Case Report

Full-Arch Mandibular Implant Rehabilitation with Use of Cerec Omnicam Scanner

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Abstract

The high success rates and good functional performances of dental implants have made them one of main treatment options for the full mouth rehabilitation of edentulous patients. However, a successful full-arch implant prosthesis requires a passively fitting superstructure on the implant-abutment connection for proper stress distribution. The completion of the associated conventional implant impression and soft tissue contour transferring requires multiple appointments, as well as lab work. The overall process is very technique-sensitive, and dimensional distortion of the master casts may occur due to impression material shrinkage and distortion, stone setting expansion, casting alloy shrinkage, or the use of non-parallel abutments made free-hand.

The use of digital dentistry can reduce the associated work time, lab work, and material expenses, facilitating clinical practice. The appropriate 3-dimensional position for an implant can be detected with an optical scanner and implant scanbodies. In addition, software can be used to process the scan data provided by a scanner in order to produce a virtual model for implant superstructure design. This report presents a case in which a full-arch mandibular implant fixed prosthesis was fabricated using a digital method. After six implants were placed on the mandibular arch, an intraoral optical impression was taken at implant level. A full-contour tooth setup and abutment/zirconia framework design were then processed on a virtual model. Next, custom titanium abutments were milled and then placed intraorally in order to evaluate their marginal positions and gingival support, after which three cemented-retained zirconia fixed partial dentures were fabricated. The final prostheses were well fitted and only required minor occlusal adjustment. There were no complications after one year of follow-up.

Keywords: CAD/CAM, digital dentistry, custom abutment, implant, Cerec Omnicam

Introduction

Implant fixed prostheses are one of the main treatment options for edentulous patients. However, the conventional

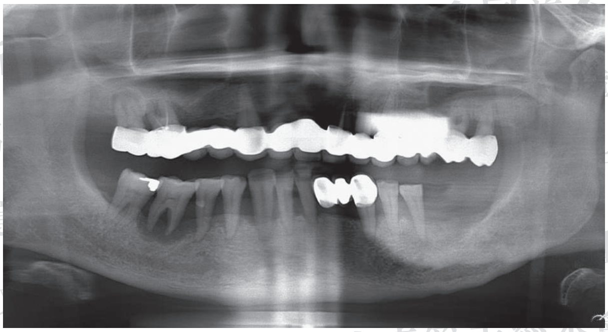

Fig.1 Panoramic film - first visit

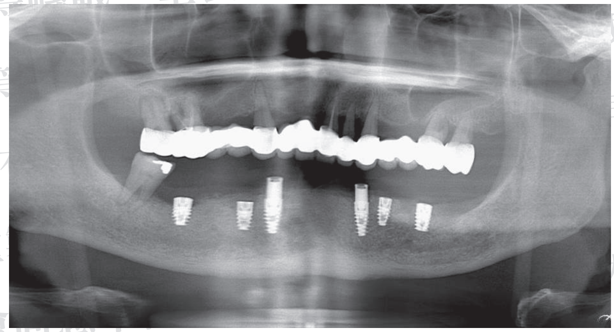

Fig.2 Panoramic film - after implant placement

method used to obtain accurate master casts and a proper implant emergence profile requires complicated chairside procedures, substantial lab work, and meticulous technique. Various problems can occur during the overall process, including impression material shrinkage and distortion, stone setting expansion, casting alloy shrinkage, and the fabrication of non-parallel abutments made by free-hand milling.

With ongoing advancements in digital dentistry, however, treatment plans and restorative procedures can be simplified, reducing chair time and lab work. Intraoral scanners are designed to eliminate the influence of impression materials and stone casts[1,2]. The optical data provided by such scanners can be processed and reconstructed into a virtual model for the design of implant restorations. Compared with the conventional impression/casting technique, this digital prosthetic procedure also provides a more convenient means of communication between dentists and technicians. The associated computer-aided milling ensures the optimal quality of the final products, in addition to allowing for the simultaneous fabrication of multiple restorations. On the other hand, frequent upgrades of the necessary equipment and design software may increase laboratory costs. Nonetheless, a successful digital workflow can simplify treatment planning, surgical procedures, and restoration fabrication when used in the context of comprehensive implant treatment.

Case report

A sixty-year-old female patient was diagnosed as having generalized moderate to severe chronic periodontitis and several teeth with chronic apical periodontitis. The present maxillary dentition was restored with an ill-fitting long span fixed partial denture from tooth 17 to 27 (missing teeth: 15, 14, 12, 11, 24, and 25) without mobility. The remaining teeth of the lower dentition were tooth 35 to 47, including a PFM bridge of 31-x-33 that was periodontally compromised with severe mobility. After the clinical and radiographic examination and a discussion regarding the treatment plan, the patient decided to have her lower teeth restored first.

All of the lower teeth were extracted, except for teeth 34, 35, 44, and 47, which were kept as interim denture abutments to maintain chewing function. Two implants (3.75 mm in diameter, BenQ AB) were placed at 33 and 43. Guided bone regeneration (GBR) was also performed in the tooth 45-46 region. After three months of healing, the remaining lower teeth were extracted, except for 47, which served as a final vertical stop. Implants 33/43 were uncovered and Locator attachments (Zest Anchor) were placed to provide retention of the second interim overdenture. Four implants were placed at the 34, 36, 44, and 46 positions with bone grafting and submerged.

After a further three months of healing, the implants were all exposed for the final impression. With six scanbodies in place, a Cerec Omnicam (Dentsply Sirona) was used to scan and record the implant position, soft tissue contour, opposite dentition, and interocclusal relationship. The scan data was then transmitted to the lab and reconstructed into a virtual model. A tooth arrangement setup and proper parallel axes and abutment profile were then designed with the use of a virtual articulator. This digital design was then sent back to the dentist for re-evaluation. Next, customized titanium abutments and temporary PMMA restorations were milled out. Almost no adjustment was needed for the abutment profile,

Fig.3 Six scan bodies in place with 47 as vertical stop

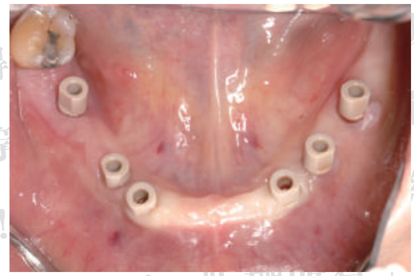

Fig.4 Six scan bodies (occlusal view)

Fig.5 Virtual model-lower

Fig.6 Virtual model-upper

Fig.7 Interocclusal relationship

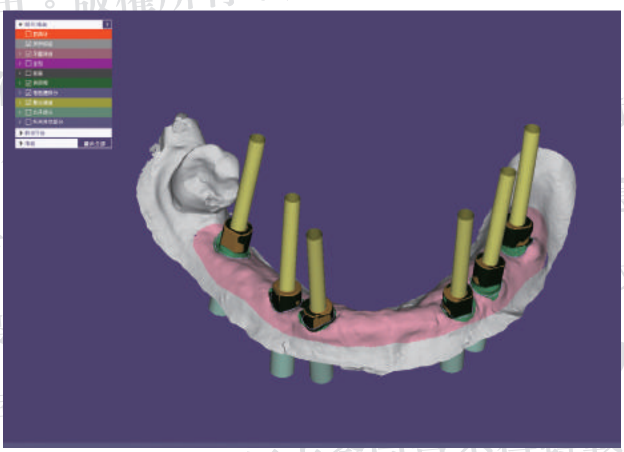

Fig.8 Matching the implant system database

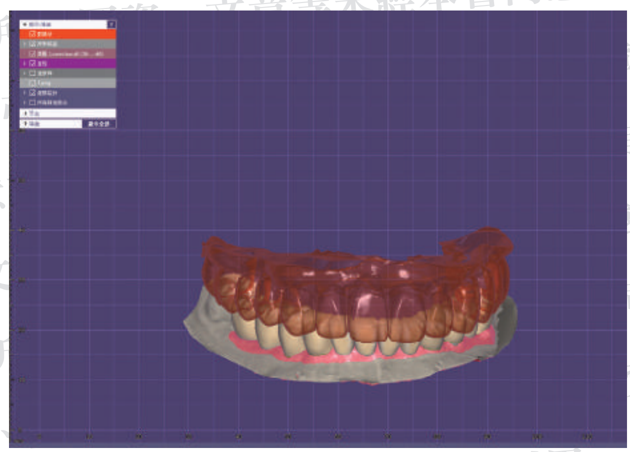

Fig.9 Virtual tooth arrangement of lower dentition

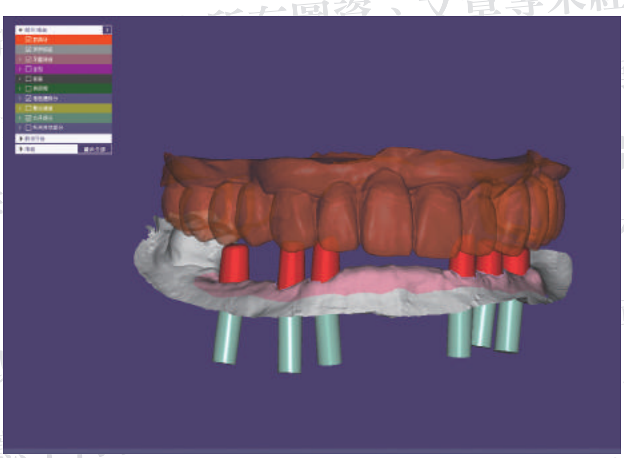

Fig.10 Custom abutment design

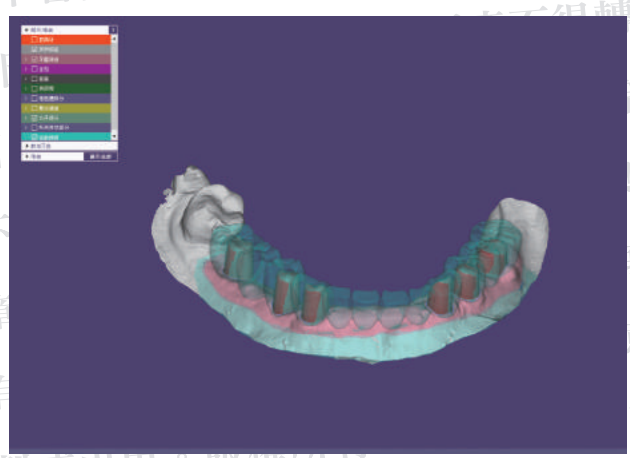

Fig.11 Temporary restoration and custom abutment

Fig.12 Custom abutment

Fig.13 Custom abutment (occlusal view)

Fig.14-16 Custom abutment

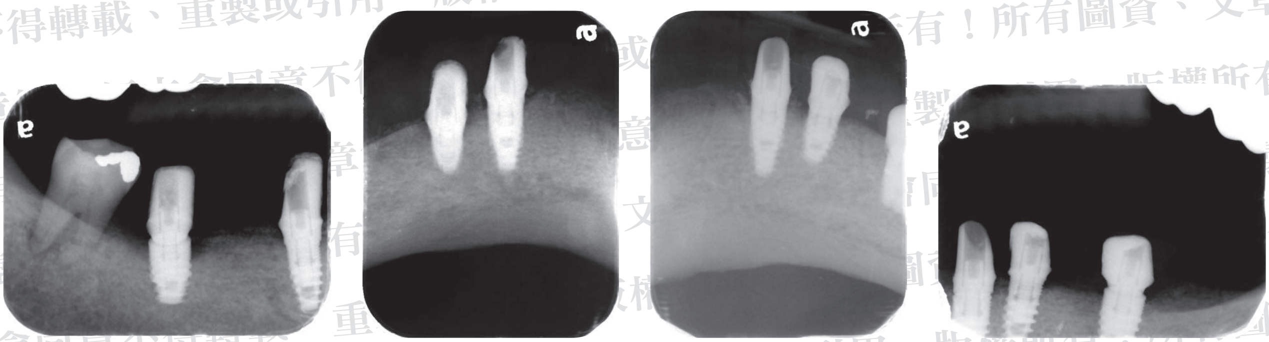

Fig.17-20 Custom abutment- PA film

marginal fit, and occlusion at the time of clinical insertion. A three-month period of observation thereafter demonstrated that the temporary restorations were stable for functional purposes, and the patient also reported being satisfied with the resulting esthetics. However, gingival recession was found at the 43 implant abutment, and a new abutment with marginal alteration was fabricated to replace the previous one.

The permanent restorations were designed as 46-x-44, 43-x-x-x-x-33, and 34-x-36 porcelain-fused-to-zirconia (Metoxit AG) FPDs based on the virtual models from the previous optical impression. In addition, a conventional impression with polyether (Impregum soft, 3M ESPE) was made for supplementary solid working casts. The interocclusal relationship was obtained with the use of a baseplate and Stonebite (Dreve Dentamid). The mounted stone casts were used to evaluate the marginal fit and occlusal relationship of the milled zirconia framework. A clinical try-in of the final restorations showed good marginal/internal adaptation, and only minor occlusal adjustment was needed. No functional or esthetic problem was found during the first year of follow-up.

Discussion

The longevity of an implant prosthesis depends on the framework design and the capacity of the framework to bear occlusal forces without inducing excessive stress-strain states around the peri-implant bone region[3,4]. The

Fig.21 Temporary restoration

Fig.22 Temporary restoration (occlusal view)

Fig.23-25 Temporary restoration

Fig.26 Permanent restoration (occlusal view)

passivity of the superstructure on the abutments of implant-supported prostheses is an important aspect of their success[5]. Therefore, it is crucial to obtain an accurate working cast. When utilizing the conventional implant prosthetic procedures, inaccurate working casts can be caused by several factors, such as dimensional distortion of the impression material, non-parallel implants/abutments, the impression coping design, and cast stone expansion[6-8].

The ideal features of intraoral scanners were first explored by Duet and Preston in the 1970s, followed by Mormann in the 1980s, with their investigations leading to the development of the CEREC system6. The most popular intraoral optical impression systems currently in commercial use are the CEREC AC (Sirona, Bensheim, Germany), Lava Chairside Oral Scanner (Lava COS; 3M ESPE, St. Paul, MN), E4D Dentist (D4D Technologies, LLC, Richardson, TX) and iTero (Cadent, Carlstadt, NJ), TRIOS (3Shape A/S, Copenhagen, Denmark), CEREC Omnicam (Sirona) 3D Progress (MHT, Verona, Italy), and True Definition (3M ESPE). These optical devices are now integrated into the digital workflows for implant prosthetic fabrication. As such, conventional impressions have been replaced by digital data acquisition with intraoral scanners and scanbodies specified for the implant system used. The scan data is then be processed into virtual models via computer reconstruction. If needed, the given virtual model can be printed out in the form of a solid working cast with stereolithographic or computer-aided milling techniques. The prosthetic design is evaluated with coordination between the relevant technicians and dentists before the fabrication of the final superstructure.

Fig.27-29 Permanent restoration - MI

Fig.30-32 Permanent restoration - Protrusion

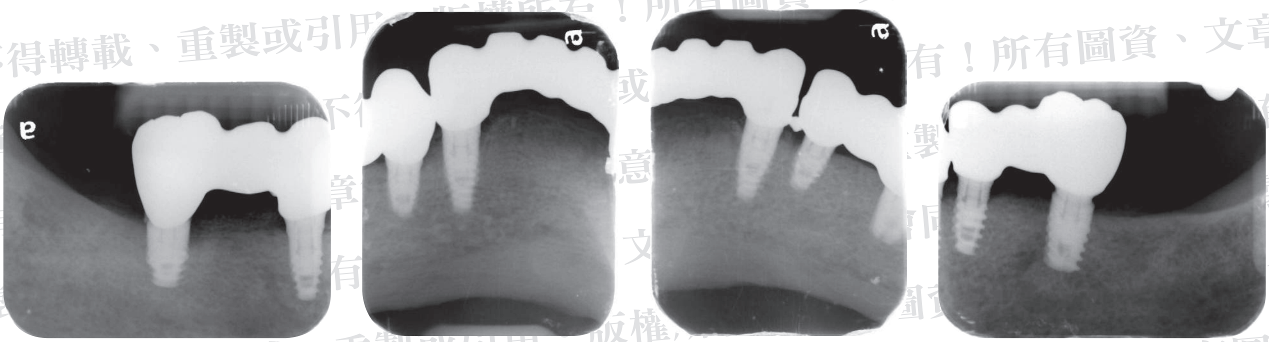

Fig.33-36 Permanent restoration - PA film

Recent studies have shown that full-arch digital acquisition is acceptable for clinical use[9,10]. Amin et al. compared splinted open-tray technique, CEREC Omnicam, 3M True Definition by 3 parallel implants and 2 angle implants and found the digital impression method was significantly more accurate than conventional technique[11]. Also, digital acquisition has been found to reduce the time and treatment costs for rehabilitation, and to improve patient compliance[12-15]. Kurz et al.[16] studied Cerec Omnicam intra-oral scanners and reported that the inaccuracies between the tooth and material surfaces, as well as the scan noise for the materials, were within the range of error for measurements used for conventional impressions and are therefore negligible. It is a powder-free system and less prone to soiling by the powder, therefore, it is not always necessary to have a dental assistant present[17]. Moreover, the improvement yielded by the minimized scanner tip makes the procedure less uncomfortable, particularly for patients with a sensitive gag reflex or fear of choking[18,19].

Digital prosthetic workflows also improve the efficiency and accuracy of framework designs. In this approach, design software automatically generates the initial design, and technicians can then fine-tune the structural details to achieve personalization for each patient. Furthermore, the transmission of digital data between technicians and dentists is low in cost, rapid, and reliable[12].

Computer-aided manufacturing (CAM) had been used in the fabrication of dental restorations for years prior to the widespread use of intra-oral scanners. In fact, the development of high-strength ceramic restorations benefited substantially from the use of CAD/

CAM manufacturing processes. A 2004 comprehensive review discussing the passive fit of implant superstructures concluded that CAD/CAM processing is either superior to or at least equivalent to the other manufacturing techniques and that both titanium and zirconia can be fabricated in highly accurate frameworks. However, due to concerns regarding the high percentage of veneering ceramic failure, that review did not recommend that zirconia be used for long-term restorations[20].

Atieh et al.[21] assessed the accuracy of intraoral optical impressions and concluded that although optical impressions obtained by the CEREC Omnicam were less accurate than those obtained in a conventional manner with vinylsiloxanether, they may be sufficiently accurate for quadrant impressions. In the present case report, the full-arch fixed implant prostheses were designed as three separate segments. The interimplant relationship within the span of a quadrant was accurate enough to allow for the simultaneous fabrication of abutments and zirconia prostheses. The outcome of these prostheses was found to be clinically acceptable after one year of follow-up. Intraoral optical impressions thus seem to constitute a new treatment alternative to the use of conventional elastomer impressions.

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