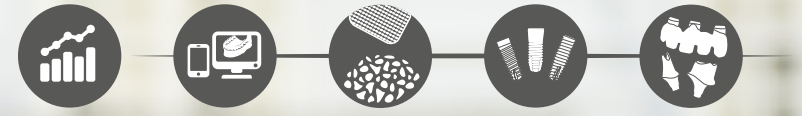
Dentsply Sirona Implants

Atlantis® Simplant®

Scientific Summary

Digital Implant Solutions

Comprehensive solutions for all phases of implant dentistry



Professional and practice development	Digital planning	Regenerative solutions	Implants	Restorations
STEPPS™	Simplant®	Symbios®	Ankylos® Astra Tech Implant System® Xive®	Atlantis®

Welcome

Are you looking for information about the excellent results with our individually designed Atlantis abutments and suprastructures and how to achieve simplicity, freedom, esthetics, and reliability when treating your patients? Or do you want to explore the research findings behind Simplant, a comprehensive digitial 3D system developed to accomplish more accurate and predictable implant treatment? You will find the answers here, and much more.

This Scientific Summary provides a synopsis of the key research findings supporting our digital solutions including Atlantis patient-specific prosthetic solutions and computer guided implant treatment with Simplant.
Each summary is based on facts retrieved from the original research article.

The Scientific Summary focuses on the following topics:

Atlantis® 9

Simplant® 23

References 30

Summary by Dentsply Sirona Implants of facts retrieved from the original articles.

For a more comprehensive view of the documentation and research on our products, please refer to our Scientific Reviews. The Scientific Reviews are available for download at www.dentsplyimplants.com/science

Ongoing innovation

For two decades, the Atlantis products and services have been continuously developed to meet the needs of all members of the treatment team for the benefit of their patients.

1999
First patient-specific Atlantis Abutment delivered in titanium

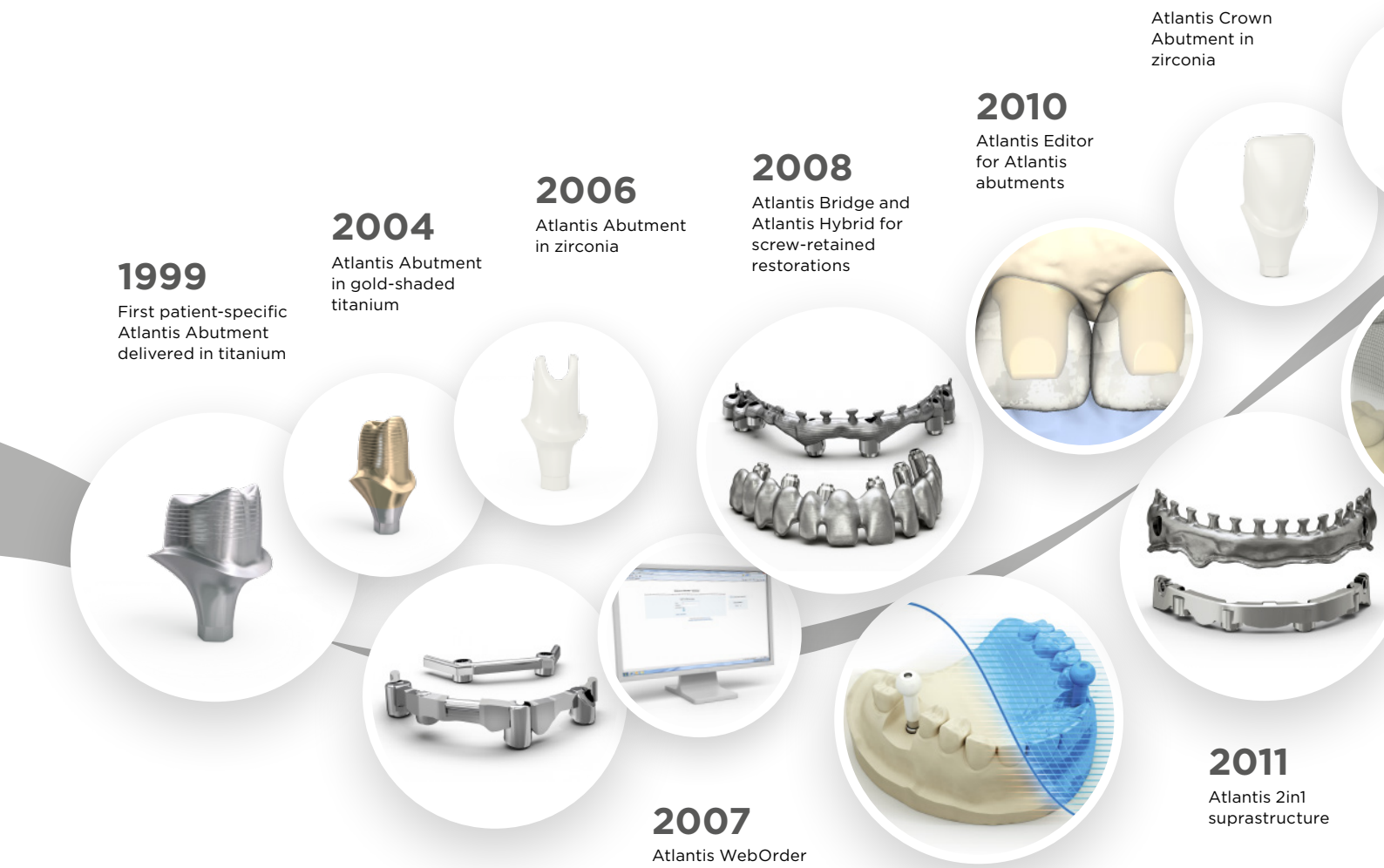
2004
Atlantis Abutment in gold-shaded titanium

2006
Atlantis Abutment in zirconia

2008
Atlantis Bridge and Atlantis Hybrid for screw-retained restorations

2010
Atlantis Editor for Atlantis abutments

2011
Atlantis Crown Abutment in zirconia



2005
Atlantis Bar delivered in titanium

2007
Atlantis WebOrder online ordering system

2009
Lab-based scanning expands efficiency in case processing

2011
Atlantis 2in1 suprastructure

2014
Atlantis Crown Abutment in titanium

2014
Angulated screw access for Atlantis Bridge and Atlantis Hybrid

2015
Atlantis Conus concept

2016
Atlantis Crown solutions

2017
Atlantis Viewer accessible on mobile devices

2012
Atlantis Core File

2014
Intraoral scanning for Atlantis abutments

2015
Atlantis suprastructures in additive manufacturing

2016
Atlantis CustomBase solutions

2017
CEREC and inLab connectivity

Atlantis® CAD/CAM patient-specific abutments

Key features

- Atlantis® abutments are patient-specific products for cement-, screw-, and attachment-retained implant restorations
- Atlantis® abutment BioDesign Matrix:
  Virtual Atlantis Design (VAD): for high precision and a more natural esthetic result
  Natural Shape: for optimal support and retention of the final restoration
  Soft-tissue Adapt: for optimal support for soft-tissue sculpturing and adaptation to the finished crown
  Custom Connect: for strong and stable fit
- Available for all major implant systems comprised in the Atlantis implant compatibility charts, including Ankylos, Astra Tech Implant System and Xive.

Clinical results

The clinical use of Atlantis abutments has been described in case reports and clinical studies where esthetic results for titanium, gold-shaded titanium, and zirconia abutments are reported. Clinical documentation on the Atlantis abutment reports on re-establishment and maintenance of the papilla, establishment of an optimal soft tissue contour and emergence profile, increased pink esthetic score and patient satisfaction.

Experimental results

Experimental studies report on different aspects of the Atlantis abutments; including ideal fit between abutment and implant, accuracy of fabrication, and ideal fit and retention of copings. Moreover, good mechanical properties, including strength and probability to survive occlusal forces, have been reported for the Atlantis abutment in zirconia.

Clinical advantages with using Atlantis® abutments

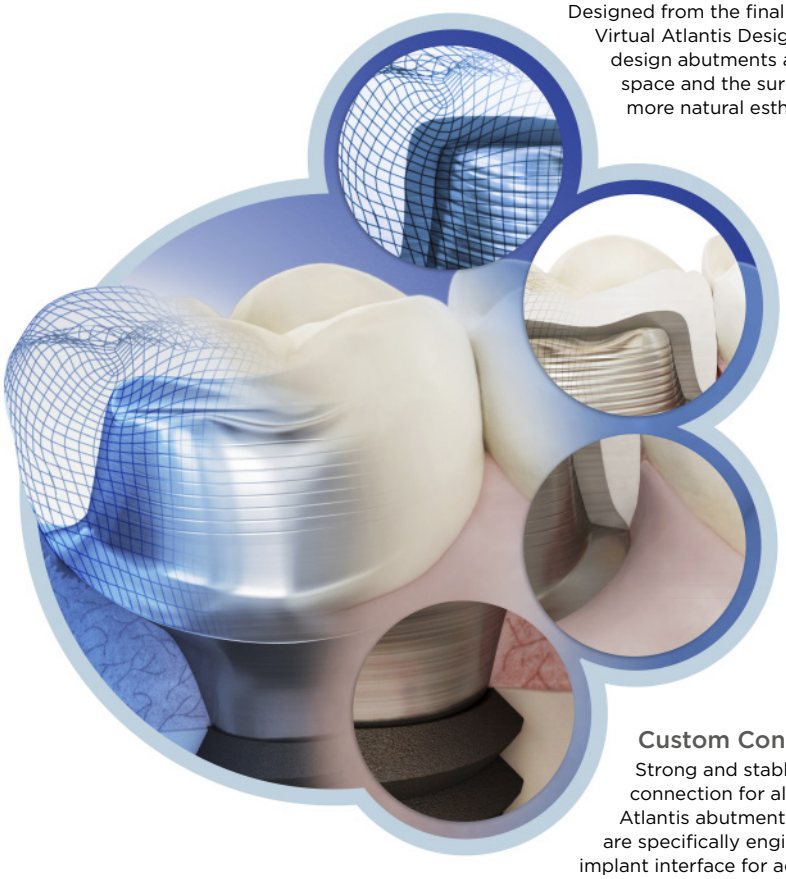
Scientific literature on Atlantis customized abutments have shown several clinical advantages such as:

- Reduced chairtime
- Cost-effective and simplified treatment procedures
- Reduced number of impression taking with duplicate abutments
- Compatibility and success when combined with several different implant interfaces

For a complete list of references supporting the Scientific Review “Atlantis CAD/CAM patient-specific abutments”, please refer to www.dentsplyimplants.com/science

Atlantis® BioDesign Matrix

The Atlantis BioDesign Matrix is a synergy of four unique features that together allow for the design and production of consistent, high-quality, patient-specific abutments for all major implant systems.[1]



Virtual Atlantis® Design

Designed from the final tooth shape. Virtual Atlantis Design (VAD) software makes it possible to design abutments and crowns in relation to the edentulous space and the surrounding teeth for high precision and a more natural esthetic result.

Natural Shape

Unique anatomical shape and emergence profile that nourishes soft tissue management and provides excellent support and retention of the final restoration.

Soft-tissue Adapt

The combination of biological, anatomical and engineering parameters that provide the beneficial conditions for healing soft tissue and adapting it to the finished crown.

Custom Connect

Strong and stable fit – customized connection for all major implant systems. Atlantis abutments connections and screws are specifically engineered and tested for each implant interface for accurate fit, stability, and a successful result.

1. Refer to Atlantis abutments implant compatibility chart.

Atlantis®

The Atlantis patient-specific prosthetic solutions include both abutments and suprastructures, produced to give a precise and passive fit for all major implant brands. They offer outstanding freedom of choice for cement-, screw-, and attachment-retained solutions. The individual anatomy of each patient is taken into consideration to achieve optimal esthetics as well as function.

In this section, we present excellent results on soft tissue management and esthetics, product compatibility with different implant interfaces, predictability, as well as patient satisfaction when using the Atlantis patient-specific prosthetic solutions.

Summarized articles:

Implant adaptation of stock abutments versus CAD/CAM abutments: a radiographic and scanning electron microscopy study 10

The influence of customized abutments and custom metal abutments on the presence of the interproximal papilla at implants inserted in single-unit gaps: a 1-year prospective clinical study 11

Prospective assessment of CAD/CAM zirconia abutment and lithium disilicate crown restorations: 2.4 year results 12

Randomized clinical trial of implant-supported ceramic–ceramic and metal–ceramic fixed dental prostheses: preliminary results 13

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Fit of cobalt–chromium implant frameworks before and after ceramic veneering in comparison with CNC-milled titanium frameworks 16

The esthetic effect of veneered zirconia abutments for single-tooth implant reconstructions: A randomized controlled clinical trial 17

Implant adaptation of stock abutments versus CAD/CAM abutments: a radiographic and scanning electron microscopy study

Authors: Apicella D, Veltri M, Chieffi N, et al.

Published in: Annali di Stomatologia 2010;1(3-4):9-13.

Conclusions

- Atlantis CAD/CAM abutments and stock abutments had a comparable fit to the OsseoSpeed implants
- Good adaptation in all samples (evaluated by conventional radiographs and by scanning electron microscopy)
- Radiographic evaluation of the abutment adaptation is a reliable method

Aim

To evaluate the difference in fit between stock abutments and patient-specific CAD/CAM abutments, when placed on implants with an internal conical connection.

Material and Methods

72 OsseoSpeed implants (Dentsply Sirona Implants) randomly divided into 6 different abutment groups (12 implants per group). See table 1 for type of abutments.

The CAD/CAM abutments were designed to match the shape of the stock abutments, for study purposes. All abutments were placed on OsseoSpeed implants, which were embedded in mandible section simulators.

Evaluation:
A radiographic evaluation was performed to simulate standard implant evaluation at a dental practice.

The implants were then embedded in acrylic resin and cut for Scanning Electron Microscopy (SEM) evaluation.

The purpose of the evaluation was to determine the precision of fit between the bearing surfaces and between the implant and the abutment. Two independent operators blindly evaluated the images, according to a three-score scale: perfect adaptation (0), no complete adaptation (1), and clear evidence of no adaptation (2).

Results

All the abutment groups showed perfect adaptation (0) for all 72 implants by radiographic (X-ray) evaluation and by SEM evaluation. Moreover, radiographic scores were in agreement with the SEM scores.

Discussion

SEM evaluation is more accurate than radiographic evaluation, but radiographs are accurate enough for evaluating implant adaptation.

Group	Abutment type
1	Titanium, stock abutment (TiDesign)*
2	Zirconia, stock abutment (ZirDesign)*
3	CAD/CAM zirconia abutment (Aadava Zr abutment)
4	CAD/CAM, Atlantis Abutment Titanium*
5	CAD/CAM Atlantis Abutment Gold shaded titanium*
6	CAD/CAM Atlantis Abutment Zirconia*

Table 1. Type of abutment

**Dentsply Sirona Implants*

The influence of customized abutments and custom metal abutments on the presence of the interproximal papilla at implants inserted in single-unit gaps: a 1-year prospective clinical study

Authors: Borges T, Lima T, Carvalho Á, et al.
Published in: Clin Oral Implants Res 2014;25(11):1222-7.

Conclusions

- Atlantis abutments is a predictable treatment, reporting no technical complications.
- Atlantis abutments improve the papilla presence between tooth and implant when compared with custom metal abutments.
- Atlantis Abutments give improved esthetic results in anterior maxilla when compared with custom metal abutments.

Aim

To assess and compare the papilla presence next to OsseoSpeed implants when restored with customized Atlantis abutments or custom metal abutments in the anterior maxilla.

Material and Methods

38 single-tooth OsseoSpeed implants (Dentsply Sirona Implants) (one per patient):

- 26 customized abutments
- 12 custom metal abutments

Process:

1. Implants placed and left to heal for osseointegration to occur (6-10 weeks).
2. Abutments attached:
   - Study group: Atlantis Abutment Zirconia and Atlantis Abutment Gold-shaded titanium (Dentsply Sirona Implants).
   - Control group: CastDesign, custom metal abutments (Dentsply Sirona Implants)

The patients were subject to radiography and photography to assess and compare:

- The presence/absence of the interproximal papilla (score 0: absent, score 1: half-present, score 2: present
- The inter-tooth–implant distance (ITD)
- The distance from the base of the contact point to the dental crest bone of adjacent tooth (CPB)

Results

36 patients (36 implants) were available for the 12-month follow-up.

Implant and prosthetic survival rate:
100%

No technical complications, such as abutment fracture, abutment loosening or ceramic chipping.

Presence/absence of the interproximal papilla:

- Papilla was significantly more present in the CAD/CAM Atlantis abutments group than the metal abutments group

ITD:

- No significant differences between the two groups.

CPB:

- No significant differences between the mean mesial and distal CPB between the two groups.

	Atlantis Abutment Zirconia/ Atlantis Abutment Gold-shaded titanium	CastDesign custom metal abutments
Mean papilla presence	1.69 ± 0.46	1.08 ± 0.65
Mean mesial ITD (mm±SD)	2.40 ± 0.96	1.84 ± 0.90
Mean distal ITD (mm±SD)	2.10 ± 1.05	1.61 ± 0.70
Mean mesial CPB (mm±SD)	5.71 ± 1.54	5.41 ± 1.31
Mean distal CPB (mm±SD)	4.01 ± 1.73	4.77 ± 1.21

Table 1. The mean papilla presence, mean mesial and distal inter-tooth-implant distance and mean mesial and distal CPB of the two abutment groups.

Prospective assessment of CAD/CAM zirconia abutment and lithium disilicate crown restorations: 2.4 year results

Authors: Cooper F, Stanford C, Feine J, et al.
Published in: J Prosthet Dent 2016;116(1):33-9.

Conclusions

- Success with Atlantis Abutment Zirconia on 3 different implant interfaces.
- Very high survival rates of implants and Atlantis Abutment Zirconia with lithium disilicate crown restorations following 2.4 years in function:
  - 98.4% implant survival
  - 100% abutment and crown survival
- Good for anterior and first premolar single-tooth implants.

Aim

To determine the survival rates and find any complications for implants and Atlantis Abutment Zirconia with lithium disilicate crown restorations on 3 different implant platforms for single-tooth replacement.

Material and Methods

141 patients in total, with three different implant-abutment interfaces:

- Conical (OsseoSpeed, Dentsply Sirona Implants)
- Flat-to-flat (NobelSpeedy Replace, Nobel Biocare)
- Platform switch (NanoTite Certain Prevail, BIOMET 3i)

Materials:

- Atlantis Abutment Zirconia (Dentsply Sirona Implants)
- Crowns: lithium disilicate (cemented with resin cement)

Timeline:

- **0 months:** Tooth extraction, patients enrolled in study
- **5 months:** Single-tooth implant placement with immediate provisionalisation
- **8 months:** Permanent Atlantis abutments and crowns fitted
- **1-3 years:** Regular follow-ups
- **3 years:** Final follow-up

Results

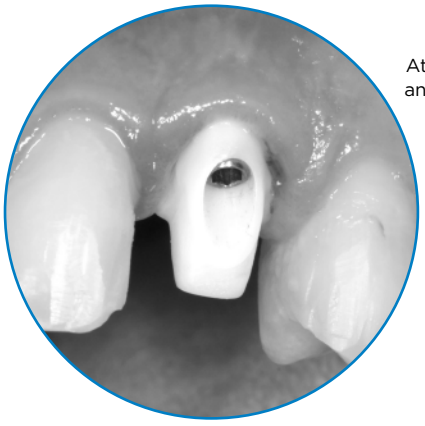
For the final follow-up, 110 patients (128 implants) were eligible for review.

Survival rates:

- 98.4% implant survival
- 100% abutment and crown survival

Complications:

- No complications at the abutment level:
  - No abutment screw loosening
  - No abutment screw fractures
  - No abutment fractures
- Other technical complications were minor and repairable eg crown debonding and a case of excess cement. No crown fractures or chippings were reported



100%
Atlantis Abutment and crown survival

0%
complications related to Atlantis Abutment after

2.4
years in function

Randomized clinical trial of implant-supported ceramic–ceramic and metal–ceramic fixed dental prostheses: preliminary results

Authors: Esquivel-Upshaw J, Clark A, Shuster J, et al.
Published in: Journal of Prosthodontics, 2014 Feb; 23(2): 73–82

Conclusions

- No complications reported for Atlantis Abutment Gold-shaded titanium.
- Implant-supported ceramic–ceramic and metal–ceramic prostheses worked equally well after 2 years follow-up.
- No significant correlation between prosthesis fractures and the:
  - Type of material system
  - Veneer thickness
  - Radius of curvature of the gingival connector embrasure
  - Connector height

Aim

To determine the survival rates of implant-supported ceramic–ceramic and metal–ceramic prostheses.

Material and Methods

A randomized, controlled clinical trial with 55 patients needing 72 prostheses, randomly assigned to receive either metal-ceramic or ceramic–ceramic prostheses (36 prostheses in each group).

The prostheses were three-unit implant-supported fixed dental bridges supported by OsseoSpeed implants (Dentsply Sirona Implants) and Atlantis Abutment Gold-shaded titanium (Dentsply Sirona Implants).

After prosthesis cementation, patients had checkups at 6, 12, and 24 months.

Vinylpolysiloxane (VPS) impressions were made at each checkup. If there was a clinical fracture, a VPS impression of the fracture surface was used to create a replicate for fractographic analysis to find the cause of the fracture and associated stress.

Replicates of the fractured prosthesis were analysed using a scanning electron microscope.

Prosthetic fractures were classified as follows:

- Class 1, refinishing required
- Class 2, repair warranted
- Class 3, replacement prosthesis indicated

Results

No reported complications for gold-shaded Atlantis abutments.

Prosthetic survival rate:
98%

10 chipping fractures (13.9%):

- 6 Class 1 fractures
- 3 Class 2 fractures
- 1 Class 3 fracture

Ceramic–ceramic and metal–ceramic prostheses performed equally well. See Table 1.

SEM analysis showed all fractures originated in the occlusal area.

	No. Fractures	Metal-Ceramic	Ceramic-Ceramic
Class 1	6	1	5
Class 2	3	3	0
Class 3	1	0	1

Table 1. Number of prosthetic failures per class and per prosthesis type.

Influence of abutment color and mucosal thickness on soft tissue color

Authors: Ferrari M, Carrabba M, Vichi A, et al.

Published in: Int J Oral Maxillofac Implants 2016;E-pub Aug 15, doi:10.11607/jomi.4794.

Conclusions

- Material (color) of Atlantis abutments does not impact soft tissue color.
- Mucosal thickness impacts soft tissue color: visible difference in soft tissue color for thinner soft tissue (≤2 mm).

Aim

To evaluate if Atlantis Abutment Gold-shaded titanium or Atlantis Abutment Zirconia improve the appearance of the soft tissue compared to Atlantis Abutment Titanium, and to evaluate if mucosal thickness impacts soft tissue color.

Material and Methods

90 patients (maximum 4 implants and abutments per patient), randomly divided into each group:

- Atlantis Abutment Titanium
- Atlantis Abutment Gold-shaded titanium
- Atlantis Abutment Zirconia
  (All Dentsply Sirona Implants)

Color of each abutment:

- Titanium – gray
- Gold-shaded titanium – gold
- Zirconia – white

Timeline:
OsseoSpeed implants (Dentsply Sirona Implants) were placed and left submerged to heal 4-6 months.

- **0 months:** 2-stage surgery, transmucosal healing abutments
- **2 weeks:** implant-level impressions for provisional restorations
- **3 weeks:** Connection of provisional restorations
- **11 weeks:** final implant-level impressions
- **15 weeks:** Atlantis abutments inserted, mucosal color measured

Mucosal thickness was determined as:

- Thin, if ≤ 2 mm
- Thick, if > 2 mm

Mucosal color was measured with a clinical spectrophotometer 10 minutes after final Atlantis abutment placement, to prevent soft tissue compression or ischemia affecting the color measurement.

The mucosal color was measured at each implant and at contralateral natural tooth in each patient, to compare the difference.

Results

Abutment color:
No statistically significant difference in soft tissue color caused by the different abutment materials (colors).

Mucosal thickness:
Statistically significant difference in soft tissue color dependent on mucosal thickness:

- Color difference in all patients with thin mucosa
- Color difference in only 2 patients (of 62) with thick mucosa

A. **B.** **C.**

Figure 1. Clinical photos showing: Atlantis Abutment Titanium (A), Atlantis Abutment Gold-shaded titanium (B) and Atlantis Abutment Zirconia (C).

Abutment material effect on peri-implant soft tissue color and perceived esthetics

Author: Kim A, Campbell S, Viana M, et al.
Published in: J Prosthodont 2016;25(8):634-40.

Conclusions
- Atlantis Abutment Zirconia had less color difference in the peri-implant mucosa than Atlantis Abutment Titanium and Atlantis Abutment Gold-shaded titanium.
- Tissue thickness does not impact color difference, but thicker tissue is less susceptible to color change.
- Patients were more satisfied than clinicians with the results.
- Clinicians' satisfaction was higher for soft tissue esthetics than crown esthetics.

Aim
To evaluate how implant abutment material affects peri-implant soft tissue color and to measure patient and clinician perception and satisfaction.

Material and Methods
30 patients/30 OsseoSpeed implants (Dentsply Sirona Implants) with 3 different Atlantis abutment materials (10 patients per group):
- Atlantis Abutment Titanium
- Atlantis Abutment Gold-shaded titanium
- Atlantis Abutment Zirconia
  (All Dentsply Sirona Implants)

Four prosthodontists were chosen to review perceived color, after performing well on a color test.

Each patient received spectrophotometric analysis 6 weeks after treatment to measure color of the peri-implant soft tissue (test site) and periodontal soft tissue of an adjacent or contralateral tooth (control site).

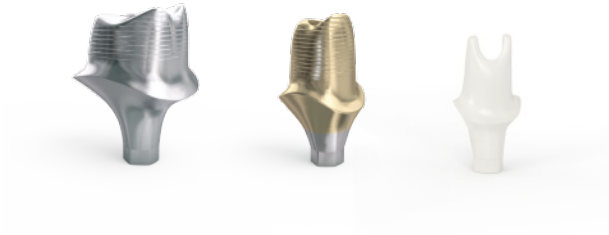
Patients completed surveys about:
- Perceived peri-implant soft tissue color
- Satisfaction

For each patient, two clinicians also completed surveys about the perceived color.

Means and standard deviations were calculated among the abutment groups for the patient and clinician surveys, and for the spectrophotometric analysis.

Results
Tissue color:
- Atlantis Abutment Zirconia had less color difference than Atlantis Abutment Titanium and Atlantis Abutment Gold-shaded titanium.
- No significant correlation between tissue thickness and color difference.
- Thick tissue had a less color difference than thin tissue.

Satisfaction:
- Patient satisfaction was significantly higher than clinician satisfaction.
- No statistical difference in satisfaction for the different abutment materials.
- No correlation between color difference and satisfaction.



Fit of cobalt–chromium implant frameworks before and after ceramic veneering in comparison with CNC-milled titanium frameworks

Authors: Svanborg P, Stenport V and Eliasson A.

Published in: Clin and Experiment Dent Res., 2015;1(2):49-56.

Conclusions

- A good fit of both titanium and cobalt-chromium frameworks were shown.
- Titanium frameworks are more accurate than CoCr frameworks.
- Ceramic veneering gave improved accuracy and fit for the CoCr frameworks.

Aim

To evaluate the fit of CNC-milled cobalt–chromium (CoCr) and titanium (Ti) implant frameworks. Further, to evaluate the effect of ceramic veneering on the fit of the CoCr frameworks.

Material and Methods

- 10 maxillary stone models with 6 Ankylos Balance Base C abutment replicas
- 10 CNC-milled CoCr frameworks (Atlantis superstructures, Dentsply Sirona Implants, Hasselt, Belgium)
- 10 CNC-milled Ti frameworks (Atlantis superstructures, Dentsply Sirona Implants, Hasselt, Belgium)

Measurement:
The mating surfaces of the stone casts and frameworks were measured 5 times with a Coordinate Measuring Machine (Mylab AB, Gothenburg, Sweden). These measurements were used to calculate the position and angulation of the center point of the abutment replicas and the corresponding framework fit surfaces. Fit measurement was also performed after ceramic veneering of the CoCr framework (na for Ti frameworks).

Analysis:
The frameworks were superimposed in a best-fit position onto the abutment replicas based on the center point positions, and the three dimensional directions of displacement of the center points were calculated.

Results

- Both Ti and CoCr frameworks showed good fit in the vertical plane (z-axis).
- Ceramic veneering decreased the deviations of the CoCr framework

Accuracy:
Vertical deviation for both framework types was not statistically significant different, but the horizontal deviation was. The Ti frameworks had smaller mean deviation of misfit than the CoCr frameworks.
See Table 1 for values.

CNC-milled Atlantis superstructure in titanium

Accuracy	Mean deviation x-axis, µm (SD)	Mean deviation, y-axis, µm (SD)	Mean deviation, z-axis, µm (SD)	Mean deviation, 3D, µm (SD)	Mean deviation, x/z angle, µm (SD)	Mean deviation, y/z angle, µm (SD)
Titanium	5.0 (1.5)	2.8 (0.6)	5.3 (2.4)	9.0 (1.5)	0.044 (0.030)	0.058 (0.020)
CoCr before veneering	13.5 (7.4)	6.3 (3.4)	4.6 (2.8)	17.8 (7.7)	0.061 (0.022)	0.067 (0.026)
CoCr after veneering	9.7 (6.9)	4.4 (4.0)	4.9 (3.1)	13.7 (7.9)	0.074 (0.038)	0.068 (0.039)

Table 1. Mean deviation per plane for CoCr and Ti frameworks

The esthetic effect of veneered zirconia abutments for single-tooth implant reconstructions: A randomized controlled clinical trial

Authors: Thoma DS, Brandenberg F, Fehmer V. et al.

Published in: Clin Implant Dent Relat Res 2016;18(6):1210-17.

Conclusions

- Veneering of the submucosal part of Atlantis Abutment Zirconia resulted in less discoloration compared with standard white zirconia abutments.
- Esthetic benefits can be achieved using pink-veneered Atlantis zirconia abutments.

Aim

Three aims were set:

1. To test if veneering of the submucosal part of zirconia abutments can positively influence the esthetic outcome.
2. To evaluate the influence of the mucosal thickness on the esthetic outcome.
3. To evaluate and compare the thickness of the soft tissue around the implant and the contralateral tooth.

Material and Methods

44 patients treated with Astra Tech Implant System (OsseoSpeed, Dentsply Sirona Implants) were randomized to receive either:

- Cement retained crowns
  - white zirconia abutment, shade 00
  - pink-veneered zirconia abutments
- Screw-retained crowns
  - white zirconia abutment, shade 00
  - pink-veneered zirconia abutments

All abutments were individually CAD/CAM manufactured (Atlantis, Dentsply Sirona Implants) and the pink color was the same for all patients, and was chosen to best match the mean color of human gingiva.

Outcome variables were evaluated 7-10 days after crown placement, and were:

- peri-implant mucosa color by using a spectrophotometer
- thickness of mucosa by using an endodontic file

Results

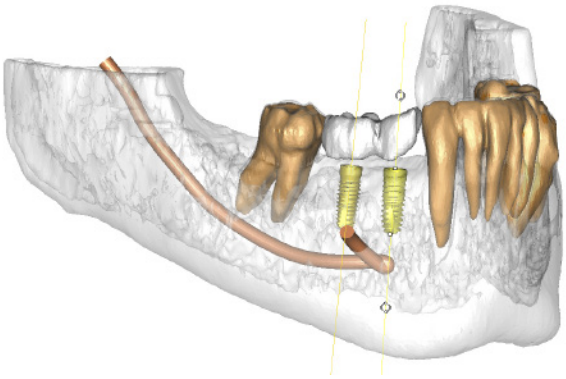
Sites with a pink veneered Atlantis abutment and a thin mucosa resulted in the most favorable esthetic outcome. The results were as follows:

1. Pink veneering positively influenced the esthetic outcome in terms of peri-implant mucosal color
2. Thickness of the mucosa (i.e. <2mm) may play a critical role for the esthetic outcome
3. Thicker mucosa was found around implants (mean 1.9 mm) compared to contralateral teeth (mean 1.1 mm).
   - 61% of the implant sites had ≥ 2mm thick mucosa
   - 9% of the tooth sites had ≥ 2mm thick gingiva

No biological or technical complications were reported during the study.

Simplant®—the key to unlocking digital potential

As part of the Dentsply Sirona Implants Digital Solutions offering, Simplant delivers predictable 3D implant treatment solutions—enabling outstanding prosthetic results as planned.



From dental scanning and planning, to drilling and implant placement, to Immediate Smile temporary restorations delivered prior to surgery, Simplant offers clinicians a comprehensive 3D system for predictable implant treatment.

The Simplant Guide forms the link between the digital treatment plan in Simplant and the surgery. Precise planning and implant placement enables minimal invasive treatment, as well as reduced chair time.

Moreover, it gives confidence to both clinician and patient and it brings surgery and restoration to a new level: The patient can be treated in one single treatment session and leave with an expertly planned temporary restoration.

Simplant solutions are cost-effective, user-friendly and uniquely compatible with the brands and equipment that clinicians already know and use. Simplant computer guided implant treatment is compatible with over 10,000 implants from more than 100 brands, as well as all DICOM compatible (CB) CT scanners and major optical and intraoral scanners.

Compatible with

10,000

implants from more than

100

brands

48

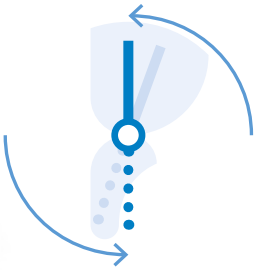
Efficient turn-around times. Simplant Guide production as fast as 48 hours when using the FastTrack order process.

3D

Comprehensive 3D communication increases case acceptance and facilitates teamwork.

ISO13485

As a manufacturer of medical devices, we are compliant with the European Medical Device Directive and with the Quality Systems Regulation (CFR section 820), under the authority of the FDA.



Precise implant placement with Simplant Guide.

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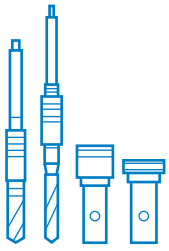


Customized Simplant SAFE Guide designs, to meet the requirements of brand-specific guided surgery instruments.

1991

Introduction of Simplant software, winning the 'European Stereolithography Excellence Award'.

For more details on this infographic, visit **www.simplantdentsply.com**

Simplant®—accuracy with guided implant surgery

What is Simplant?

- The most used software system for 3D planning of implant placement in clinical studies
- Individualized 3D solution covering all steps from implant planning to final prosthetic delivery
- Custom made Simplant Guides connect the digital plan with the surgical intervention
- Compatible with most implant systems, including Ankylos, Astra Tech and Xive Implant System

Confident implant placement

- Higher accuracy for implant placement with Simplant Guide compared to non-guided surgery, shown in both clinical and experimental studies (with one exception)
- Published data indicate higher accuracy in anterior positions, in the mandible, in thin mucosa (e.g. non-smokers), in dense bone and for mucosa supported guides
- Higher accuracy has been presented when optimizing tolerances and length of the sleeves in the guide, when using shorter implants and when anchoring the guide rigidly to the bone

The results from 21 studies evaluating accuracy between planned and actual implant positions when using Simplant Guide are shown in the table below.

No study reported any adverse events or risks when using the guides. Equivalent or better performance for Simplant Guide, than competitors, are reported in clinical and experimental studies.

Type of study	Overall mean deviation, entry point, mm	Overall mean deviation, implant apex, mm
Clinical studies	1.1	1.4
Experimental studies	0.7	0.9

Table presenting the overall mean deviation (planned vs. actual) reported in 14 clinical and 7 experimental studies.

Conclusion

The published literature clearly supports the use of Simplant Guide for predictable implant surgery.

- Higher accuracy compare to freehand surgery
- Safe and predictable surgery can be employed in all locations in the mouth
- Minimally invasive treatment (e.g. flapless surgery) is possible
- Reduced chair time can be achieved
- Maintained patient's satisfaction at yearly follow-ups

For a complete list of references supporting the Scientific Review "Simplant®-accurancy with guided implant surgery", please refer to www.dentsplyimplants.com/science

Powered by a complete digital workflow

The digital solutions from Dentsply Sirona support you from the planning to the final restoration and allows you to order all case-specific components including the possibility to receive the restoration – all prior to surgery.

1. Computer guided treatment planning

The Simplant SAFE Guide and patient-specific Atlantis Abutment are ordered in the Simplant Online shop.

2. Digital design of the abutment

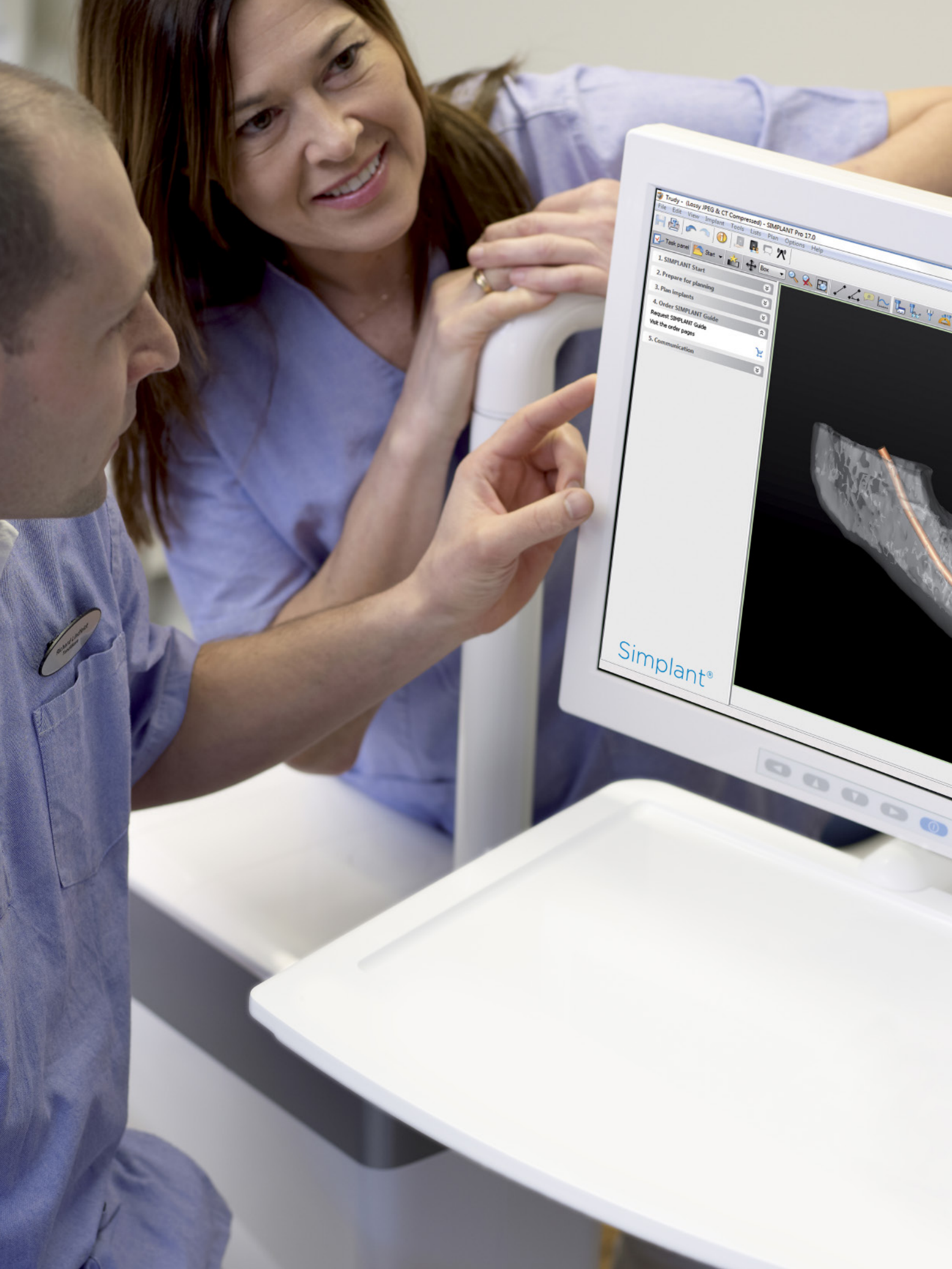
The patient-specific Atlantis Abutment is designed in the Virtual Atlantis Design (VAD) software.

3. Digital design of the crown

The Atlantis Abutment Core File allows the dental laboratory to design a temporary crown before the Atlantis Abutment is delivered.

4. Guided implant placement and immediate temporization

The Atlantis Abutment and crown including the Simplant SAFE Guide and surgical components are delivered prior to surgery.


Trudy - (Lossy JPEG & CT Compressed) - SIMPLANT Pro 17.0
1. SIMPLANT Start
2. Prepare for planning
3. Plan implants
4. Order SIMPLANT Guide
Request SIMPLANT Guide
Visit the order pages
5. Communication
Simplant®

Simplant®

Simplant offers a comprehensive 3D system for predictable implant treatment with all major implant systems. The Simplant Guide connects the digital plan with the surgical intervention. It has been proven that the use of Simplant guides significantly improves accuracy of implant placement compared to free hand implant surgery.

In this section, we present documented benefits such as high accuracy for implant placement when using Simplant guides supported by teeth, mucosa and bone.

Summarized articles:

Accuracy of two stereolithographic guide systems for computer-aided implant placement: a computed tomography-based clinical comparative study 24

How does an error in positioning the template affect the accuracy of implants inserted using a single fixed mucosa-supported stereolithographic surgical guide? 25

Effect of smoking habits on accuracy of implant placement using mucosally supported stereolithographic surgical guides. 26

Deviations between placed and planned implant positions: an accuracy pilot study of skeletally supported stereolithographic surgical templates 27

A randomized clinical trial comparing guided implant surgery (bone- or mucosa-supported) with mental navigation or the use of a pilot-drill template 28

Accuracy and patient-centered outcome variables in guided implant surgery: a RCT comparing immediate with delayed loading 29

Accuracy of two stereolithographic guide systems for computer-aided implant placement: a computed tomography-based clinical comparative study

Authors: Arısan V, Karabuda Z.C and Özdemir T.

Published in: Journal of Periodontol, 2010;81(1):43-51.

Conclusions

- Using Simplant software for the CAD/CAM of surgical guides, based on CBCT images, helps clinicians place implants.
- Implants placed with mucosa-supported guides are more accurate than implants placed with bone-supported guides.
- Simplant guides resulted in smaller implant deviations compared to Aytasarim guided implants (significant for tooth- and mucosa supported guides).

Aim

To analyze and compare the accuracy of two stereolithographic guide systems by support type for computer-aided implant placement.

Material and Methods

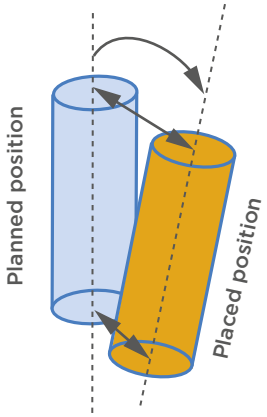
54 patients were randomized to receive one of three types of surgical guides:

- Mucosa-supported
- Bone-supported
- Tooth-supported

Guides were planned and made by either Simplant[1] or Aytasarim[2] system, based on CBCT images.

In total, 294 implants were placed using the guides. The implants were either parallel-walled (145 SPI implants Thommen Medical) or had a tapered design (149 Xive implants, Dentsply Sirona Implants).

After osseointegration (1.5–5 months), new CBCT scans were taken, and deviation from the planned implant placement was measured.



Results

No anatomical complications occurred in relation to the use of the guides. Deviation was measured for 279 implants (15 implants could not be followed-up because 1 patient dropped out, 2 guides broke at surgery and 3 implants did not osseointegrate).

Accuracy:

- Mucosa-supported guided implants had the lowest mean deviations (significant for both guide systems)
- Bone-supported guided implants had the highest mean deviations (significant for both guide systems)
- Incorporating metal sleeves, use of special drill kit and rigid (screws) guide fixation minimized deviations

See Table 1 for values from Simplant Guides.

No statistically significant differences in terms of accuracy between:

- Bone anchored guide systems
- Implant brands
- The maxilla and the mandible (for any guide system)

Deviation	Bone Supported	Mucosa Supported
Angular (°)	5.0 ± 1.66	2.9 ± 0.39
Implant shoulder (mm)	1.70 ± 0.52	0.7 ± 0.13
Implant tip (mm)	1.99 ± 0.64	0.76 ± 0.15

Table 1. Mean deviations for Simplant guides.

[1] Simplant (SurgiGuide and Safe systems, Dentsply Sirona Implants, Hasselt, Belgium)

[2] Aytasarim (Classic and Otede systems, Kos-gep, ODTU Ankara, Turkey)

How does an error in positioning the template affect the accuracy of implants inserted using a single fixed mucosa-supported stereolithographic surgical guide?

Authors: Cassetta M, Di Mambro A, Giansanti M, et al.

Published in: International Journal of Oral Maxillofacial Surgery, 2014; 43: 85–92.

Conclusions

- The guide positioning error affected accuracy of implant placement.
- The type of arch and mucosal thickness did not affect the guide positioning error.
- Accurate positioning of the surgical guide and use of at least three fixation screws to fix the surgical template can reduce positioning error.

Aim

To measure and compare the deviation in implant positioning based on an error in the positioning of the surgical guide, and to see if the type of arch and the mucosal thickness can affect the guide positioning error.

Material and Methods

24 patients with completely edentulous jaw (13 upper, 11 lower), rehabilitated with a total of 172 implants.

Patients had a CT scan to plan implant placement and implant length and width using Simplant software (Dentsply Sirona Implants).

Implant placement:

1. A surgical mucosa supported stereolithographic guide was fixed to the bone based on the Simplant planning (External Hex Safe, Dentsply Sirona Implants).
2. Cylindrical implants (10–15 mm long) were inserted using a stereolithographic surgical template.

The surgical guide was used to:

- Allow control of the implant site preparation.
- Guide implant insertion.

After implant placement, the patients had another CT scan and the images from the two CT scans (preoperative and postoperative) were compared to evaluate the deviation between the planned and placed implants.

Results

No complications in any critical anatomy or related to inaccurate placement of the implants.

Implant survival rate:
100%

Implant deviation was analyzed based on:

- Total error
- Random error
- Systematic (reoccurring) error

The deviation was measured in terms of coronal distance and angular error. See Table 1.

Deviation	Mean	Standard Deviation
Coronal total error (mm)	1.10	0.39
Coronal random error (mm)	0.74	0.30
Coronal systematic error (mm)	0.36	0.43
Angular total error (°)	4.33	1.42
Angular random error (°)	3.61	0.88
Angular systematic error (°)	0.72	1.03

Table 1. Coronal and angular mean and standard deviation between planned and placed implant position.

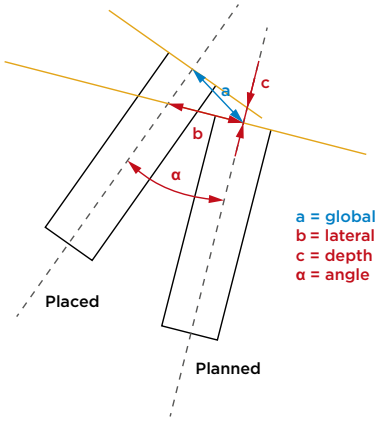


Figure 1. Definition of deviation parameters global, lateral, depth and angular. The first three deviation parameters (global, lateral, and depth) are shown at coronal level.

Effect of smoking habits on accuracy of implant placement using mucosally supported stereolithographic surgical guides

Authors: D'haese J, De Bruyn H.

Published in: Clin Implant Dent Relat Res 2013;15(3):402-11.

Conclusions

- Less accurate implant placement for smoking patients than non-smoking patients.
- Smokers have a thicker mucosa than non-smokers, meaning, when using a mucosally-supported device:
  - Reduced stability
  - Reduced implant placement accuracy

Aim

To see how smoking habits affect the accuracy between virtually planning and actual placement of implants using mucosally supported stereolithographic surgical guides.

Material and Methods

13 patients, 78 OsseoSpeed implants (Dentsply Sirona Implants) (6 per patient) placed in edentulous maxillae:

- 6 smoking patients (36 implants)
- 7 non-smoking patients (42 implants)

Process:

1. Provisional upper jaw dentures were made.
2. Dual scan procedure.
3. Scans converted into 3D models using Facilitate software (Dentsply Sirona Implants).
4. Virtual planning
5. Implants placed using a surgical guide.
6. New scans taken (4-8 weeks after surgery).
7. Scans evaluated for implant accuracy.

The accuracy was based on the comparison of four deviation parameters (global, angular, depth and lateral) when comparing the planned and actual implant placement.

Mucosal thickness was also measured for each patient, as the distance between the surface of the alveolar crest and the base of the scanning template.

Results

Accuracy:

- Significant differences for coronal and apical deviation in smoking patients.
- No significant differences for angular deviation.

See Table 1 for values.

Mucosal thickness (mean average):

- Smoking patients, 3.19 mm (range of 2.39–4.01 mm)
- Non-smoking patients, 2.43 mm (range of 1.44–3.03 mm)

	Patient Type	Mean	Range
Global coronal deviation (mm)	Non-smoking	0.8	0.29–1.67
	Smoking	1.04	0.29–2.45
Global apical deviation (mm)	Non-smoking	1.02	0.32–2.59
	Smoking	1.26	0.39–3.01
Angular deviation (°)	Non-smoking	2.57	0.18–8.86
		2.64	0.41–6.81

Table 1. Deviation Mean and Range for Patients.

Deviations between placed and planned implant positions: an accuracy pilot study of skeletally supported stereolithographic surgical templates

Authors: Stübinger S, Buitrago-Tellez C and Cantelmi G.
Published in: Clin Implant Dent Rel Res., 2014;16(4):540-51.

Conclusions

- Surgeons should be aware of current safety margins when using static navigation tools.
- Minor deviations will always occur, but good planning helps ensure predictability.

Aim

To evaluate deviations between planned and actual implant placement by the use of a 3D planning system and bone supported surgical guides.

Material and Methods

Ten edentulous patients received a total of 44 OsseoSpeed implants (Dentsply Sirona Implants, minimum of 3 implants per patient).

Implant placement was planned on CT images and 3D reconstruction using Simplant software and the plans were used for the CAD/CAM of the bone anchored stereolithographic guides (Dentsply Sirona Implants, Hasselt, Belgium).

The same surgeon did the planning and performed the surgery on each patient.

There were four follow-up appointments after surgery:

- 2 days
- 10 days (sutures removed)
- 6 weeks
- 1 year

At the 1 year follow-up, new CT scans were taken and the deviation from the planned implant placement was measured.

Results

Implant survival rate was 100%.

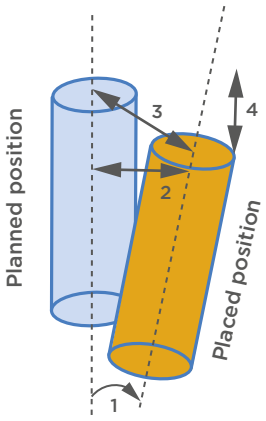
There were no major complaints about the surgical procedure or prosthetic rehabilitation from any patients.

Accuracy:

- Deviations were smaller (not significant) at the coronal tip compared with the apical tip.
- Lateral measurements were the only statistically significant differences.
- Location of the implant in the jaw did not significantly impact deviation, nor did position in the mouth.

Accuracy at the coronal tip of the implant

Deviation	Mean ± SD
1) angle (deg)	2.39 ± 0.97
2) lateral, mm	0.43 ± 0.29
3) depth, mm	0.47 ± 0.43
4) global, mm	0.71 ± 0.40



A randomized clinical trial comparing guided implant surgery (bone- or mucosa-supported) with mental navigation or the use of a pilot-drill template

Authors: Vercruyssen M, Cox C, Coucke W, et al.
Published in: J Clin Periodontol 2014;41(7):717-23.

Conclusions

- Guided implant surgery using Simplant software is more accurate than non-guided implant surgery.
- Type of guide, bone or mucosa supported, did not influence the accuracy on guided implant placement.

Aim

To compare the accuracy of guided surgery (using Simplant software) with non-guided surgery, in fully edentulous jaws.

Material and Methods

In this randomized clinical trial patients were split into six groups with 12 jaws in each group (59 patients total, 72 jaws for surgery) for the different surgical procedures.

Guided surgery groups (Dentsply Sirona Implants):

- Materialise Universal, mucosa supported placement (MatMu)
- Materialise Universal, bone supported placement (MatBo)
- Facilitate, mucosa supported placement (FacMu)
- Facilitate, bone supported placement (FacBo)
- Non-guided surgery groups:
- Mental navigation (Mental)
- Pilot-drill template (Templ)

In total, 314 Astra Tech implants (Dentsply Sirona Implants) were used as follows:

- 4-6 implants per jaw
- Implant diameter: 3.5 mm or 4 mm
- Implant length: 8–15 mm

Procedure for guided surgery:

1. Drill keys were inserted in the guide sleeves.
2. The drill keys guided the drilling position and angle.
3. The holes were drilled:
   - For the Materialise Universal group the depth was visually checked to ensure it was completed correctly.
   - For the Facilitate group a physical stop was used when drilling (no visual checks required).

Mental navigation surgery used visual planning software to plan the implant placement, and pilot-drill template surgery used a surgical stent to plan the drilling position.

Ten days after each surgery, a scan was taken to check accuracy of implant placement compared to the pre-surgery planning data.

Results

- Guided surgery was more accurate than non-guided surgery.
- Significant difference in coronal, apical, and angular deviation between the guided and non-guided groups.
- Larger deviation in the lower jaw for guided surgery and non-guided surgery.

	Mean coronal deviation (mm)	Mean apical deviation (mm)	Mean angular deviation (°)
MatMu	1.23	1.57	2.86
MatBo	1.60	1.65	3.79
FacMu	1.38	1.60	2.71
FacBo	1.33	1.50	3.20
Mental	2.77	2.91	9.92
Templ	2.97	3.40	8.43

Table 1. Statistical deviation per surgical procedure.

Accuracy and patient-centered outcome variables in guided implant surgery: a RCT comparing immediate with delayed loading

Authors: Vercruyssen M, Cox C, Naert I, et al.

Published in: Accuracy and patient-centered outcome variables in guided implant surgery: A RTC comparing immediate with delayed loading. Clin Oral Implants Res 2016;27(4):427-32.

Conclusions

- The accuracy of ExpertEase guided surgery system is comparable to that of other systems.
- No difference in the patient-centered outcome between immediate loading or delayed loading.

Aim

To assess the accuracy and patient-centered outcome of a novel guided surgery system for placing implants in an edentulous upper jaw.

Material and Methods

15 patients, 6 Ankylos implants (Dentsply Sirona Implants) per patient:

- 7 patients for immediate loading
- 8 patients for delayed loading

The immediate loading patients received the final prostheses within 24 hours from surgery, and the delayed loading patients received the final prostheses after 3 months.

CT scans were taken and exported to Simplant software (Dentsply Sirona Implants) to plan the prostheses and surgery for each patient, including the CAD/CAM stereolithographic drill guides (ExpertEase, Dentsply Sirona Implants).

Analysis:
CBCT scans were taken after surgery and compared to the data for the planned implant positions using Simplant software to measure the deviation in position.

Patients were asked to fill in a diary for the week following surgery, and 10 days after surgery the patients had a clinical evaluation to look at the diary, concerning:

- Swelling
- Perceived pain
- Pain response
- Quality of life
- Treatment perception

Results

Patient-centered outcome:
The delayed loading patients had tendency to more discomfort and swelling for longer time than the immediate loading patients, and as such took painkillers for a longer period.

There were no statistical differences for either set of patients for pain response or treatment perception.

Accuracy:
Deviation was comparable to similar studies.
See Table 1 for values.

Deviation	Mean Deviation
At entry point	0.9 mm
At apex	1.2 mm
Angular	2.7°
Horizontal	0.7 mm
Vertical	0.5 mm
Mesio-distal	0.5 mm
Bucco-lingual	0.5 mm

Table 1. Mean deviation compared to the planned implant position.

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A rct comparing immediate with delayed loading.
Clin Oral Implants Res 2016;27(4):427-32 29

Notes

Notes

Notes

Checklist for critical reading of clinical documentation and scientific articles

Reading scientific articles and clinical documentation is essentially about being able to judge how reliable the results are and what they mean for you in your clinical work. In order for a scientific article to be deemed credible, certain data must be present. Here is a list of important and necessary information to look for:

☐ **Purpose of the study**
Why was the study performed? The purpose should be compared with the conclusion.

☐ **Type of study**
Is it a prospective or retrospective study? Generally, prospective studies are better, since the criteria are set before the patients are treated.

☐ **Number of clinics involved**
How many clinics are involved? More than one clinic should be involved in the study, in order to judge the possibility of repeated results.

☐ **Number of patients**
How many patients are included in the study?

☐ **Inclusion and exclusion criteria**
What are the criteria for a patient to be included in or excluded from the study?

☐ **Number of implants for upper and lower jaws respectively**
The number of implants should always be listed separately for upper and lower jaws, including failure statistics, as the treatment prognosis is different in each jaw. An additional advantage is if you can see the difference between anterior and posterior treatment.

☐ **Follow-up**
How many implants have been followed for how long? When did the follow-up start; at installation or at loading?

☐ **Indications**
Which indications are covered in the study; single, partial or full bridge? If it is a full bridge, is it fixed prosthesis or overdenture?

☐ **Loading**
When were the implants loaded (immediate, early or conventional loading)?

☐ **Implants lost**
A study should include both the number of implants and number of patients not accounted for during the entire follow-up period. It should also include the reasons for drop-outs.

☐ **Success criteria**
What is a successful result according to the authors? It is important that the success criteria are clearly described.

☐ **Other important parameters**
How were the results verified? Was x-ray used when determining bone levels? How were bone levels measured? Was the bridge removed to control implant stability?

☐ **Statistical analysis of success and failure rates**
A study should include statistical facts and figures to reveal how many implants were actually followed up and for how long. It should also include a “worst-case” analysis, meaning a calculated failure rate assuming that all drop-outs were lost implants.

☐ **Complications**
If there are complications or drop-outs, they should be clearly described.

☐ **Conclusion**
The conclusion should be compared with the purpose of the study. Was it fulfilled? What does the study actually tell you? How does the result affect your daily clinical work?

About Dentsply Sirona Implants

Dentsply Sirona Implants offers comprehensive solutions for all phases of implant therapy, including Ankylos®, Astra Tech Implant System® and Xive® implant lines, digital technologies, such as Atlantis® patient-specific solutions and Simplant® guided surgery, Symbios® regenerative solutions, and professional and business development programs, such as STEPPS™. Dentsply Sirona Implants creates value for dental professionals and allows for predictable and lasting implant treatment outcomes, resulting in enhanced quality of life for patients.

About Dentsply Sirona

Dentsply Sirona is the world's largest manufacturer of professional dental products and technologies, with a 130-year history of innovation and service to the dental industry and patients worldwide. Dentsply Sirona develops, manufactures, and markets a comprehensive solutions offering including dental and oral health products as well as other consumable medical devices under a strong portfolio of world class brands. As The Dental Solutions Company™, Dentsply Sirona's products provide innovative, high-quality and effective solutions to advance patient care and deliver better, safer and faster dentistry. Dentsply Sirona's global headquarters is located in York, Pennsylvania, and the international headquarters is based in Salzburg, Austria. The company's shares are listed in the United States on NASDAQ under the symbol XRAY.

Visit www.dentsplysirona.com for more information about Dentsply Sirona and its products.

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