

Dr. Anthony Mak
W Dental

Placement of **implant-retained provisional bridge** using guided surgery and a full digital workflow



Solutions featured:

3Shape TRIOS
3Shape Implant Studio
3Shape Dental System

Background

The utilization of a full digital workflow eliminates the disadvantages and difficulties commonly associated with conventional analog techniques. Some of these common limitations include patient discomfort commonly associated with the impression procedure, the potential for distortion of the impression material and inaccuracies of subsequent steps in the manufacturing process, the potential of damage to the dental cast and delay, due to logistics of sending lab work between the dental practice and the laboratory.

These disadvantages do not occur in the full digital workflow where the impression is taken with an intraoral scanner and the design of the prosthesis is done on CAD software. The data from the digital impression is also simply sent over the Internet, significantly reducing the time needed to manufacture the wax-ups and prosthesis.

The following case report presents a fully digital workflow from the treatment planning to the guided surgery phase in the provision of an immediate implant retained fixed provisional bridge.

There are many advantages of a fixed provisional over a removable provisional that includes:

- stability of the prosthesis and associated implants
- aesthetics
- less interference of speech patterns
- better mastication and comfort for the patient
- most importantly minimize soft tissue complications associated around the peri-implant site

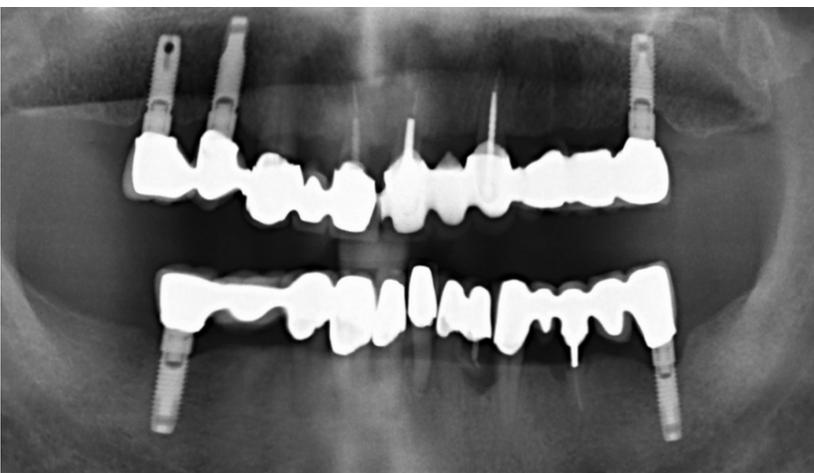


Fig. 1. Failed lower dentition and very old sterioss implants

The patient requested for his lower dentition to be rehabilitated with the use of dental implants due his good perception of longevity stemming from his past treatment experience. It was the patient's brief and request that the procedure be simple and not time consuming due to *several factors*. These factors included:

1. His struggle to keep his mouth open for long periods of time.
2. Difficulty in tolerating conventional impression techniques.
3. His perceived age and health status.

In treatment planning the case, the following *criteria* were established with the goal of delivering a fixed implant retained provisional bridge.

1. To deliver the complete treatment process in 3 appointments with the appointments being:
 - The consultation and treatment planning phase utilizing intraoral scanning with the 3Shape TRIOS intraoral scanner, BioHorizon's Digital Library, 3Shape Implant Studio and a CBCT from Instrumentarium Maxio OP.
 - Extraction of all lower natural teeth and immediate placement of implant fixtures utilizing a fully guided surgical placement protocol. An intra-oral scan will then be completed utilizing implant scan markers to allow the fabrication of the provisional prosthesis.
 - Delivery of a fixed provisional implant retained bridge.
2. To deliver the planned treatment utilizing a full digital protocol without the use of conventional impression techniques.
3. For implant surgery to be fully guided keeping the surgical procedure simple, accurate with minimal trauma and discomfort.

Case information

A patient in his early 80s presented with the chief complaint of recurrent pain, discomfort and swelling from his lower dentition. An examination revealed moderate to advanced bone loss of his remaining mandibular teeth. Peri-apical radiolucencies associated with chronic apical periodontitis were also diagnosed on the lower anterior segment. His lower dentition at the time of presentation was restored with fixed crown and bridge prosthesis with implant fixtures on the 37 and 47 site, placed 20 years prior. The implant fixtures were abutments for fixed bridges that were linked to natural teeth abutments (Fig. 1). The patient's health history was unremarkable.

Appointment 1.
The Consultation and Treatment Planning

The Pre-Operative presentation. Failing lower dentition that was heavily restored with metal ceramic crowns on the anterior segment, and implant to teeth bridge on the posterior segment (Fig. 2-4).



Fig. 2. The Pre-Operative Presentation – Occlusal View



Fig. 3. The Pre-Operative Presentation – Labial View

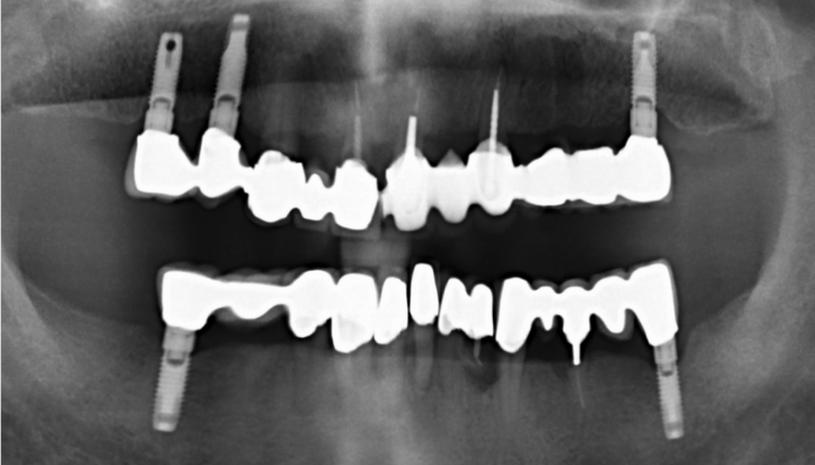


Fig. 4. The Pre-Operative Presentation – OPG



Fig. 5. The Preoperative Intraoral Scan – Occlusal View



Fig. 6. The Pre-Operative Intraoral ScanView – Labial View



Fig. 7. Virtual extractions for digital implant planning – Labial view

3Shape TRIOS intraoral scanning of the full arch. Virtual extractions and BioHorizons implant fixture planning on 3Shape Implant Studio using the BioHorizons digital library (Fig. 5, 6).

The teeth were virtually extracted using 3Shape Implant Studio software, leaving behind the 47 and 37 implant prosthesis. These crowns will act as reference points, stability anchors for the implant surgical guide. By maintaining the distal abutment implant prosthesis, we will also maintain the occlusion and VDO (Fig. 7, 8).

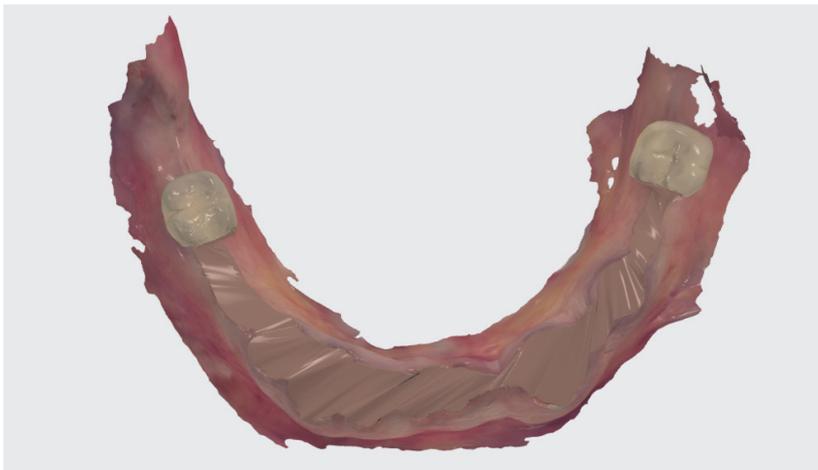


Fig. 8. Virtual extractions for digital implant planning – Occlusal View

Distal implants left in situ. Still very well integrated and good to maintain occlusion and vertical dimension. Also will be using the abutment crowns as locators for the surgical implant guide as they will give ideal stability.

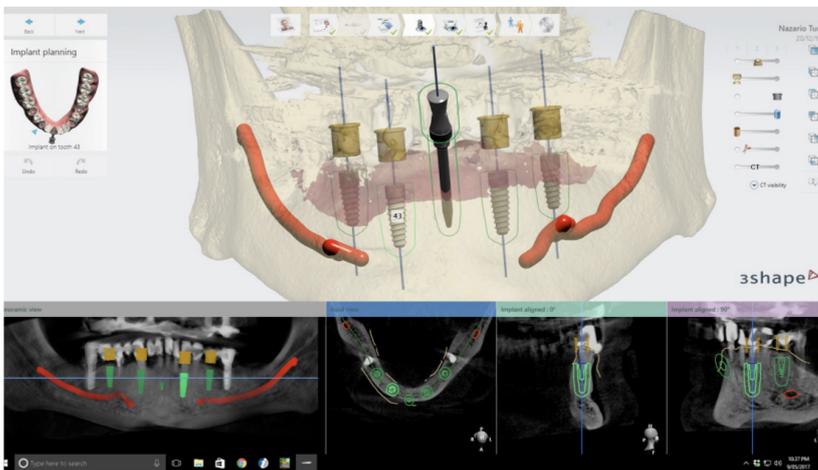
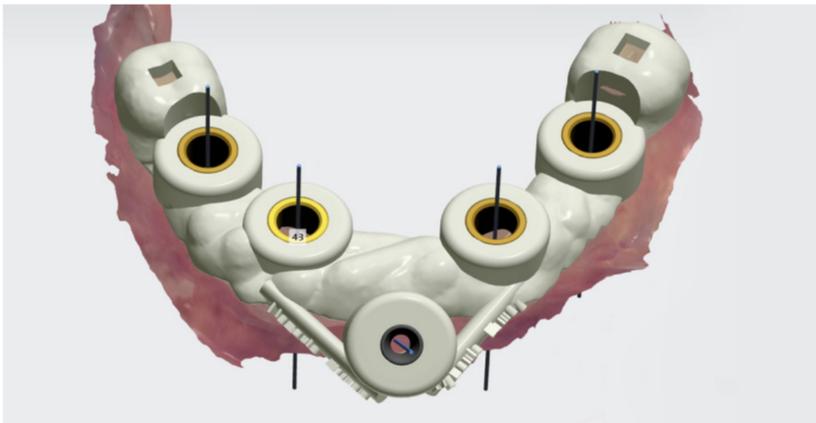
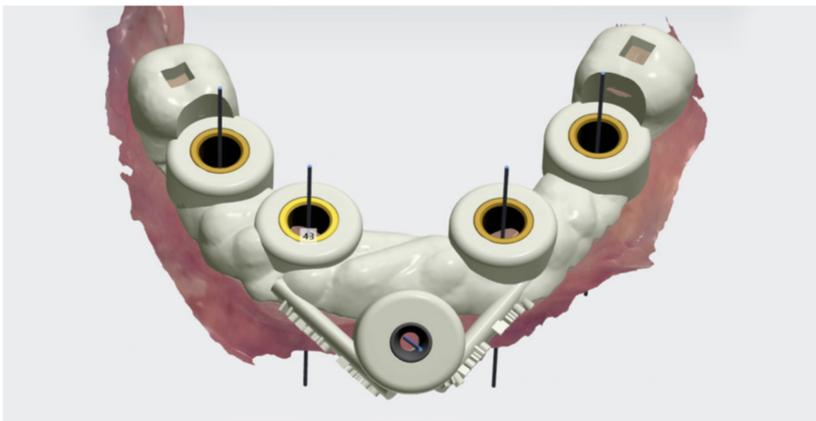
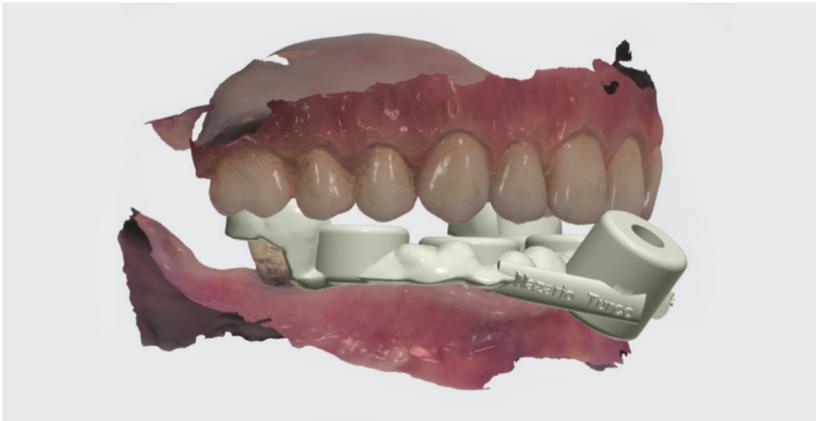


Fig. 9. Virtual Implant Treatment Planning with 3Shape's Implant Studio.

Implant Planning in 3Shape Implant Studio – Four BioHorizon Tapered Internal Implants with a guide-pin to maintain stability of 3D printed surgical guide (Fig. 9).



Then a 3D surgical guide was designed using 3Shape Implant Studio. We used the distal abutment teeth and a guide pin in the anterior mandible to create trapezoidal stability of the surgical guide in the mouth during surgery. Stability of the guide is extremely important in immediate extraction of full arch cases (Fig. 10–13).



Placing the guide pin/osteotomy in immediate extraction cases can sometimes be less accurate as the guide can rock on the soft tissue area where the extractions just took place. To avoid this from occurring, a simple 3D guide was designed to place the guide pin osteotomy when the teeth were still present. Hence once the teeth were extracted, the implant surgical guide was easily referenced and fitted without any loss of accuracy, using the distal implant prosthesis and the anterior guide pin osteotomy that was already placed with the 1st guide pin 3D guide. This is easily achieved with 3Shape Implant Studio.



The problem with immediate extractions and guided surgery is that there are no reference points for the surgical guide to sit after the extractions. Using soft tissue and opposing occlusions is less than ideal and not as accurate as it should be. The beauty of having a guide-pin surgical guide is we were able to place the guide pin osteotomy prior to extraction of the teeth. Hence this guide was using the hard tissue of the existing teeth prior to extractions occurring. Having the guide holes, we were able to accurately locate our second implant surgical guide once all the extractions and full clearance had occurred.

Fig. 10–13. 3D surgical guide design and planning with 3Shape Implant Studio



Fig. 14. Sectioned bridge prior to extraction

Appointment 2.
The surgical appointment

Sectioning of long span bridge prior to extraction of all remaining teeth (Fig. 14).

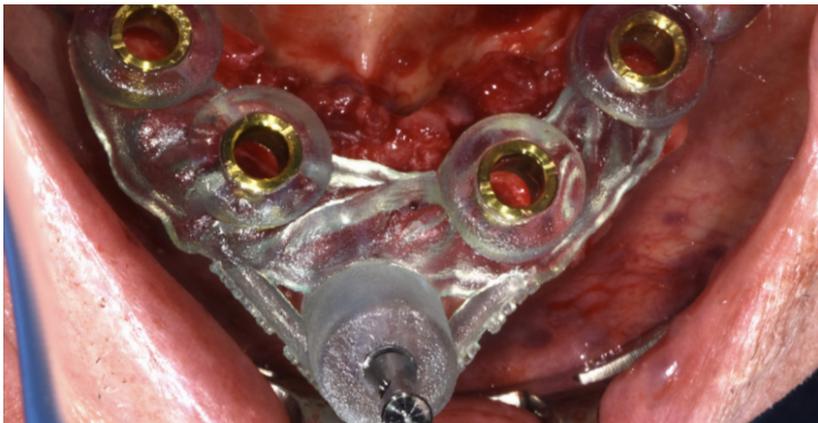


Fig. 15. Digitally planned Implant surgical guide in situ

Implant surgical guide in place after full clearance and osseous crestal reduction (Fig. 15).



Fig. 16. Completed guided implant fixture osteotomy



Fig. 17. Digital scan markers positioned to allow intraoral scanning of the placed implant fixtures

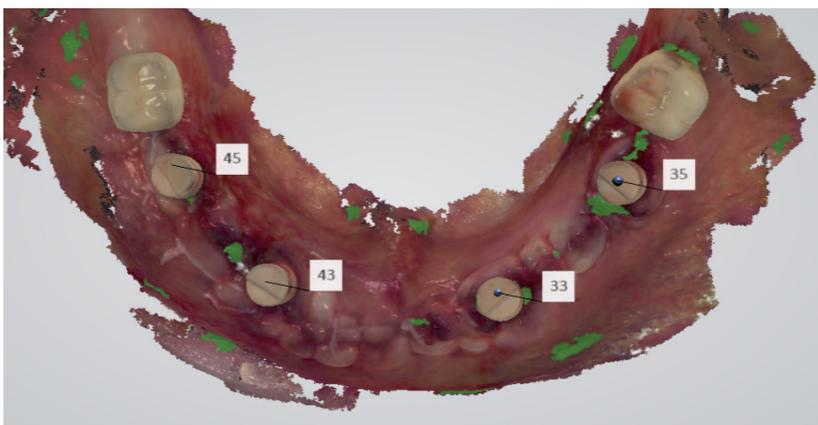


Fig. 18–20. 3Shape TRIOS intraoral scan after implant surgery

Immediately after surgery, BioHorizons snap on digital markers were placed and a 3Shape IOS scan was performed immediately after surgery and soft tissue closure had taken place. I find this option more accurate than planning the prosthesis at the same time as implant planning. There are tolerances that may affect passive fit in multiple implant cases (Fig. 17).

Having the ability to scan the occlusion and the scan markers in a three-dimensional spatial environment allows this workflow to be much more accurate and time saving when compared to the analog workflow (Fig. 18–20).

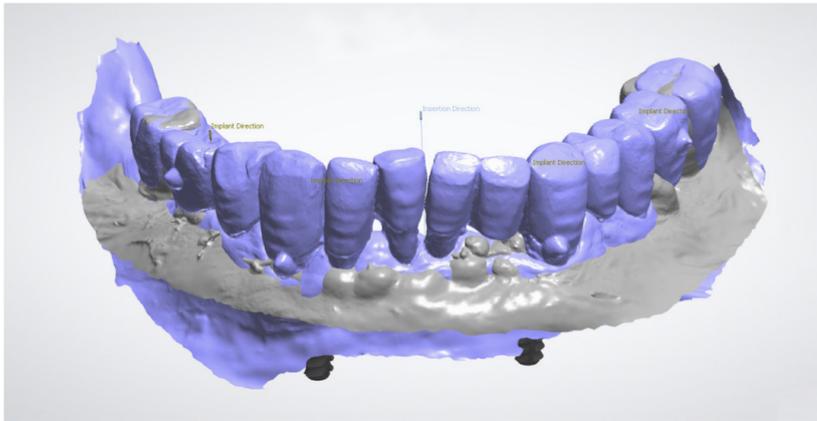
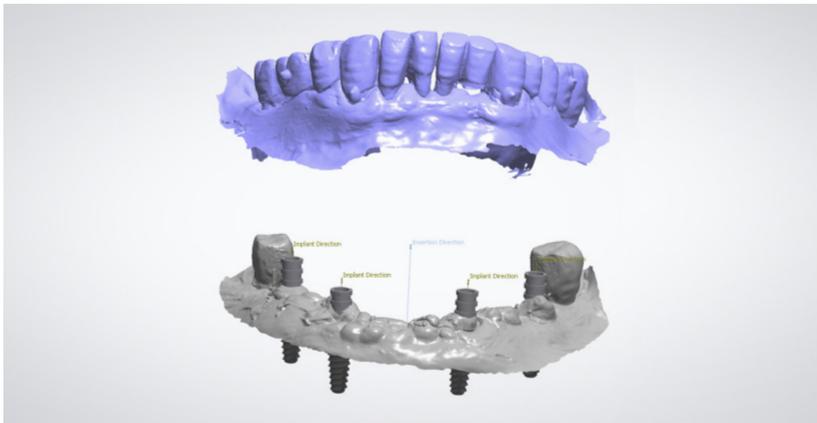
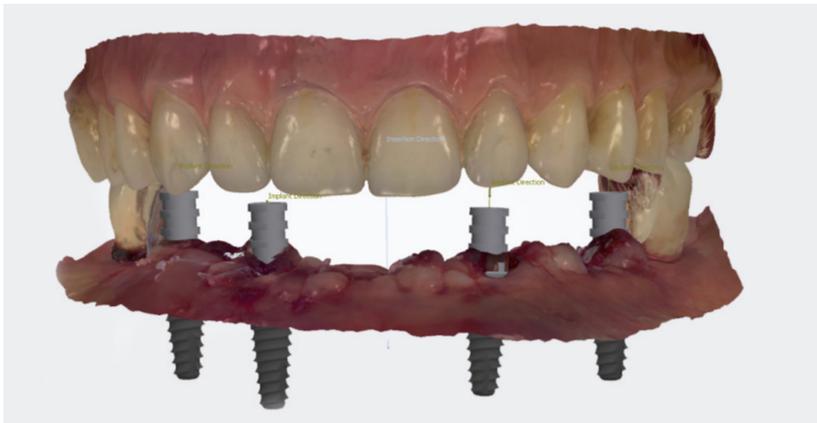


Fig. 21–22. Superimposition of the preoperative scan over the intra-oral scan of the implant fixtures

The Laboratory component – Brad Grobler Oral Dynamics

Superimposing the pre-operative scan for fabrication of the temporary bridge allows an exact copy of what the patient had prior to extractions. With the ability of the previous picture where we were able to scan the occlusion, the digital workflow allows for an effortless prosthetic portion of the whole treatment process (Fig. 21, 22).



An immediate temporary bridge was then designed and milled on non-engaging temporary cylinders (Fig. 22–24).

The treatment plan was to fabricate the immediate prosthesis with a PMMA framework with pink composites and stains.

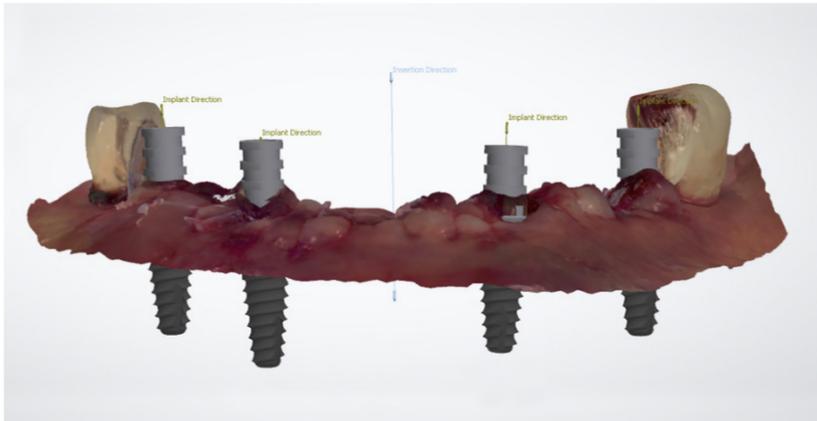


Fig. 22–24. Designing the immediate temporary bridge



Fig. 25. Digital mock-up of the prosthesis

The beginning of the CAD design by ceramist Bradley Grobler. You can see on this picture that he was able to incorporate all the information/data on one screen making the prosthetic design also very simple (Fig. 25).

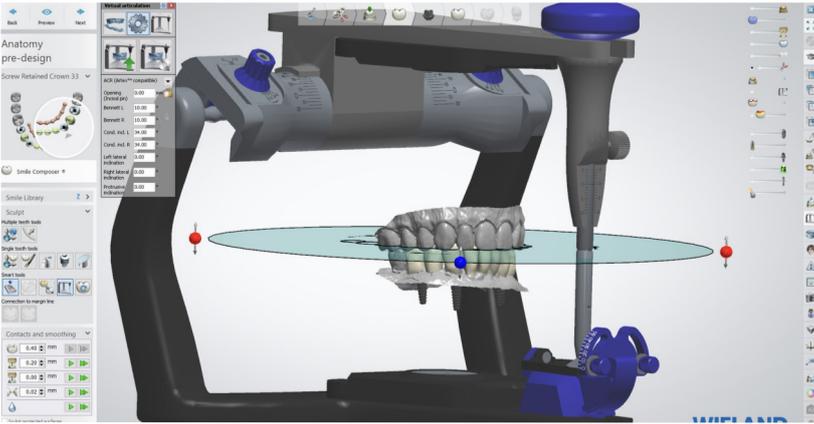


Fig. 26. Virtual articulation using 3Shape Dental Design Software

Virtual articulation in 3Shape Dental Design software to ensure there were no lateral or excursive interferences (Fig. 26).



Fig. 27. Virtual planning of the occlusal scheme

Checking the occlusion on the virtual articulator (Fig. 27).



The wonders of digital implant dentistry! With good planning and use of technology, we were able to achieve a direct to fixture prosthesis. No multi-unit abutments were required to achieve perfect prosthetic screw access channels (Fig. 28, 29).

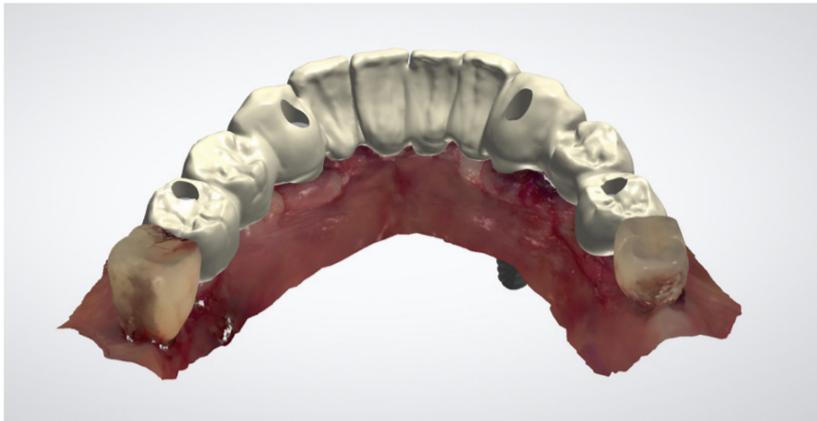
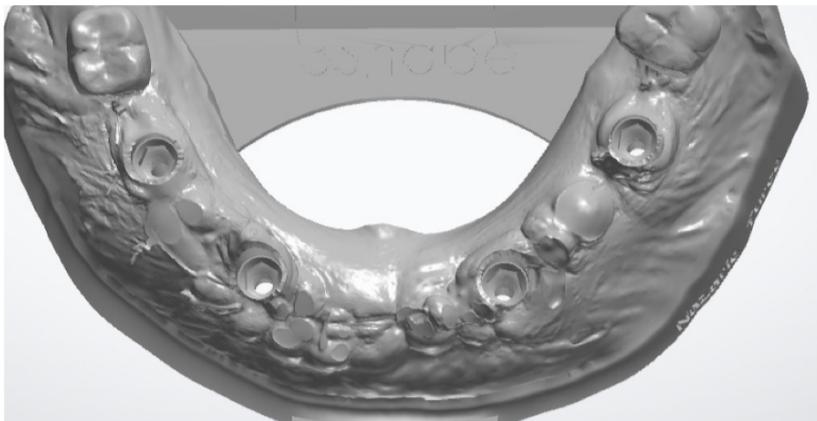


Fig. 28–29. Development and designing of a direct to fixture prosthesis



BioHorizons implant library – digital metal analogs or 3D printed analogs. BioHorizons have a complete digital library that allows simplicity in the digital workflow to work synergistically with their implant system. Having both option for implant model fabrication allows for easy logistics in the ability to cover most scenarios (Fig. 30, 31).

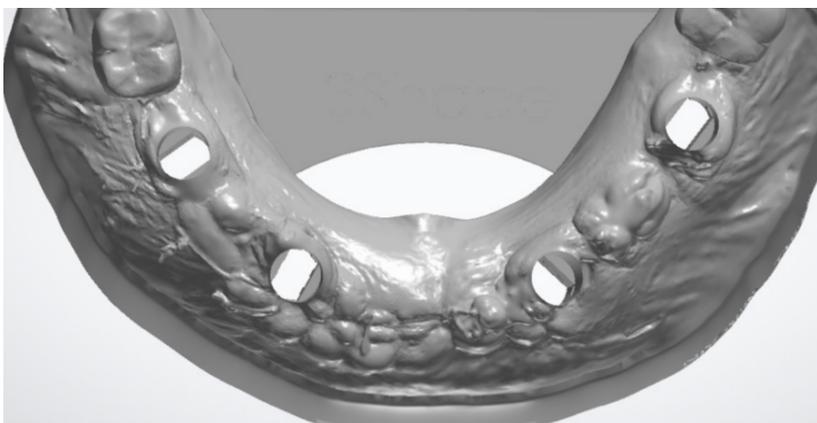


Fig. 30–31. Implant model fabrication utilising BioHorizon Implant Library



Milled temporary bridge on non-engaging temporary cylinders. Pink composite and GC Optiglaze were used to create an aesthetic provisional bridge (Fig. 32–35).



Fitting surface showing non-engaging temporary cylinders.



Fig. 32–35. Completed milled provisional bridge on non engaging temporary cylinders



3D printed models. The model on the left have the implant connection printed in the 3D model. The model on the right have metal digital implant analogs inserted into the model. Both techniques readily available on the BioHorizons digital library (Fig. 36–37).



Fig. 36–37. 3D printed models



Fig. 38. 1 week post surgery

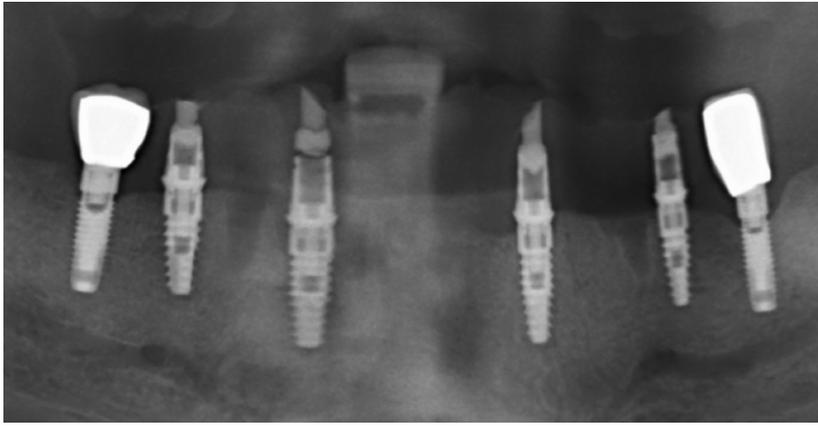


Fig. 39–41. Inserted milled temporary bridge

Appointment 3 Fitting the temporary prosthesis

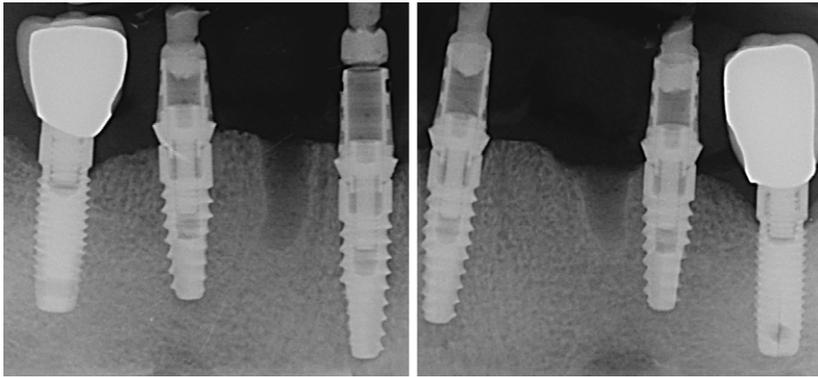
One week post surgery. Guided surgery allows for a much more minimally invasive approach leading to much better healing and better morbidity for the patient (Fig. 38).

One week post surgery – temporary bridge fitted and in situ (Fig. 39–41).



OPG showing implant angulation and placement (Fig. 42).

Fig. 42. Fixture angulation review – OPG view



Periapical xrays to confirm fit of temporary bridge (Fig. 43).

Fig. 43. PA for seating and fitting verification



Final image of the lower implant bridge in the patient's mouth. Start to finish in 3 appointments.

About Dr. Anthony Mak

Dr. Anthony Mak graduated with multiple awards from the University of Sydney in 2002. He then went on to complete his Post Graduate Diploma in Clinical Dentistry (Oral Implants).

Dr. Mak is a much sought after speaker, especially in the field of direct restorative dentistry. He has lectured extensively in Australia, New Zealand and across Asia; and his hands-on workshops have gained such popularity that they are almost always booked out soon after registrations open. He is also gaining great popularity on the International circuit.

Anthony is the author of a compelling compendium detailing both anterior and posterior direct composite cases; the clinical photography can only be described as exceptional. He has published numerous case studies and articles for local and international dental bodies and associations.

Anthony's interest lies in dental technologies, advances in materials and techniques; and he has a unique understanding of CAD-CAM digital dentistry.

Anthony runs two practices in metropolitan Sydney, focusing on quality modern comprehensive care, including implant dentistry. He is also a clinical consultant for ZFX, a global leader in dental CAD-CAM technology, and is an opinion leader for several companies focusing on development in new dental technologies.

Dr. Mak talks about full digital workflow advantages

The case presented illustrates how advances in digital technologies can provide clinicians with the tools for diagnosis, treatment planning, placement and restoration of dental implants in a truly transformative way.

Simplification of clinical protocols, increased accuracy over conventional analog techniques and improved patient comfort and outcomes are compelling reasons as the benefits of a full digital workflow in the provision of implant retained restorations.

A main advantage of the full digital workflow is the ability and the simplicity in accurately diagnosing and virtually planning the implant position using the digital scan and CBCT data. This in turn, allows the fabrication of an accurate surgical implant guide that allows the surgical protocol in the placement of the implant fixtures to be accomplished in a simplified and predictable manner.

Full digital workflows in implant treatment planning and surgical workflows in short has the following benefits:

1. Reduced the number of patient visits for the procedure.
2. Provides for a simplified and predictable workflow in implant treatment planning and guided surgery.
3. Provides better angulation and accuracy of placement of single and multiple implants.
4. The prosthetic design process is much simpler and easier.

It should be noted that the software utilized in the delivery of this case (the BioHorizons digital Library and the 3Shape TRIOS® intraoral scanner, 3Shape Implant Studio and 3Shape Dental Designer) has allowed the following aspects of the implant workflow to be achieved:

- Allows the clinician to accurately assess bone volume, bone density and restorative space.
- Allows the location of the prosthesis to be merged from a digital wax-up (or in this case the patient's pre-operative dental setup) and pre-operative scan for prosthetically driven implant planning.
- Facilitates accurate and safe planning of implant placement and critical anatomical landmarks such as nerves, sinuses and adjacent teeth can be identified and avoided through safety zones set up in the planning software.
- Allow the fabrication of a highly accurate surgical guide or stent. Compared to free-handed surgery, computer generated surgical guides significantly reduces the chance for positional errors at the time of implant placement. (Di Giacomo et al J Periodontol. 2005)
- Digitally designed and fabricated provisional restorations can be manufactured before or immediately post-surgical procedure for immediate temporization.

About 3Shape

3Shape is changing dentistry together with dental professionals across the world by developing innovations that provide superior dental care for patients. Our portfolio of 3D scanners and CAD/CAM software solutions for the dental industry includes the multiple award-winning 3Shape TRIOS® intraoral scanner, the 3Shape X1® CBCT scanner, as well as market-leading scanning and design software solutions for both dental practices and labs.

Two graduate students founded 3Shape in Denmark's capital in the year 2000. Today, 3Shape employees serve customers in over 100 countries from 3Shape offices around the world. 3Shape's products and innovations continue to challenge traditional methods, enabling dental professionals to treat more patients more effectively.

Let's change dentistry together

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