Dr. Anthony Mak
W Dental

Screw retained implant crown restoration with digital workflow using scan body and surgical guide

Solutions featured:

3Shape TRIOS
3Shape Implant Studio
3Shape scan bodies
3Shape Dental System

3shape

Fig. 1

Introduction

Digital technologies in the field of implantology have paved way for simplified and predictable protocols for treatment planning, surgical placement and prosthetic implant rehabilitation in an interdisciplinary approach.

The use of 3Shape's TRIOS intraoral scanner, Implant Studio and Dental System software allows the seamless delivery of what traditionally was deemed a procedure reserved only for the specialist or the truly gifted practitioners.

The use of 3Shape's scan bodies provided a fast, easy and accurate acquisition of the digital fixture level impression and the seamless transfer of the digital information to the 3Shape Dental System software for the design process of the final restoration.

Case Information

This case study describes the full digital workflow in the planning, immediate guided surgical placement and the prosthodontic restoration of the lower right first premolar (#44) with a screw-retained implant supported crown.

Pre-operative peri-apical radiograph. (Fig. 1)

Treatment

Stage 1 Diagnostic Record Collation and Treatment Planning Phase

The patient complained of pain and mobility from the lower right first premolar (tooth 44). A comprehensive examination revealed that the lower right first premolar had class 2 mobility and deep periodontal pocketing localized to the tooth. The tooth was buccally displaced due to crowding of the lower arch, which also contributed to the localized periodontal defect.

A delayed vitality response was also noted when tested compared to adjacent control teeth.

Following a full evaluation of all the clinical information, the extraction of the 44 followed by the immediate placement of an implant fixture was presented and accepted by the patient.

Following the completion of the clinical examination, a 3D CBCT radiographic scan was taken to obtain the necessary DICOM data. (Fig. 2 i-ii)

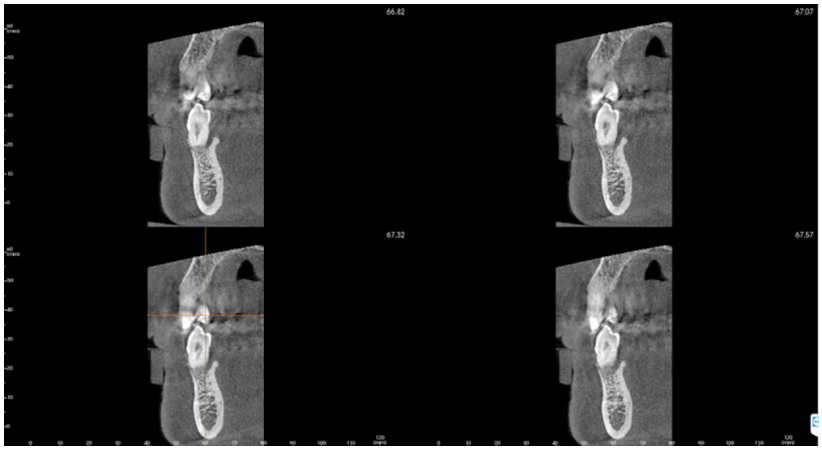

Fig. 2 (i)

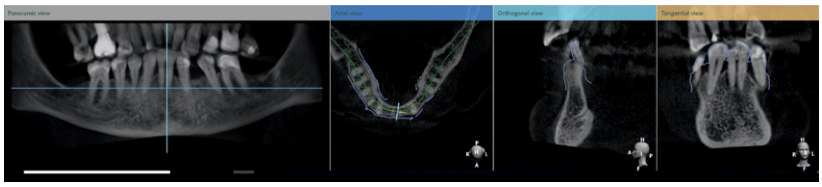

Fig. 2 (ii)

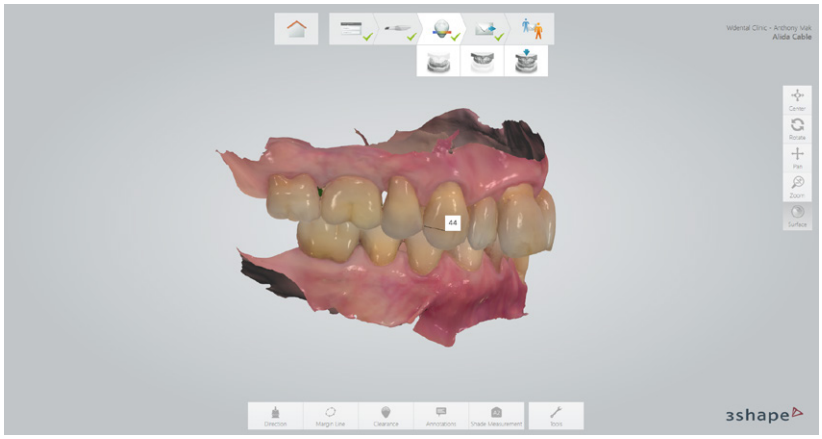

Fig. 3 (i)

Fig. 3 (ii)

Fig. 3 (iii)

Full arch intraoral surface scans (digital impressions) of the maxillary and mandibular arches as well as the patient's occlusion (bite) were then taken with the use of the 3Shape TRIOS intraoral scanner.

Pre-operative TRIOS surface scans. (Fig. 3 i-iii)

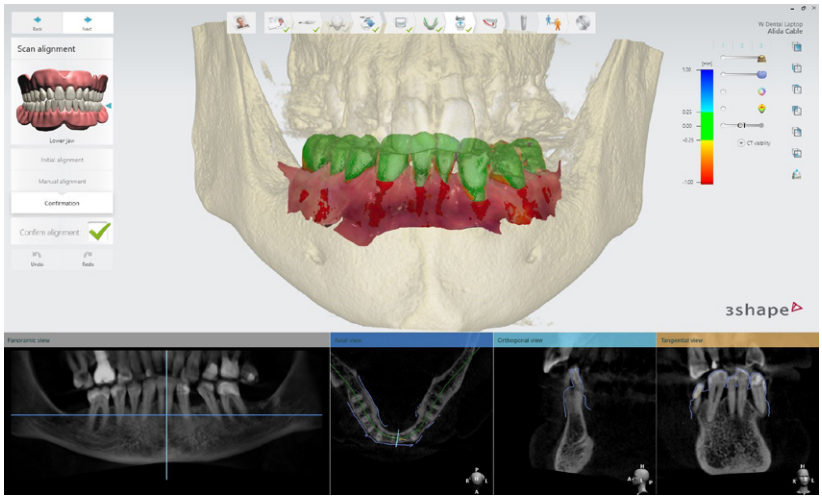

Fig. 4 (i)

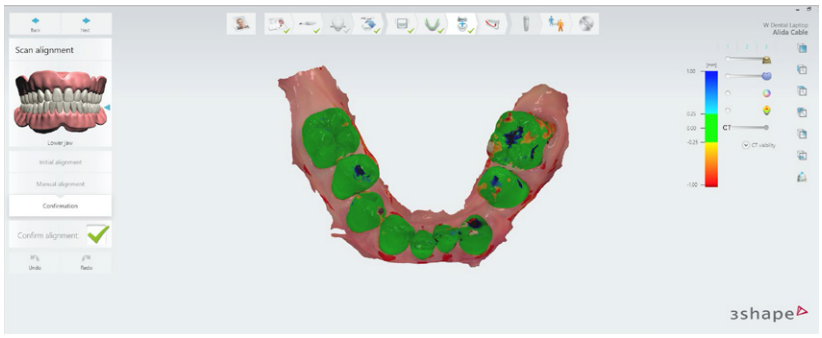

Fig. 4 (ii)

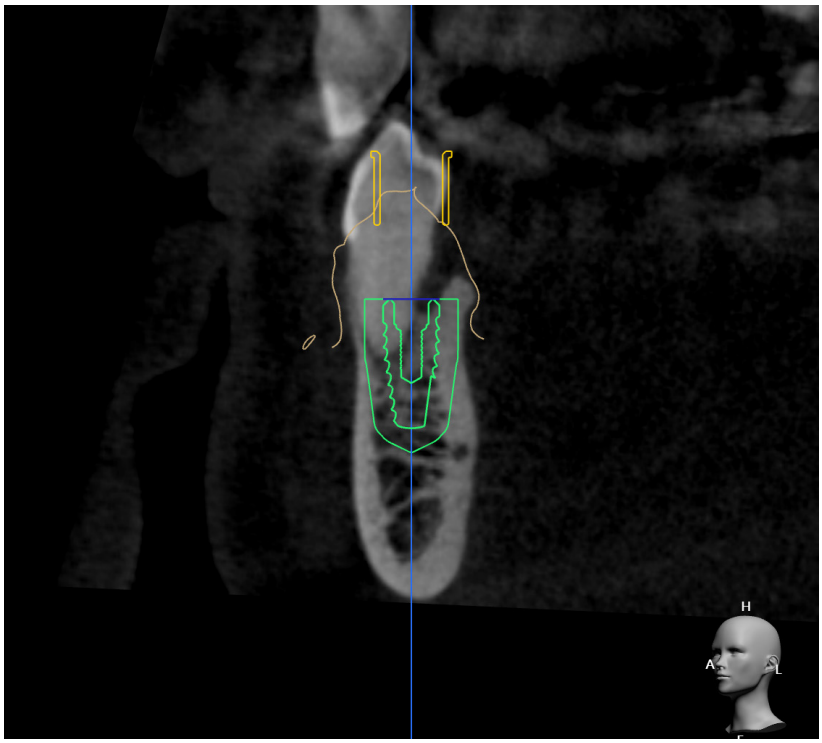

Fig. 5 (i)

Stage 2 – Digital Implant Planning and Surgical Guide Fabrication

The patient's TRIOS scans and the DICOM CBCT data were then assimilated and superimposed in 3Shape Implant Studio software. The accuracy of this merge is confirmed using a differential color map that shows how close the alignment is visually.

Screenshot of the differential color map.
Note green indicates <0.25 mm difference. (Fig. 4 i-ii)

The confirmed file merge will then create an accurate virtual rendering on which the digital planning of the implant placement from a restorative perspective can be performed. There is an extensive library of all major implant brands and guide sleeves incorporated into the 3Shape Implant Studio software. A digital BioHorizon implant fixture and the associated digital library were used for the planning of this case.

Digital planning of implant placement based from a restorative perspective. (Fig. 5 i-v)

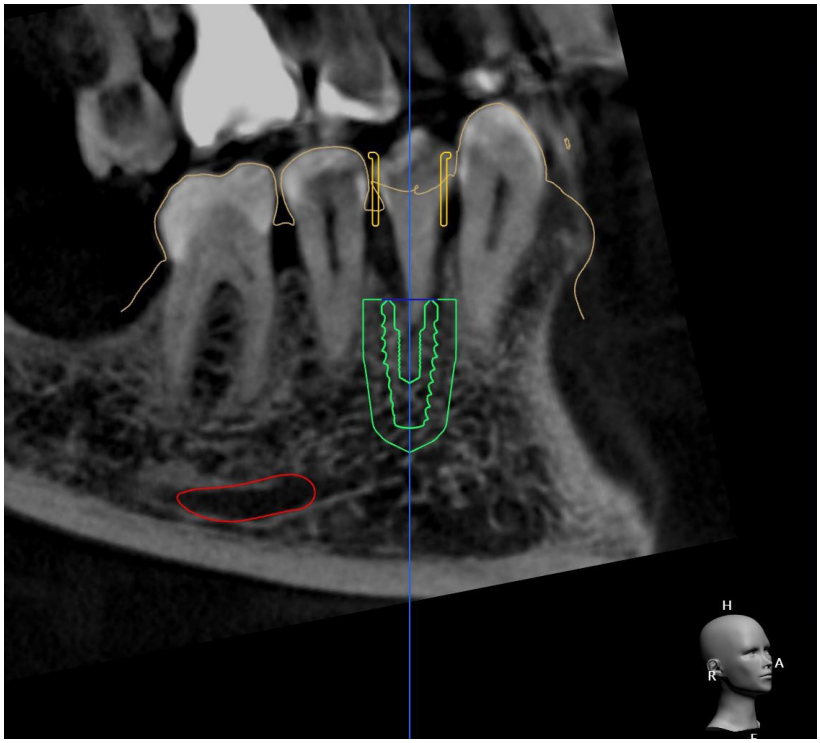

Fig. 5 (ii)

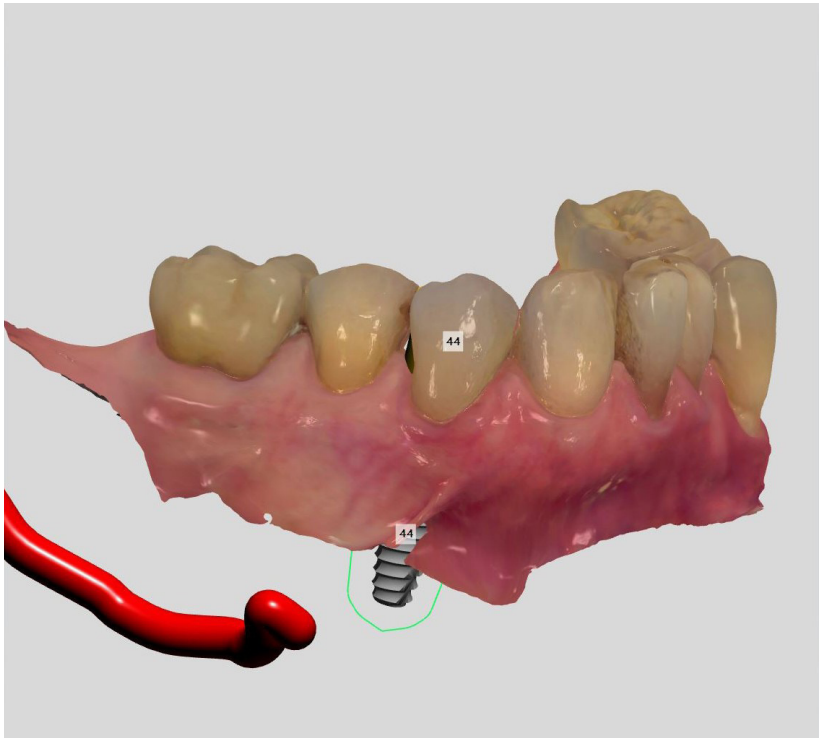

Fig. 5 (iii)

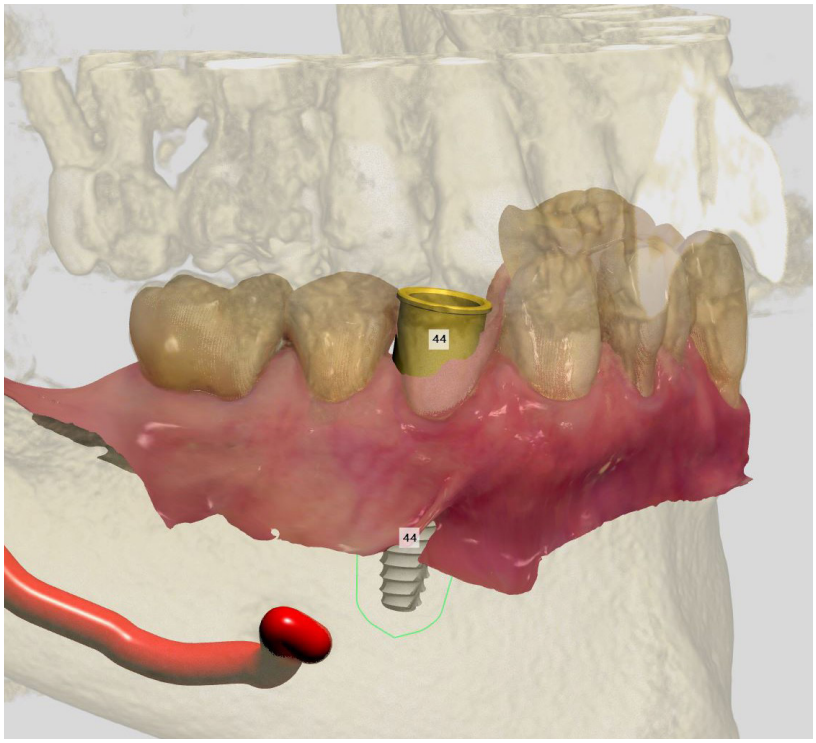

Fig. 5 (iv)

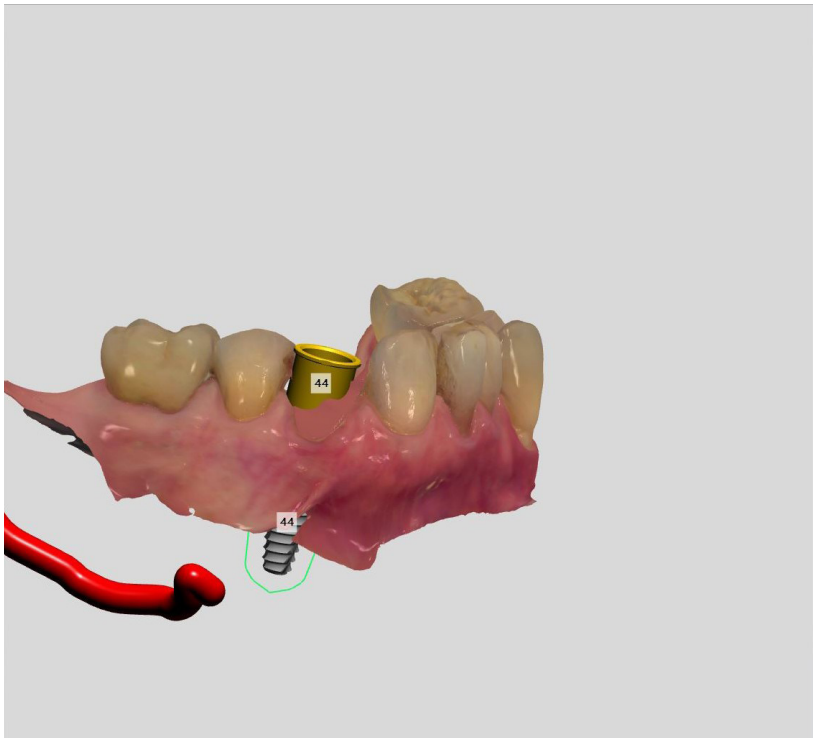

Fig. 5 (v)

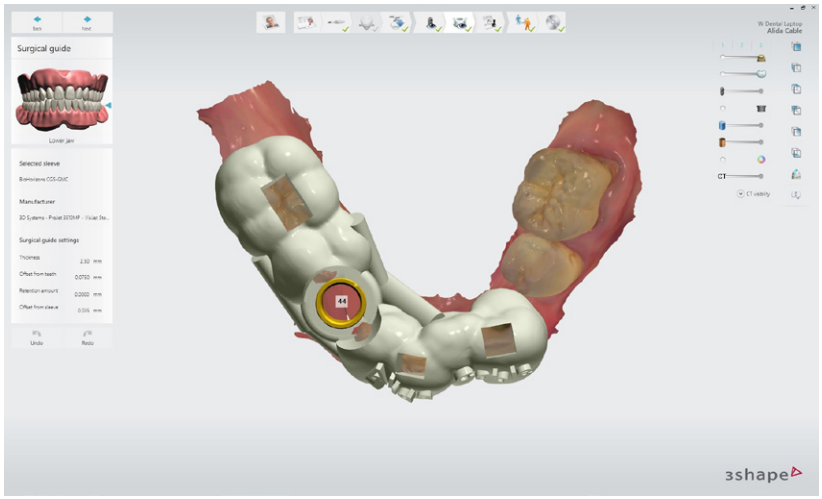

Fig. 6 (i)

Once the position of the implant was established, a surgical guide with the planned 3-D implant positioning was then designed in the Implant Studio software.

The use of virtual windows and additional bars allows for the better visualization and reinforcement of the 3D printed surgical guide.

Digital planning of the surgical guide with the optimal 3-D implant positioning. (Fig. 6 i-ii)

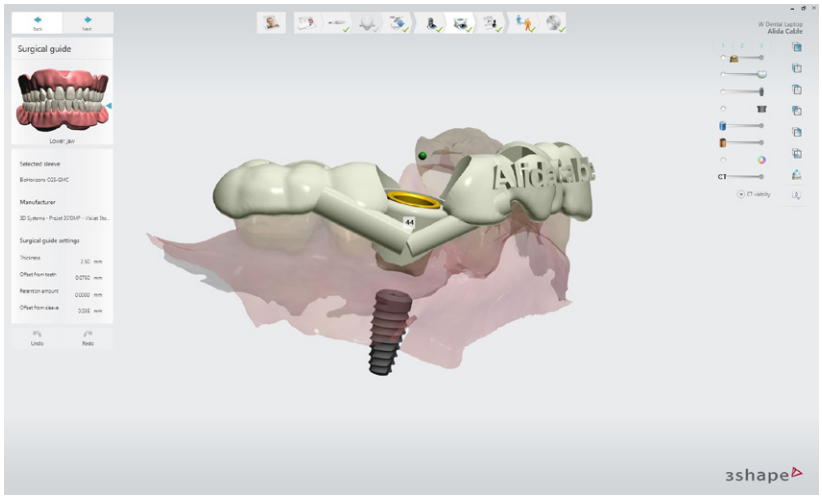

Fig. 6 (ii)

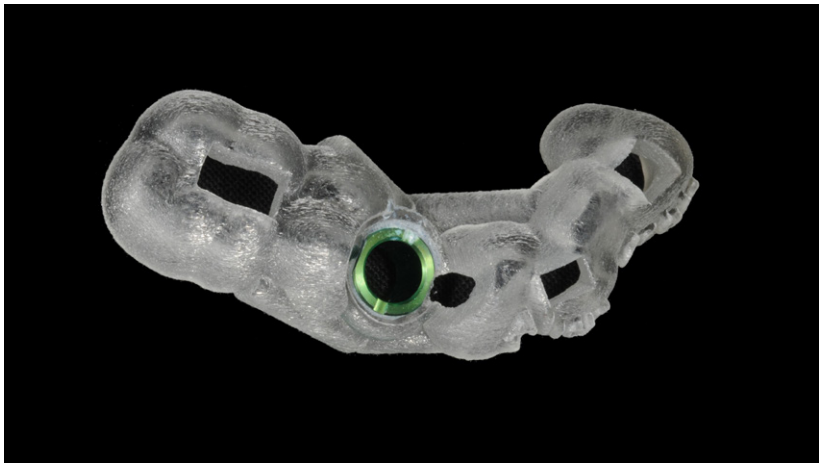

Fig. 7 (i)

The virtually planned surgical guide was then manufactured with a 3D printer.

Once printed, the implant surgical guide is smoothed and finished and metal guide sleeves are inserted into the precisely planned drill guide hole.

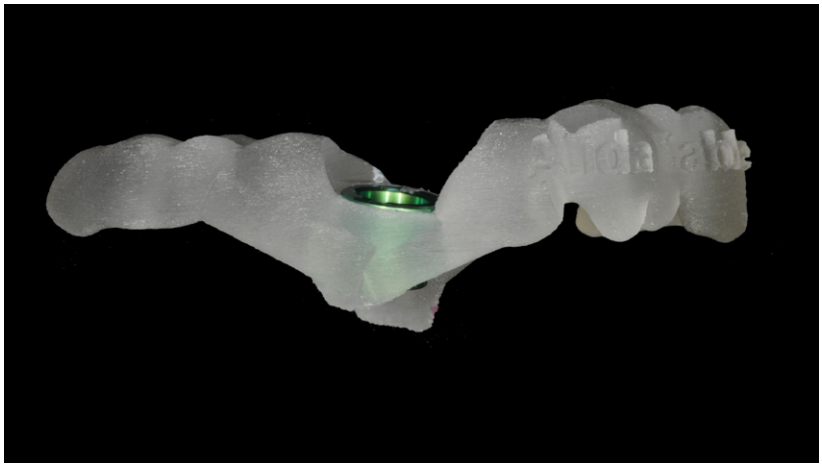

Fig. 7 (ii)

Printed implant surgical guide with inserted metal guide sleeve. (Fig. 7 i-ii)

Stage 3 (i) – Clinical Phase of Treatment (Extraction, immediate fixture placement)

The following clinical procedures were then completed on the day of surgery:

- The tooth 44 was extracted atraumatically.
- A small crestal soft tissue flap was raised and the implant fixture placed utilizing the digitally planned surgical guide. The BioHorizon fully guided surgical protocol was used.
- Primary stability of the fixture was confirmed before Bio-Oss grafting material was utilized to fill the voids between the implant fixture and the bony walls of the socket.
- The healing abutment was then placed and the flap repositioned.

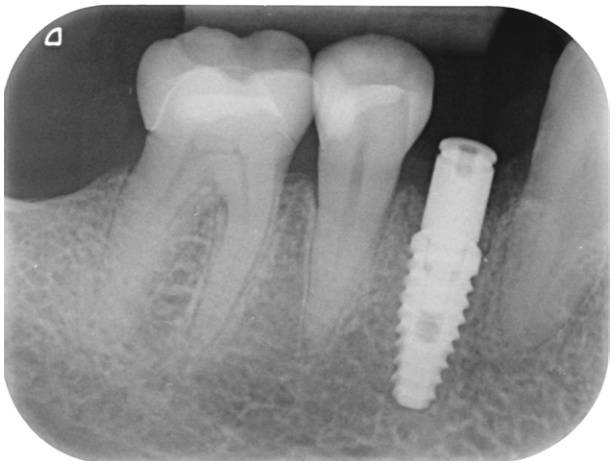

Fig. 8

A delayed healing protocol was employed with osseointegration confirmed after a period of 8-12 weeks.

Periapical radiograph of fixture placement with healing abutment in situ. (Fig. 8)

Stage 3(ii) – Clinical Phase of Treatment (master digital fixture level impression)

Once the 8-12 weeks healing phase was complete and the fixture integrated, a master digital impression using the TRIOS implant scan strategy was taken.

In this strategy, the following sequence of digital scans were taken:

1. A pre-preparation scan with the healing abutment in situ.
2. An emergence profile scan which was taken immediately after the healing abutment was removed to record gingival contours around the implant before any collapse of the tissues.
3. The scan body scan.

The corresponding 3Shape scan body was fixed to the implant and then scanned.

The seating of the scan body was confirmed radiographically before the digital TRIOS scan was completed.

Fig. 9

Shade image prior to intraoral TRIOS surface scan. (Fig. 9)

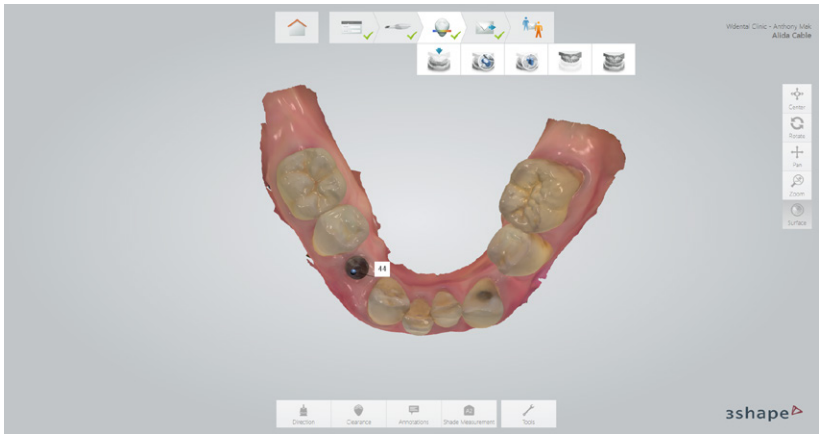

Fig. 10 (i)

Pre-preparation scan with healing abutment in situ. (Fig. 10 i-ii)

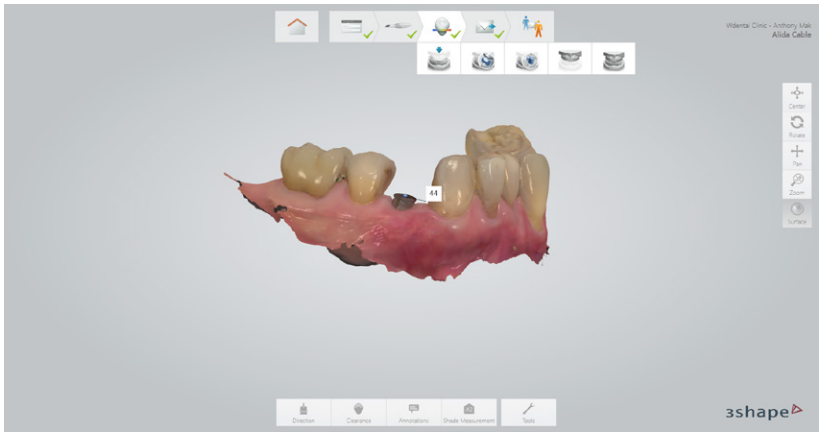

Fig. 10 (ii)

Fig. 11 (i)

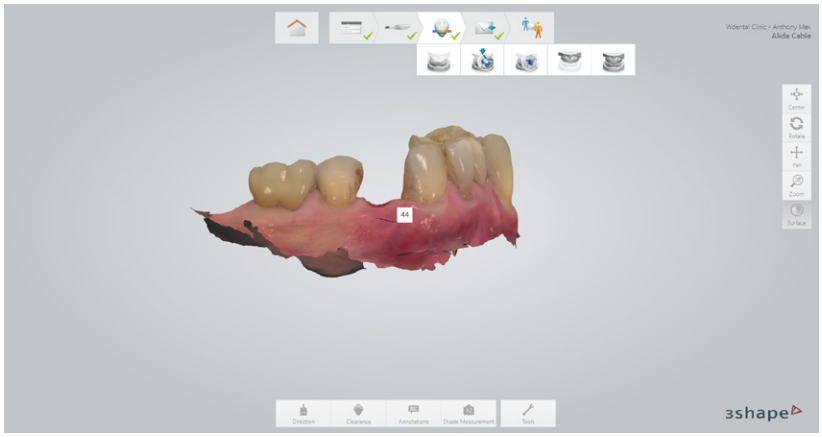

Fig. 11 (ii)

An emergence profile scan which was taken immediately after the healing abutment was removed to record gingival contour around the implant before any collapse of the tissues. (Fig. 11 i-ii)

Fig. 12 (i)

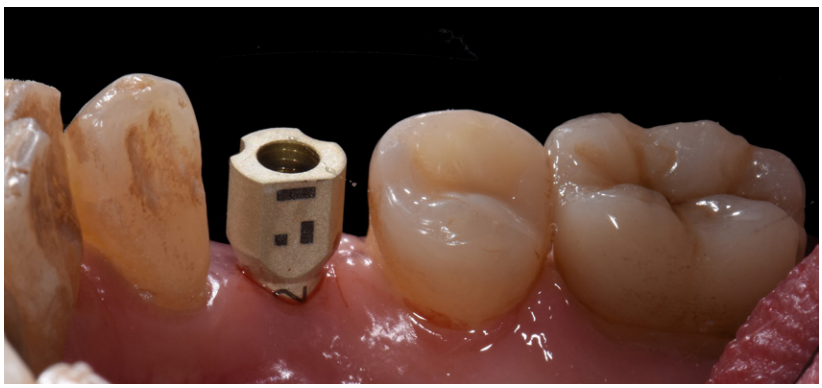

Fig. 12 (ii)

3Shape scan body positioned and screwed into position. (Fig. 12 i-iii)

Fig. 12 (iii)

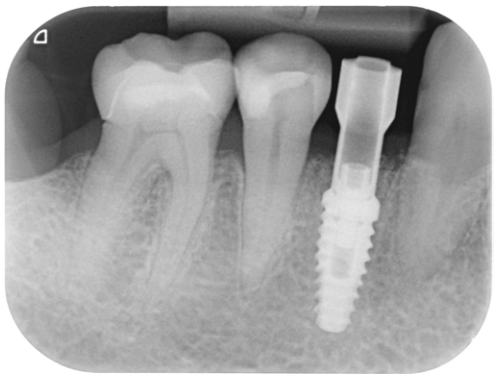

Fig. 13

Periapical radiograph confirming the seat of the scan body. (Fig. 13)

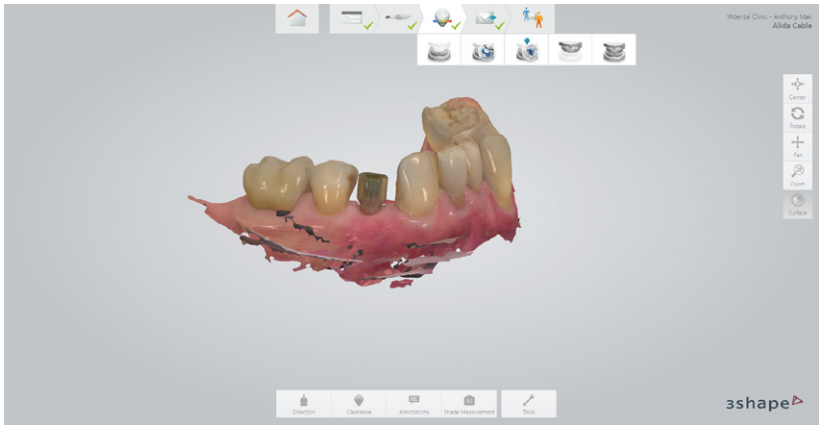

Fig. 14 (i)

The scan body scan digitally capturing the position and orientation of the implant fixture. (Fig. 14 i-v)

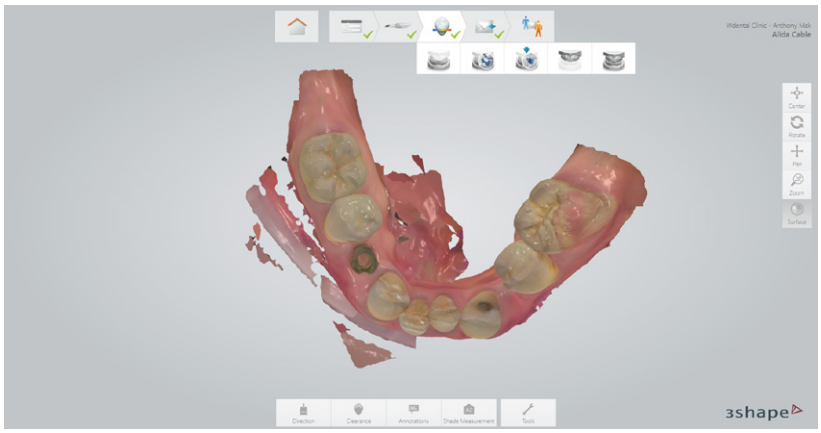

Fig. 14 (ii)

Fig. 14 (iii)

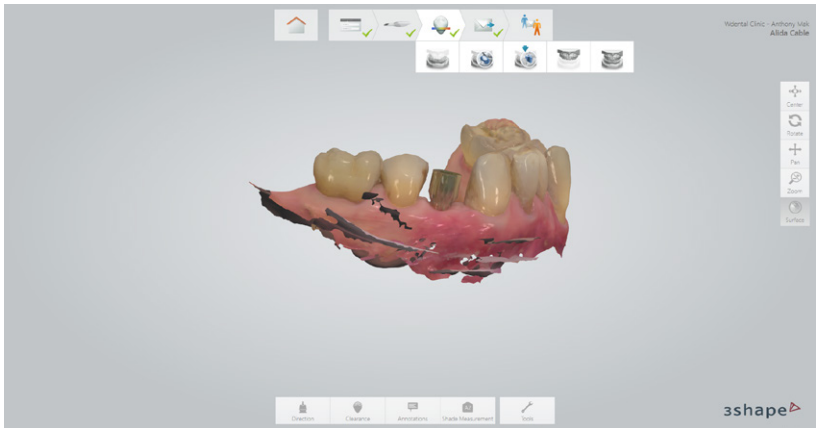

Fig. 14 (iv)

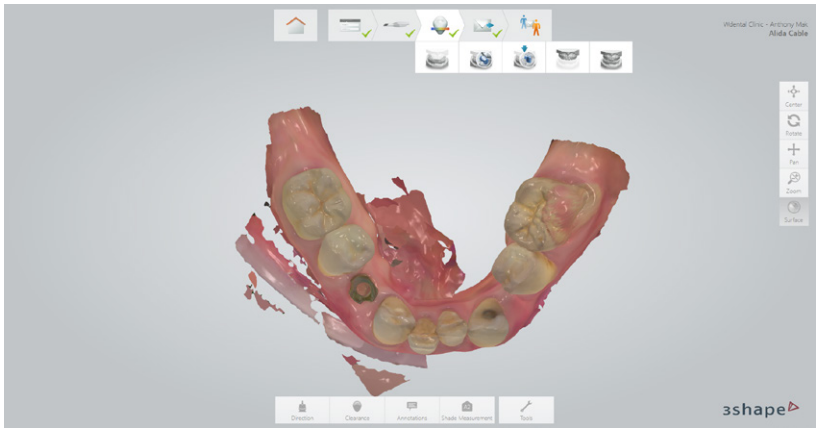

Fig. 14 (v)

All other prosthodontic records including the bite registration and the opposing arch were also captured with the intraoral scanner.

All the digital data was then sent to the ceramist through the 3Shape Communicate portal for the fabrication of the screw-retained crown.

Stage 4 – Laboratory fabrication of the final prosthesis

A direct access screw-retained crown (Lithium Disilicate crown to a zirconia abutment with a titanium interface) was then fabricated and the contact and occlusion verified by means of printed models.

The completed prosthesis was then sent back for the restoration to be inserted.

Fig. 15

Printed master model. (Fig. 15)

Fig. 16

Final Lithium disilicate on zirconia abutment screw-retained restoration. (Fig. 16)

Stage 5 – Finalization and insert of the screw-retained prosthesis

The screw-retained crown was inserted and torqued to 30Ncm2, which is the recommended level for the BioHorizon fixture. The abutment screw access was then sealed with PTFE tape and a direct bonded composite restoration, completing the restoration of the edentulous 44 site.

Fig. 17 (i)

Fig. 17 (ii)

Final screw-retained restoration inserted. (Fig. 17 i-ii)

Fig. 18

Final peri-apical radiograph of completed implant retained restoration on the lower right first premolar (tooth 44). (Fig. 18)

Conclusion

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 analogue techniques and improved patient comfort and outcomes are compelling reasons of the benefits of a full digital workflow in the provision of implant retained restorations.

Comments

Digital Implant Scans

Digital implant impressions constitute a major role in the development of the full digital workflow for fixed implant prosthetic restorations (Christensen 2009).

Intraoral scan bodies have been developed for most major implant brands that facilitate the transfer of the implant specifics, position and alignment by scanning and transfer of this information to the laboratory CAD software.

Once received in the CAD software, 3Shape Dental System, the corresponding abutment library is matched to allow the dental technician to design the implant prosthesis and manufacture the abutment and crown.

However, traditionally each company manufactures a specific scan body for their own digital library and this has on many occasions created problems between the clinical team and the dental laboratory fabricating the implant prosthesis.

The common problem is when dentists and technicians are not in harmony and do not have the same clinical and laboratory parts and information to put the digital pieces of the puzzle together.

An example is when a dentist scans an implant fixture with one type of scan body and then sends it to a laboratory that may not have all the information, parts (e.g. implant analog) or access to the library of that scan body.

This has been challenging and has made clear communication with the dental technician prior to implant scanning of a case crucial. Especially in the final design and manufacture of the prosthesis.

3Shape has solved this with their universal scan body that will marry up all original and third-party implant libraries that they collaborate with. This has allowed for a much simpler system, whereby one scan body can be used with multiple implant abutment libraries in the laboratory software, 3Shape Dental System.

This is a world first that has eliminated many of the limitations and boundaries for both the clinical and laboratory team in this field of dentistry.

Most importantly, it has made digital implant prosthetics more “Open Sourced” as the libraries in 3Shape Dental System are available at no additional cost to the user.

3Shape intraoral scan body. (Fig. 19 i-ii)

Fig. 19 (i)

Fig. 19 (ii)

3Shape scan bodies also provide the following benefits in simplifying the digital implant impression process:

- **Auto-recognition of implant system and connection.**

  The new 3Shape scan bodies feature a unique ID code to determine the implant system and connection. When scanned with the 3Shape TRIOS intraoral scanner, the software will detect and read the ID code on the scan body and automatically fill out the order form with the correct implant system and connection.

  This feature is currently in beta and will be released with a TRIOS upgrade in 2019.

- **The scan bodies are manufactured from titanium, highly durable and autoclavable.**

  Scan bodies can be used up to 100 times if proper care and cleaning has been maintained between each use. Since they are made from titanium, the 3Shape scan bodies will not bend or deform if you over-tighten the screw. Most other scan bodies are made from PEEK, which is a softer material that can be more prone to bending. Once a scan body is bent, the alignment will be off, which will result in errors in the final restoration design.

- **Visible in clinical X-rays to confirm fit to implant.**

  It is vital to be able to see the implant scan body connecting accurately with the implant fixture

- **One piece, one material manufacture**

  Allows for optimal accuracy and minimizes tolerance issues if different materials are used and need to be “assembled” together in a scan body.

This article was co-written with Dr Andre Chio, Melbourne, Australia. Many thanks for his support ad input.

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 digital and 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 two compelling compendiums detailing direct composite and indirect ceramic restorations, the clinical photography and documentations 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 and key opinion leader for several global dental companies focusing on development of new dental technologies.

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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