **Fig. 8:** Vacuum-formed matrix on the cast.

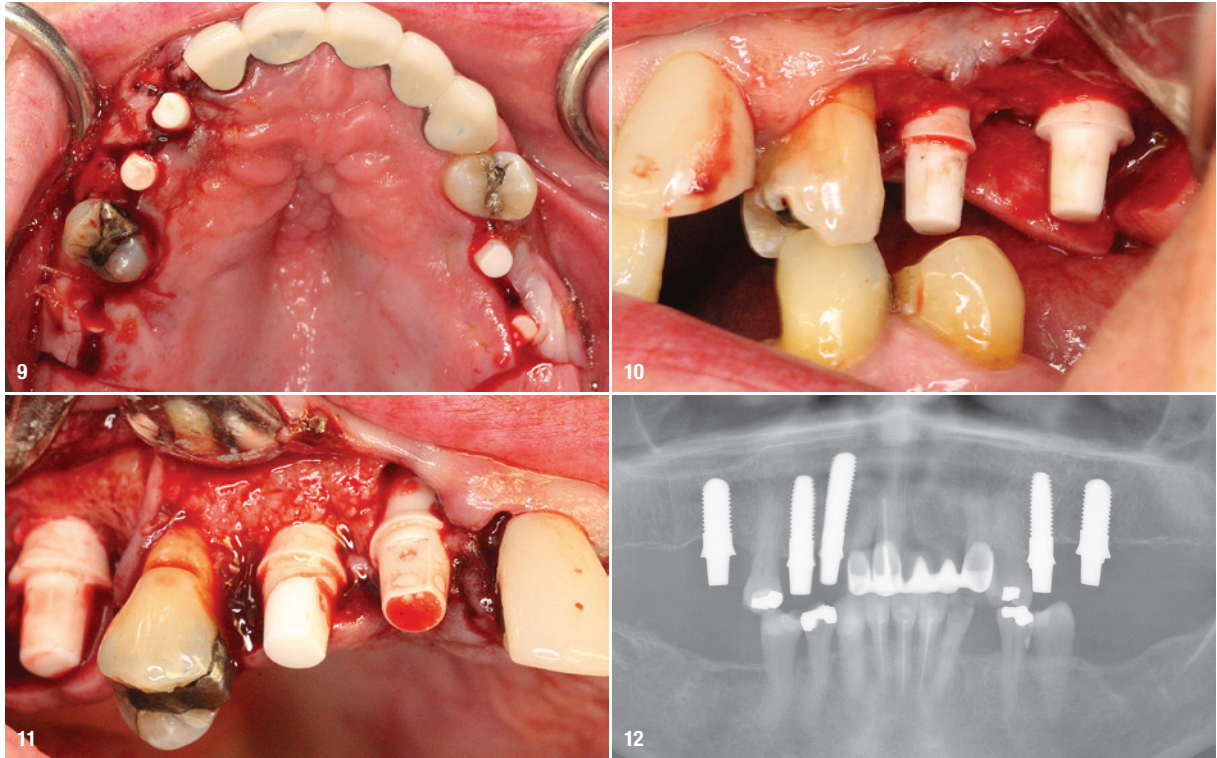


Fig. 9: Implant placement in the maxillary arch, occlusal view. **Fig. 10:** Implants on the maxillary right side, buccal view. **Fig. 11:** Implants on the maxillary left side, buccal view. **Fig. 12:** Panoramic radiograph, after surgery.

The remaining root was removed. Implants were placed in the areas of the right first molar (\varnothing 5.0 × 11.5mm), right second premolar (\varnothing 4.0 × 11.5mm), right canine (\varnothing 4.0 × 14.5mm), left second premolar (\varnothing 4.0 × 11.5mm) and left second molar (\varnothing 5.0 × 11.5mm; Figs. 9–12). The final insertion torques were between 25 and 40 Ncm. The facial side of the socket in the right canine area was filled with bone grafting material (MinerOss Cortical, BioHorizons) and covered with a membrane (AlloDerm, BioHorizons) after the implant was inserted. The wound was closed with synthetic resorbable sutures (4/0 Monocryl, Ethicon). Amoxicillin (500mg, four times daily

for two weeks) and an oral rinse with 0.12% chlorhexidine were prescribed for postoperative care.

After the surgery, an occlusal record with a polyvinylsiloxane (PVS) material (Regisil PB, Dentsply Sirona) in the centric relation position was taken. The maxillary and condylar relationships were transferred to a semi-adjustable articulator with a facebow record. Plastic impression posts (COHO Biomedical Technology) were inserted on to the abutments (Fig. 13). The impression was made with a PVS impression material (Aquasil Ultra Monophase, Dentsply Sirona). The tray with the impression material

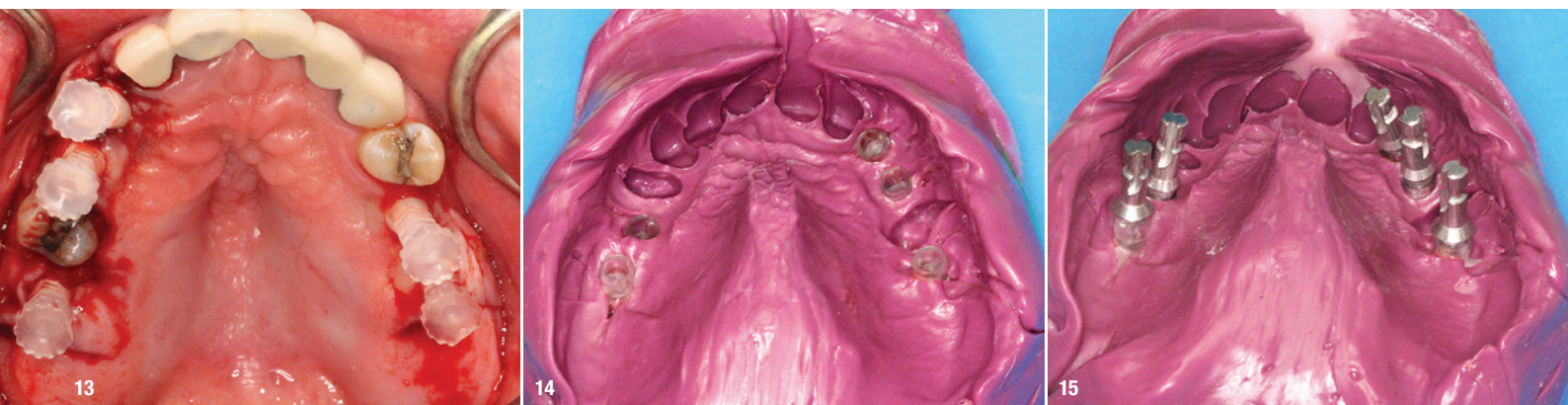


Fig. 13: Impression posts on the implant abutments. **Fig. 14:** Impression with the impression posts in position. **Fig. 15:** Analogues inserted into the impression posts.

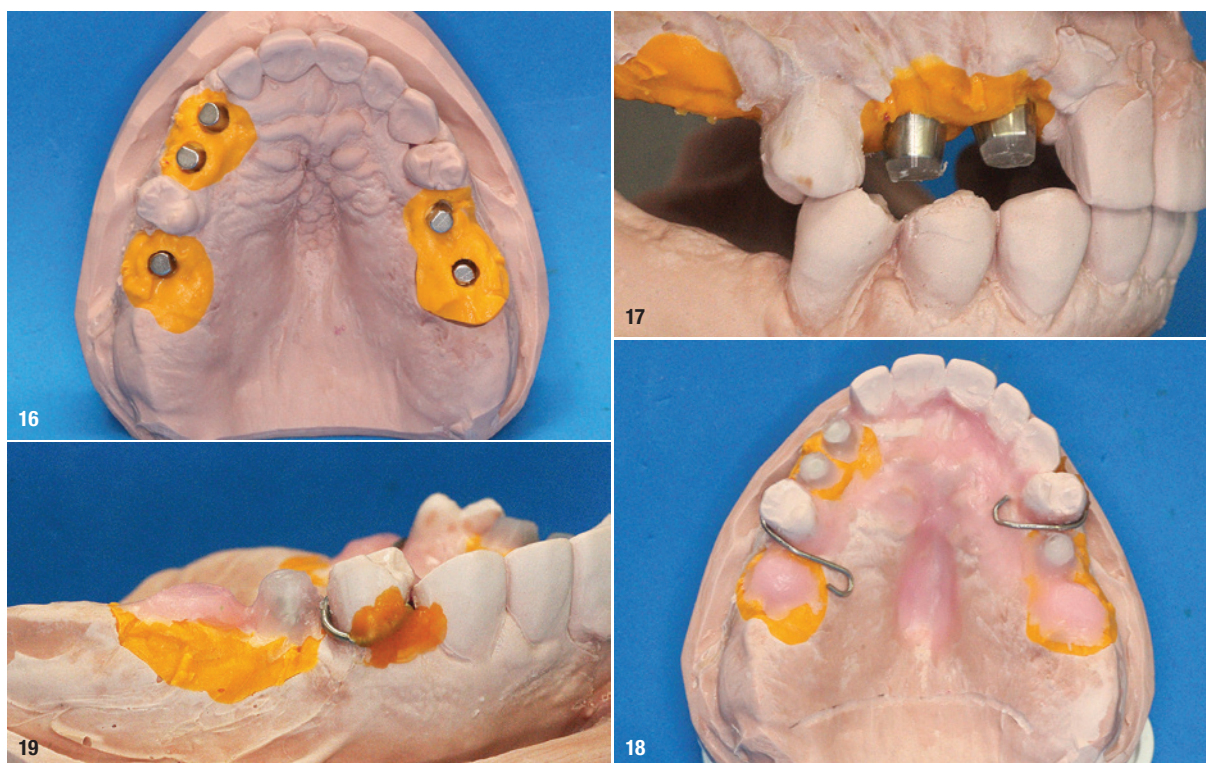


Fig. 16: Cast with the analogues and soft-tissue replica. **Fig. 17:** Clearance between the opposing surfaces and cut plastic impression posts. **Fig. 18:** Wax covering the analogues. **Fig. 19:** Wrought wire secured on the tooth with sticky wax.

was removed after the PVS had polymerised (Fig. 14). Implant analogues were inserted into the impression posts (Fig. 15). A thin layer of lubricant (Vaseline, Unilever) was painted on to the impression material around the impression post and analogue assemblies. A low-viscosity PVS impression material (Aquasil Ultra XLV, Dentsply Sirona) was injected to create the soft-tissue replica around the implants on the definitive cast (Fig. 16). The impression was poured with a Type IV stone (Silky-Rock). A beading groove was carved on the definitive cast at the distal palatal area. The maxillary cast was mounted using the occlusal record. Plastic impression posts were inserted on to the implant analogues and were trimmed to a minimum clearance of 0.5–1.0mm from the opposing occlusal surfaces (Fig. 17). The lateral surfaces of the impression posts were covered with a baseplate wax. Undercuts on the adjacent teeth and irregular surfaces on the stone cast were blocked out with the wax. Wrought-wire clasps were secured on the buccal and facial surfaces of the selected abutment teeth with a sticky wax (Figs. 18 & 19). Several relief cuts on the abutments with clasps were created on the vacuum-formed matrix (Fig. 20). This matrix was placed on the stone cast to evaluate the occlusal relationship and tooth replacement position. A tooth-coloured autopolymerising acrylic resin (Jet Acrylic, Lang Dental Manufacturing Company) was mixed and filled into the areas of missing teeth of the matrix and immediately placed over the stone cast. The articulator was closed to maintain the occlusal relationship (Fig. 21).

After the tooth-coloured acrylic resin had polymerised, the matrix was removed and a pink autopolymerising acrylic resin was mixed to cover the palatal and buccal areas (Fig. 22). This cast was placed in a pressure pot with warm water for 20 minutes. After the acrylic resin had polymerised, the acrylic dental prosthesis was removed from the cast and additional acrylic resin was added to fill the defects on the acrylic resin base. The prosthesis was trimmed and polished. A pressure-indicating paste (PIP, Keystone Industries) was applied to the intaglio surface to evaluate the heavy-contact areas and was relieved by an acrylic bur. The occlusion was adjusted until there was no lateral contact and only light centric contact from the opposing teeth. A low-viscosity PVS impression material (Aquasil Ultra LV, Dentsply Sirona) was injected into the intaglio teeth areas, and the prosthesis was placed intra-orally. The patient was asked to occlude and grind the teeth heavily (Fig. 23). After the impression material had polymerised, the acrylic dental prosthesis was removed and any contact between the acrylic base and the implant abutments was removed. This procedure was repeated until a space between the abutment and the acrylic base could be ensured. The fit and aesthetics of the IDP were evaluated (Figs. 24 & 25). Instructions on post-delivery home care, including insertion and removal, wearing the IDP to protect the implants when eating, and cleaning were given to patient. The patient was scheduled for 24-hour, one-week, one-month and two-month follow-up appointments. At each

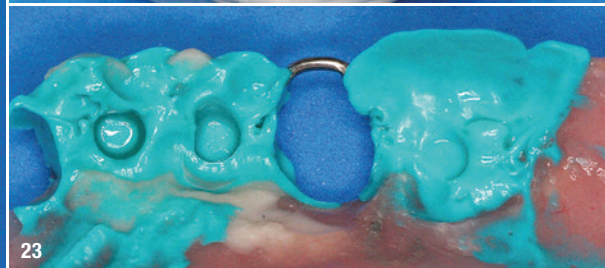
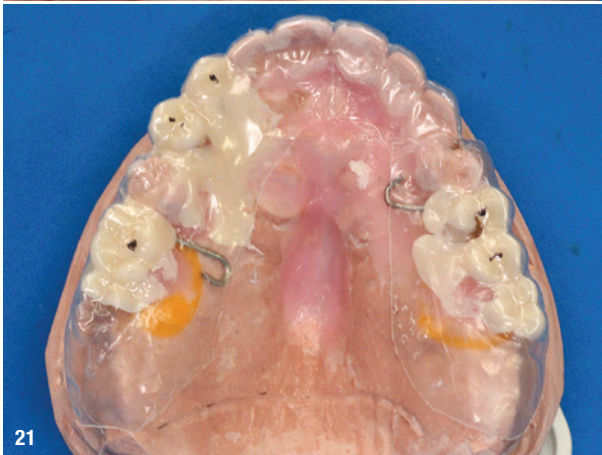


Fig. 20: Vacuum-formed matrix on the cast. **Fig. 21:** Tooth-coloured acrylic resin on the cast. **Fig. 22:** Pink acrylic resin on the palatal area. **Fig. 23:** PVS as a space indicator.

appointment, the low-viscosity PVS impression was used to ensure a space between the acrylic base and the implant abutment.

Discussion

The zirconia implants used in this case were implants fabricated with yttria-stabilised tetragonal zirconia polycrystals. Compared with two-piece zirconia implants, one-piece implants have less risk for bacterial accumulation at the gap between the abutment and implant and better fracture strength. Immediate replacement of

an extracted tooth in the maxillary aesthetic zone with a zirconia implant has been documented as a feasible treatment option.¹³ Immediate loading on one-piece titanium or zirconia implants may result in a higher failure rate and bone loss;^{14,15} therefore, a protective device must be provided to patients to avoid loading, especially for one-piece zirconia implants.

A removable IDP could be fabricated before surgery; however, this prosthesis must be relieved intra-orally, and it will take too much time when multiple implants are placed. In addition, it will apply too much force on



Fig. 24: Final prosthesis, front view. **Fig. 25:** Final prosthesis, occlusal view. **Fig. 26:** The definitive restorations, occlusal view. **Fig. 27:** The definitive restorations, frontal view.

the implant abutment before the denture base is fully relieved. A prefabricated removable prosthesis will not fit into a cast made after the surgery. Furthermore, the flapped surgery will change the soft tissue and the prefabricated prosthesis will create heavy pressure, not only on the implants but also on the soft and hard tissue around the surgical sites. The impression posts provided by the manufacturer are taller than the occlusal plane; therefore, additional PVS impression material should be loaded in the tray to ensure coverage of the soft tissue and palate. If the tray flange is too short to record the vestibular area, the height of the impression posts can be reduced or the tray flange extended with a light-activated composite resin material (Triad, Dentsply Sirona).

There are several advantages to using a vacuum-formed matrix to fabricate denture teeth. The position of the matrix can be moved slightly to accommodate the implant abutments. In addition, the contour of the teeth can be easily adjusted to create the best aesthetic results. After the matrix has been removed, the occlusal surfaces can be added to create the contacts. A disadvantage of the acrylic resin teeth is colour matching with the adjacent teeth. The shade can be modified by using the shade modifier (Minute Stain, George Taub Products).

Once the tooth-coloured acrylic resin polymerises, the acrylic resin must not be removed from the cast because the baseplate wax on the cast may prevent the acrylic resin from seating in the previous position. The adjacent stone teeth may also be broken when removing the acrylic resin from the cast. Ideally, the tooth-coloured acrylic resin will cover the wrought-wire clasps at this time. Although the wrought-wire clasps may be visible and compromise the aesthetics, the clasps will provide better retention for the prosthesis and minimise the lateral movements of the prosthesis. After the wound healing, the IDP will seat in a different position from that on the day of fabrication. It is very important to follow-up with the patient and use low-viscosity PVS to ensure that there is enough clearance between the abutments and the prosthesis. Occlusal contacts also need to be re-evaluated at the follow-up visits.

In this article, the authors used the impression posts as spacers for the clearance of the implant abutments. The advantage is ease of ensuring adequate clearance with the impression post. One can use the wax to cover the analogues, but the amount of wax over the analogues must be verified. The manufacturer adds a spacer part in its products and this will simplify this procedure. The technique presented in this article could be done chair-side immediately after the surgery. The wrought-wire clasps can be fabricated before the surgery, but must be carefully evaluated on the cast with implant analogues to ensure clearance from the analogues. The relief cuts on the matrix will accommodate the space for the clasps and sticky wax.

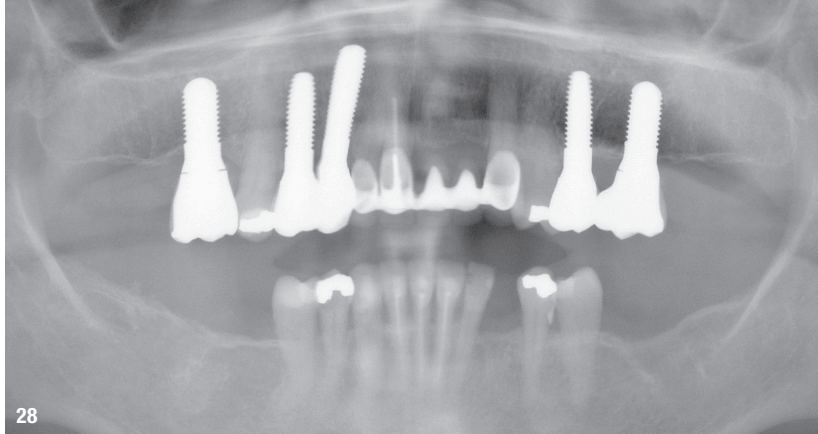
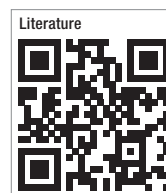


Fig. 28: Control radiograph of the definitive restorations.

Conclusion

A removable IDP should be considered as a treatment of choice when immediate loading on a one-piece implant is not the first option of treatment choices. The technique presented in the article provides clinicians with an easy reference for fabricating a device for aesthetics, function and protection before the definitive prosthesis can be delivered.



about the corresponding author



Dr Yung-Tsung Hsu is a US-based prosthodontist in Birmingham, AL, who has been involved in many clinical implant studies. He obtained his DDS degree from Chung-Shan Medical University (CSMU) in Taiwan in 1988 and a DMD degree from the University of Alabama at Birmingham (UAB) in 2010. He studied Advanced Prosthodontics at

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