Case Report

restoration with the "parallel workflow" - A novel technique for multiple restorations

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Abstract

Digital dentistry has been popular in recent years due to increased accuracy and relatively friendly prices. Among all specialties, prosthetic dentistry was affected by the digital dentistry the most. Digitalization brings not only an increase in efficiency of making impressions, but also a change in the entire workflow. Especially in chair-side computer-aided design and computer-aided manufacturing (CAD/CAM), the clinical collaboration between dentists and technicians can significantly improve the predictability and efficiency of treatment. The aim of this clinical case report was to demonstrate a novel technique "parallel workflow", which allows the dentist to work in sync with the technician for multiple restorations.

Key words: Chair-side CAD/CAM, Digital dentistry, Full mouth rehabilitation, Parallel workflow

Introduction

Intra-oral scanning acquires a digital representation of the patient's oral and dental conditions. It is not only faster than traditional impressions[1,2,3,4,5,] but also eliminates the need for gypsum models and transportation[6]. Furthermore, digital scans of the original dental morphology can be used as reference during restoration design. Chairside computer-aided design and computer-aided manufacturing (CAD/CAM) has the additional advantage of allowing the clinicians full control of the final restoration, making changes and adjustments when needed[7].

Further, digital workflow dramatically shortens the distance between the dentist and the technician, and even in-office technicians are possible. In this case, while the doctor performs clinical treatment, the technician may process required prostheses of such patient simultaneously. This process is known as the "parallel workflow".

For multiple restorations, the parallel workflow is an indispensable tool for reliable and systematic design of the prostheses. By making use of manipulation of digital files, parallel workflow streamlines the digital workflow for maximal efficiency. This case report will demonstrate this parallel workflow.

Case report

Patient was a 73-year-old male. The chief complaint was poor chewing function and sensitivity of multiple teeth. Upon intraoral examination, this patient showed full-mouth severe wear with

Figure 1. Initial intraoral photographs, which shows full mouth severe worn down and multiple erosion lesions with dentin exposure.

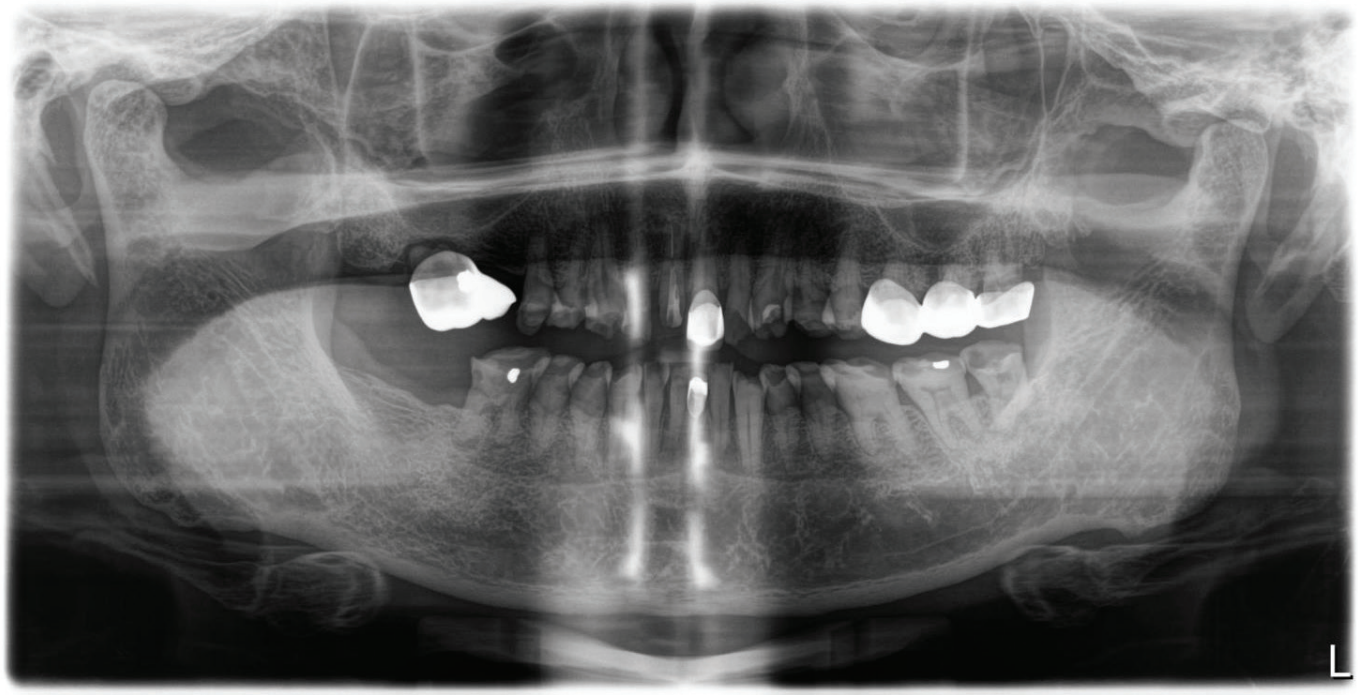

Figure 2. Panoramic film shows 17 severe bony destruction with ill-fitting prosthesis, 11 prior root canal treatment with crown dislodged, ill-fitting crown on 21, 26, 27 and 28, periapical lesion on 46 distal root.

lots of matched facet and multiple erosion lesions with cupping dentin exposure (Figure 1). X-ray showed 17 severe bony destruction with ill-fitting prostheses, 11 prior root canal treatment with crown dislodged, ill-fitting crown on 21, 26, 27 and 28, periapical lesion on 46 distal root (Figure 2).

After discussion, the tentative treatment plan is: 17 extraction, removal of all ill-fitting crowns and provisional restorations on 15-27 and 37-46 as shorten dental arch, which is restored in the new vertical dimension. After provisional prostheses is made, 11 root canal retreatment and 46 root canal treatment should be performed. After 3-month follow-up of new occlusal relationship and all infection control is done, final prostheses can be made.

After we reached an agreement with the patient, primary intraoral scanning (CEREC Primescan; Dentsply Sirona, USA) of upper and lower jaw with buccal scan bite registration in a new vertical dimension was done (Figure 3). The new occlusal vertical dimension (OVD) was determined by assessment of freeway space[8], with the aid of a calliper and a leaf gauge. As I exported this file to

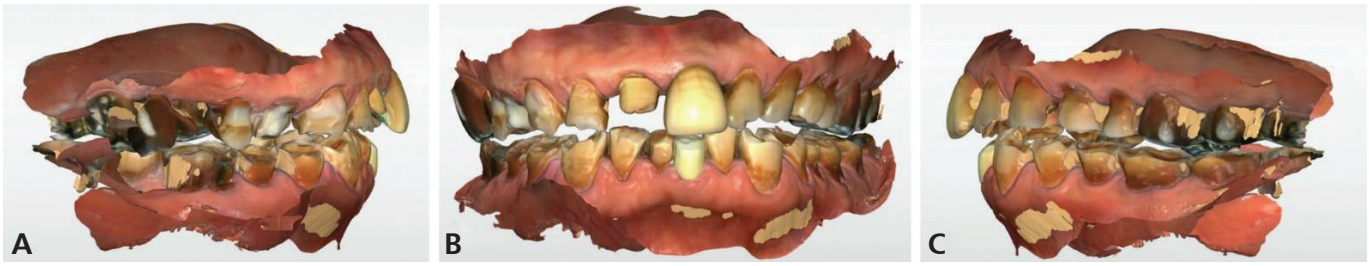

Figure 3. Primary intraoral scan models, with buccal scan bite registration in a new vertical dimension.

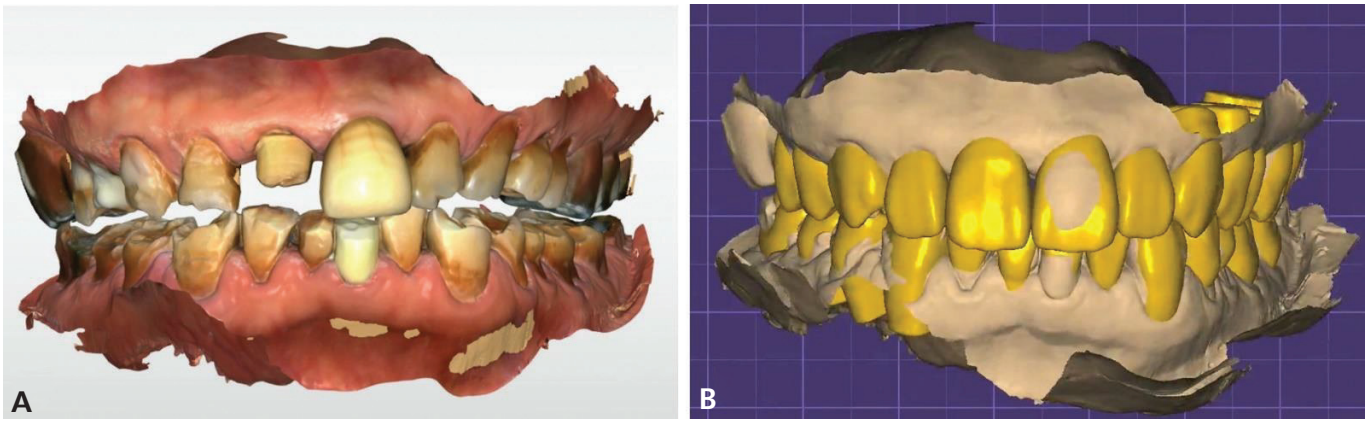

Figure 4. Diagnostic design with new vertical dimension.

Figure 5. Transfer diagnostic design into mouth with the silicon key made from 3D printed model.

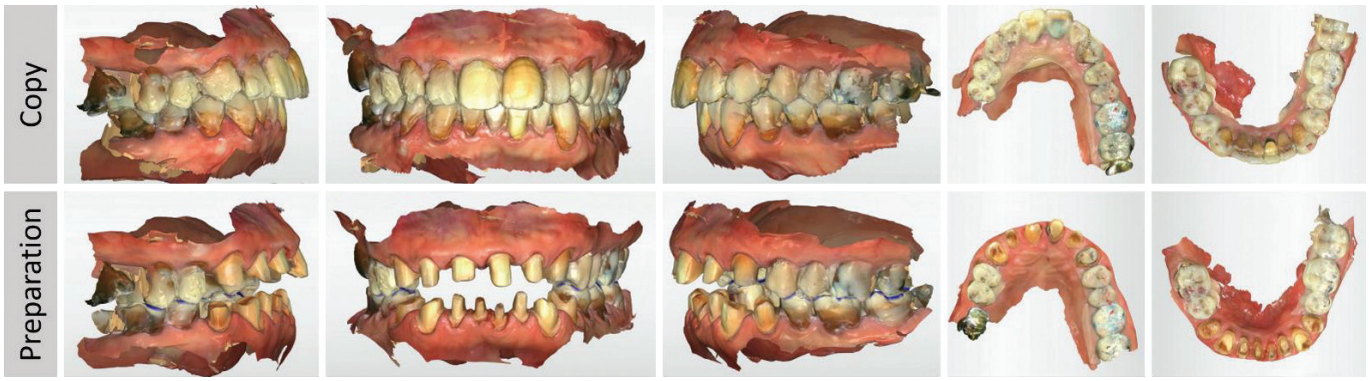

Figure 6. The "file 1", which combined the mock-up scan as copy and anterior preparation scan.

CAD software (exocad 2.3; exocad, Germany). In the software, I have designed the ideal prostheses design with mutually protected occlusion concept[9] (Figure 4) and upper anterior-six combine with extraoral photos in exocad Smile Creator module. Then I exported the design as .stl file, 3D printed it with 3D printer (Form2; Formlab, USA). This 3D printed prototype serves as the diagnostic model.

In the appointment of the provisional prostheses fabrication, before teeth preparation, the intra-oral mock-up was done by the silicon key (Aquasil; Dentsply Sirona, USA) made from the diagnostic model (Figure 5). After clinical occlusal adjustment of mock-up, patient felt comfortable with the new occlusal design and facial aesthetic. From here on, it is the "parallel workflow". The process is divided into several stages and is described as following.

Stage 1. The mock-up was scanned as the copy.

Stage 2. 13 to 23 and 34 to 44 were prepared and scanned with buccal scan bite registration. This file combined with mock-up scan and preparation scan, we called it "file 1" (Figure 6). Then "file 1" was

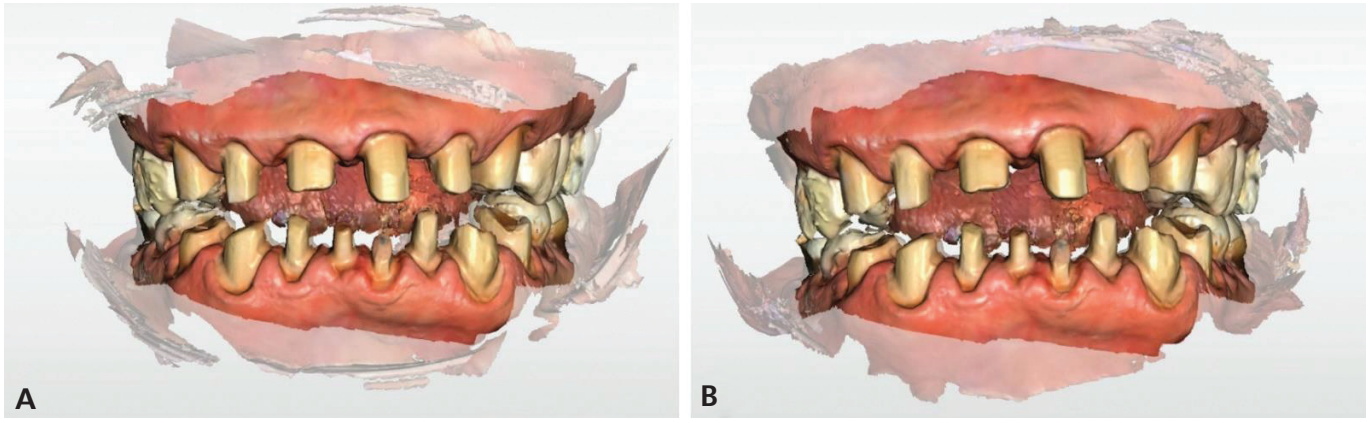

Figure 7. The "same" buccal scan bite registration can be used in 2 different treatment stages.

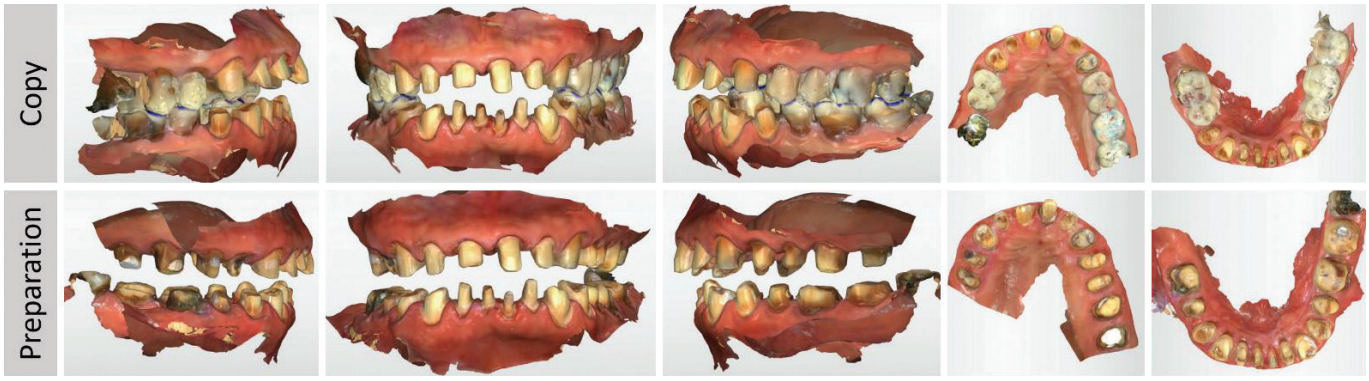

Figure 8. The "file 1", which combined the mock-up scan as copy and anterior preparation scan.

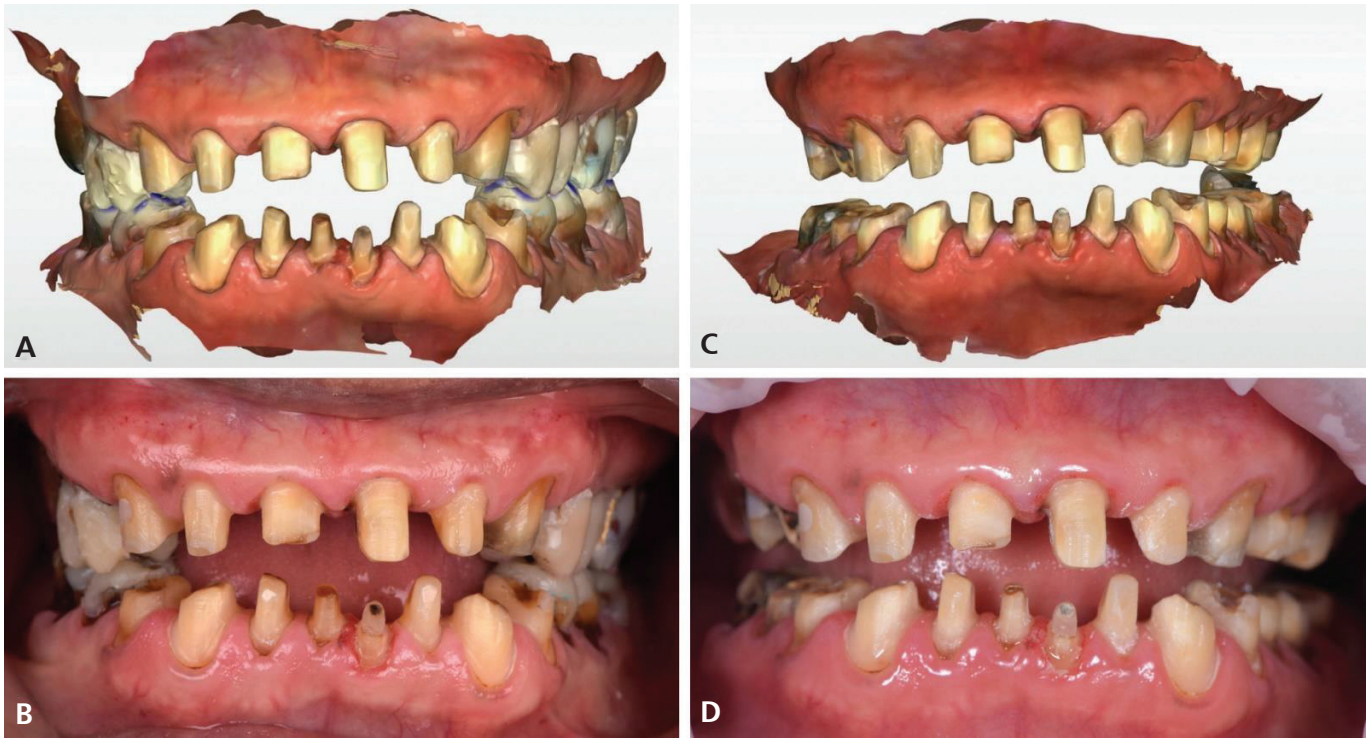

Figure 9. The "same" buccal scan bite registration can be used in 2 different treatment stages.

sent to the in-office laboratory. By using the mock-up copy as reference, the provisional restorations for 13 to 23 and 34 to 44 can be designed and fabricated.

Stage 3. During technician design (CEREC 4.6; Dentsply Sirona, USA) and mill (MCXL; Dentsply Sirona, USA) anterior provisional prostheses, I started to prepare rest of teeth. After I finished all posterior preparation, I copied the "file 1" as the new copy file first. Then scanned full upper and lower jaw, but kept previous buccal scan bite registration, which still work in matching upper and lower jaw (Figure 7). Now, this file combined with "file 1" and posterior teeth preparation, listed as

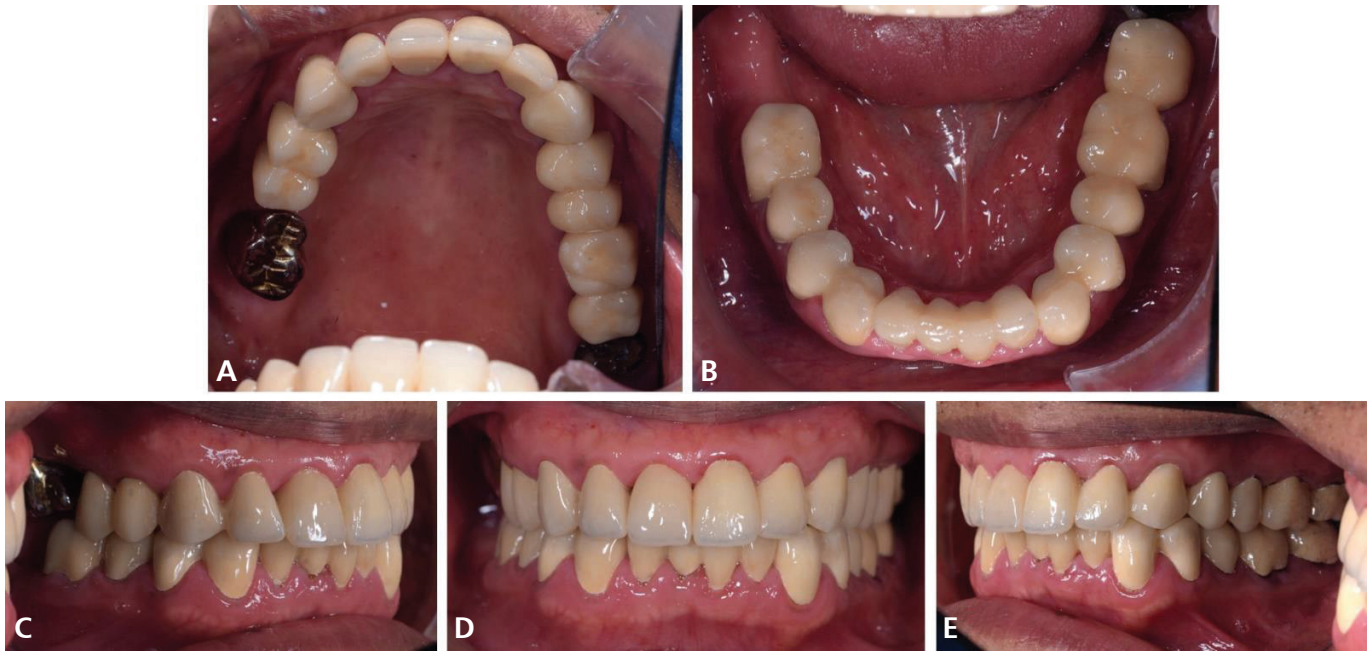

Figure 10. Full-mouth provisionals after delivery. The mock-up with diagnostic design was precisely transferred.

Figure 11. Extraoral comparison.

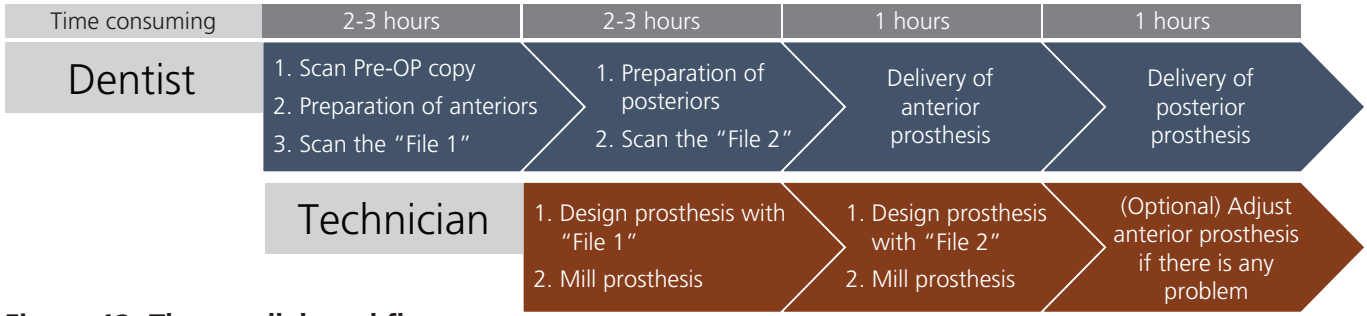

Figure 12. The parallel workflow.

"file 2" (Figure 8). Again, "file 2" was transferred to the in-office laboratory for the remaining provisional prostheses.

Stage 4. The anterior provisional prostheses were delivered after its completion around the same period of time. As the anterior teeth were cemented, the provisional prostheses of the posterior teeth were almost finished.

Stage 5. The posterior provisional prostheses were cemented. The parallel workflow finished (Figure 10,11).

After this appointment, this patient is undergoing infection control and occlusal adaptation now.

Discussion

With "parallel workflow", dentists can work with technicians synchronously (Figure 12), which contains several benefits. First, this can greatly improve efficiency and eliminate time consuming procedures which allows the dentist to concentrate on teeth preparation and cementation. The dentist can start delivery immediately after completing the

preparation. This process can be used not only in provisional prostheses, but also in single-visit final prostheses.

Second, under such segmentation procedure, the occlusion relationship between the upper and lower jaws can be controlled well. Suppose we have a full-mouth scan and bite record after all the teeth prepared, one is that the upper and lower buccal scan for bite registration lacks a stable support and is prone to error; the other is that this model will be very difficult in mapping with the preoperative mock-up model. Because the difference is too large. This will result in the inability to accurately replicate the patient's occlusal design that has been adjusted.

Third, because the technician's design is to copy the dentist's mock-up, and this mock-up has been occlusal adjusted at the very beginning, as long as we can control the precision of the intraoral scanning and milling procedure, the finished prostheses will be very predictable. For example, this patient did not need any occlusal adjustment during these provisional prostheses delivery.

But in the implementation of this process, there is a point that must be paid attention to, that is, the contact of the adjacent teeth at the segment point (e.g. 13 and 14 in this case) must be perfectly copied in the design. Otherwise, because this is designed in two separate files, it is not possible to see the contact area directly of these two tooth designs during designing.

This case report demonstrates the clinical efficacy and reliability of parallel workflow for multiple restorations. This workflow can be used to accurately transfer our prosthetic designs to provisional prostheses or final restorations, which also shows the dramatic changes in the clinical prosthetic workflow of chair-side CAD/CAM and digital dentistry.

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