Deviation rate average of 0.9 degrees, greatest accuracy and stability
DIOnavi brings a butterfly effect to patient marketing and dental treatment system.

“DIOnavi is a DIO digital implant system”

1st Generation
2D Panorama Stent

Panorama image, stent considering the approximate prosthetic relationship. Only used as reference.

2nd Generation
CT analog guide

CT guide in the early 2000s that applied a CT image.

3rd Generation
CT + Impression Analog Guide & RP Guide

Took the impression stone model with a CT. Produce by introducing a coordinate concept on S/W.

4th Generation
CT + Oral scan Surgical Guide

Digital Impression. Modeless Customized Abutment Design. 3D Printing & CAD/CAM
DIO navi is an equipment that 100% digitalizes the whole treatment process and it is optimized to complete the implant treatment without taking an impression. Especially, DIO navi surgical kit will provide not only optimal convenience and accuracy to the doctors but will also provide comfortability to the patients.

Greatest accuracy and stability

Through implant planning that considered occlusion and stress dispersion, DIOnavi Digital Implant System increases the accuracy of the implant treatment and enabled 3D simulation that is used for patient counsel purposes.

- Digital Diagnosis
- Planned implant treatment
- Digital impression
- Customized prosthetic

DIOnavi Treatment

Implant can withstand the highest load because the crown is designed first in consideration of occlusion and stress diversion, followed by fixture placement.

Normal Treatment

Due to the fact that it is difficult to adjust the center of the implant and crown, the load is not effectively dispersed and this may lead to prosthetic fracture of failure of implant placement.

DIOnavi. One-Step Protocol

If CT data and oral scan data were sent to the DIO digital center, implant treatment is possible with a surgical data created with a 3D printer in a week.

Dental Clinic

CBCT Data + Trios Data

Simulation
diagnosis completed

DIO Digital Center

C.A / Abutment jig / Surgical guide
3D Printing & CAM milling
Customized Abutment & Provisional crown design
Surgical-guide design

5 days of production period After confirmation
Great precision and stability in existence

- Procedure deviation average of 0.9° (greatest exactitude with 1.9° at most)
- Exact oral data acquisition with CT and Digital Impression

### Surgical Guide | Analog vs Digital

<table>
<thead>
<tr>
<th></th>
<th>Analog</th>
<th>Digital</th>
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<tbody>
<tr>
<td>Manufacture</td>
<td>after plaster scanning</td>
<td>by scanning the plaster mode</td>
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</table>

Guide produced in plaster model

Guide produced by scanning the oral cavity

### Surgical Guide | Other Companies

<table>
<thead>
<tr>
<th>N Company</th>
<th>M Company</th>
<th>DIONavi.</th>
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<tbody>
<tr>
<td>Impression</td>
<td>Alginate Impression</td>
<td>Alginate Impression</td>
</tr>
<tr>
<td>Stone Model</td>
<td>Stone Model</td>
<td></td>
</tr>
<tr>
<td>Guide Height</td>
<td>9mm</td>
<td>12-13.5mm</td>
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<tr>
<td>Recommended Drilling RPM</td>
<td>1,000-1,200 RPM Irrigation</td>
<td>1,000-1,200 RPM Irrigation</td>
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<tr>
<td>Degree of Precision before and after surgery</td>
<td>0.1-15.3 degree</td>
<td>0.1-5 degree</td>
</tr>
<tr>
<td>Average of 4.9°</td>
<td>Average of 2.5°</td>
<td>Average of 0.9°</td>
</tr>
</tbody>
</table>

### Literature

<table>
<thead>
<tr>
<th>Reference</th>
<th>Deviation</th>
</tr>
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<tbody>
<tr>
<td>Van Assche N. Clin Periodontol 2010</td>
<td>2.7°</td>
</tr>
<tr>
<td>Ozan O. J Oral Maxillofac Surg 2009</td>
<td>4.1°</td>
</tr>
<tr>
<td>Di Giacome GA. J Periodontol 2005</td>
<td>7.3°</td>
</tr>
<tr>
<td>Valente F. Int J Oral Maxillofac Implants 2009</td>
<td>7.9°</td>
</tr>
<tr>
<td>DIONavi.</td>
<td>0.9°</td>
</tr>
</tbody>
</table>

※Reference: Thesis about Guide system comparing the degree of precision
Normal procedure vs. DIONavi procedure

**Doctors & patients’ convenience provides a Butterfly effect**

Because DIONavi is a flapless surgery, the pain and swelling decreases, and it is suitable for patients with diabetes, high blood pressure, mental disease and it can create a new blue ocean such as busy businessmen, patients who were afraid to get a surgery, and senior implant.

*All of DIONavi procedure takes only 10~20 minutes (1~2 unit)*

---

**Time for DIONavi system to make a temporary prosthetic – average of 5~7 days**

**Time for normal implant to make a temporary prosthetic – average of 4 months**

The DIONavi system is fast and accurate because the total process is digitalized.

- ✓ Less pain
  - There is less pain due to no incision

- ✓ Less bleeding
  - There is less bleeding due to no incision

- ✓ No suture
  - There is no suture due to no incision

- ✓ No damage
  - There is no damage of surrounding nerve or teeth due to the use of exact guide

- ✓ No inconvenience
  - Can be treated without inconvenience due to the use of comfortable guide

---

**About 123 days till temporary prosthetic (minimum of 4 months)**

**Surgery 50 minutes + maxillary and mandible impression taking 20 minutes / stone model creation 40 minutes + 20 minutes = 130 minutes (To temporary prosthetics)**

**Average time for DIONavi (1~2unit)**

- Surgery & temporary prosthetic 15 minutes
  - = 15 minutes (To temporary prosthetics)

---

**Average time that takes for normal treatment (1~2unit)**

**Surgery 50 minutes + maxillary and mandible impression taking 20 minutes / stone model creation 40 minutes + 20 minutes = 130 minutes (To temporary prosthetics)**

---

**Digital oral scan**

- Average of about 5 ~ 7 days till temporary prosthetic

**Average of about 5 ~ 7 days till temporary prosthetic**

**Final prosthetic**
The patient has a history of general disorder such as high blood pressure and diabetes, slight paralysis due to stroke, and uses full dentures with only one canine tooth which is wobbly. Align the CT data and trios oral scan image. Surgical guide is automatically designed adjusted to the planned implant placement location, and exact placement direction and location can be confirmed. Place the virtual crown for the optimum implant position. Modify the tooth placement and design and obtain the best occlusal status. This is a CT image of the implant that is placed exactly on the spot it was planned. Not only the mock implant surgery plan that considered the occlusion and stress dispersion, but 3D simulation that can be used as a counseling material for the patient is provided. The doctor can establish a satisfactory treatment plan and with a provided surgical guide, he can operate a safe and accurate procedure.

**Implant treatment 3D diagnosis and simulated surgery system**

**History Taking**
The patient has a history of general disorder such as high blood pressure and diabetes, slight paralysis due to stroke, and uses full dentures with only one canine tooth which is wobbly.

**Scan Alignment**
Align the CT data and trios oral scan image.

**Virtual Crown set up**
Place the virtual crown for the optimum implant position.

**Simulation**
Modify the tooth placement and design and obtain the best occlusal status.

**Implant Plaring**
Consider the crown location, design, occlusion, bone density and nerve location to set the optimal implant location.

**Implant Simulation**
Check the implant occlusion and path that considered a prosthetic relationship in a top-down method.

**Surgical Guide design**
Surgical guide is automatically designed adjusted to the planned implant placement location, and exact placement direction and location can be confirmed.

**Finish Design**
The optimal surgical guide design that considered patients' bone density, prosthetic location and occlusion relationship is completed.

**Implant Surgery**
Procedure case that used DIONavi surgical guide.

**DIONavi**
This is a CT image of the implant that is placed exactly on the spot it was planned.
When performing a surgery with a surgical guide, DIONavi surgical kit is optimized to easily and accurately place implants with the superb cutting force of swiss-made technology.

**DIONavi. Surgical Kit**
*Drills Swiss made*

The first step to the perfect implant placement

---

**DIONavi. Surgical Drill Components**

**No water**
- No water ponding during the procedure
- Provides comfort to patients

**No suction**
- Easy to collect autoknoten

**No noise**
- Minimize noise with low speed drilling and no suction

**No heat**
- Low speed drilling below 50rpm
- Use a Swiss drill with great cutting force

**DIONavi. Master Kit**

Kit that can place UFII Narrow and Regular Fixture

**DIONavi. Starter Kit**

Simple kit that can place the fixture with length 10mm, 11.5mm and diameter 3.6, 4.0, 4.5 that is used most

**Bone Flattening Drill**

- Flattens the bone surface for an accurate 1st drilling

**Tissue Punch**

- Removes the soft tissue on the alveolar gum where the implant will be placed.
- It has a second blade inside that cuts the gum and removes it at the same time.

**Abutment Profile Drill**

- Removes the bone and gum that bothers the abutment placement.
- Able to adjust the height with a stopper and form an abutment profile by spinning 360 degrees.
**DIOnavi. Clinical Case_01**

**Pre-operative CT**

**CT image cutting**

**Image matching**

**Set up plan**

**Detect a nerve**

**Virtual**

**Implant Planning -1**

**Implant Planning -2**

**Guide Design**

**Surgical guide materials**

- **Name**: PPG (52/M)
- **Date Of Surgery**: 2014. 02. 14. (Segyero Dental Hospital)
- **Surgery Done By Dr. Chung Dongkeun**
- **Pre-Medical History**: N/S
- **C.C**: I want to place implants where there are no teeth

**Patient Information**

Patient who is sensitive to small stimulation, easily gets cold sore in the mouth, and has severe stomatitis.

Match the Trios scan file and CT image file, the rate of matching is higher with greener colors Set up plan

Set the range of surgical guide for a sufficient stability and retention.

Design a fixture size considering the location of the inferior alveolar bone nerve, relationship with the adjacent teeth, and quality and quantity of bone.

Design a virtual crown

Surgical guide Customized abutment & PMMA Provisional crown (14.02.14)
Intra-operative Photo

Teeth surrounding the surgical area secure the stability of the surgical guide.

Drilling is easy because the guide is manufactured lower than the occlusion level.

#47 is a fixture that is planted in a common way and the fixture and abutment is tilted toward the abutment mesial.

#37 is a fixture that is planted using a surgical guide, and the abutment is located in the center.

Autogenous bone that is collected with no irrigation and low RPM

Locate the screw hole in the center

You can see that the relationship with the antagonist tooth is good

Abutment + Provisional crown connected on the day of the surgery

Flapless surgical method is favorable functionally and esthetically, and the complications are minimized after the surgery.

When compared the two methods, if one proceeds with the surgical guide op that considered the prosthesis' function, the abutment shape will be fabricated in an ideal way.

Korea Dental News published document

Professor Choi Byung Ho

1982 ~ 1985 Training at the Oral & Maxillofacial Surgery Dept., Yonsei University, Korea
1989 ~ 1991 Training and Ph.D. Degree at the Oral and Maxillofacial Surgery Dept., Freiburg University, Germany
1992~present Professor, College of Dentistry and Wonju College of Medicine, Yonsei University

Awards Best Paper Award for 2008 by the journal “Oral Surg Oral Med Oral Pathol” in USA

Book publications

Contents
- From Initial Diagnosis to the Final Prosthesis: Full Digitalization (First)
- From Initial Diagnosis to the Final Prosthesis: Full Digitalization (Second)
- Computer-Guided Flapless Implant Surgery (First)
- Computer-Guided Flapless Implant Surgery (bottom)
From Initial Diagnosis to the Final Prosthesis: Full Digitalization (First) Outline

There are two types of dental implant treatment systems: analogue and digital. Analogue system involves the act of manually creating the prosthesis using plaster casts; while digital system, uses CAD/CAM scanned image instead. Digital system has had limitations thus far in the overall implant treatment procedures.

Digital system was utilized in designing the surgical guide and abutment after the plaster cast had already been manually created (1). Or the digital system was used to model the upper prosthesis using the scanned image of the placed implant area (2)(3). However, the efforts to digitize the entire process, from initial diagnosis, designing surgical guides and developing both temporary and permanent prosthesis, had not yet been fully realized. This paper therefore, attempts to suggest a method where the whole implant treatment procedure can be 100% digitized, eliminating the need for impression-taking and cast-making.

Analogue System vs. Digital System

There are a number of steps involved in an analogue system. Firstly, impression material is used on the desired area to obtain a basic outline, which is then filled with plaster material to develop a cast. After removing the wax from the cast, either gold or ceramic can mold the shape. This cast is also used to design and develop the surgical guide. As noted, impression taking constitutes the beginning of the analogue system. Thus, if a bad impression is developed, rest of the steps becomes difficult and the final prosthesis will lack precision. Therefore, the impression-taking process is a difficult and time-consuming process for the practitioner. In particular, extra time and attention is needed to accurately capture the cervical margin of the implant abutment during impression-taking.

Moreover, the patient must oftentimes endure the discomfort of waiting for impression material to solidify inside the mouth and those patients with a weak stomach may suffer from nauseous feelings.

Digital implant System Steps

1. Digital impression

Digital implant system begins with digital impression. Digital impression refers to the scanned image, which was obtained using an intra-oral scanner inside the mouth. Intra-oral scanner TROS™, developed by Denmark’s 3Shape, can take over three thousand 2D images per second to create a highly accurate 3D digital model.

2. Digital Implant Treatment Plan

The patient’s oral scanned image and Cone Beam Computed Tomography (CBCT) of the jaw is compiled together using diagnostic software. This compiled image illustrates the anatomical structure of the teeth, gum and jaw in one image, and also allows the implant’s placement position to be analyzed and designed more effectively.
There is a number of diagnostic software available in the market and the most well known software is a 3D modeling software called Implant Studio™, developed by 3Shape. Implant Studio™ matches the digital image from the oral scanner and the image from CBCT to help make a decision regarding the implant’s placement position.

3. Developing Digital surgical guide
Once the placement position has been determined, surgical guide can be designed using the oral scanned image.

4. Digital production of a customized temporary prosthesis
The implant placement position (determined by using Implant Studio™) is loaded onto the 3D modeling software called Dental System™, which is also developed by 3Shape.

5. Implant surgery
Using a surgical guide makes flapless procedure a possibility. This is because the surgical guide contains all the necessary information, including implant placement position, direction of placement, and drilling depth. The position, direction and drilling depth is guided by the surgical guide and therefore, the implant can be placed more accurately without having to open up the gum to locate the bone.

The advantage of the flapless surgery is that any aesthetic prosthetic restoration can take place immediately after the implant placement. This is due to the fact that soft tissue profile of the alveolar region is stabilized even post-surgery (40S).
So this kind of software can be used to calculate the bone density level before the surgery and allow drilling sequence to be planned accordingly, which can help achieve initial fixation.

**From Initial Diagnosis to the Final Prosthesis: Full Digitalization (Second)**

6. **Implant Digital Impression**
   Immediately after placing the implant, place the scan body on the implant to scan for digital impression.

   ![Image 16: Image of scan body placed on the implant]

   This digital impression is used to make the final prosthesis. Scan body provides necessary information for developing the abutment and crown later on (637).

7. **Immediate Restoration**
   Once the implant has been fixed on its initial position, place the pre-manufactured, customized temporary PMMA abutment and crown on the implant for immediate prosthetic restoration. If necessary, adjust the abutment and the crown inside the mouth.

   ![Image 14: Accurately illustrating the bone density level of the proposed implant placement area according to implant's height and width in Hounsfield Unit]

8. **Digitally manufacturing customized prosthesis**
   Use Dental System™ software to design the abutment and crown, using the digital impression obtained from the scanned image from step 6.

   ![Image 18: Designing customized abutment and crown]

   Then, use the Arum S-Axis Milling Machine to manufacture those abutment and crown. Titanium or Zirconia is used to make the abutment and zirconia is used for the crown.

9. **Final Prosthetic Restoration**
   Depending on the level of stability with the implant bone marrow, final prosthetic restoration can take place 1-3 months after the surgery. This final stage involves connecting the customized abutment to the fixture and capped off with the crown.

**CASE STUDY**

A 39-year-old woman needed an implant on the maxillary right central incisor.

   ![Image 19: Image of the patient’s mouth]

   It was 3 months after from when the damaged tooth was removed and the surgery area had healed well. At the time, she was wearing a temporary prosthesis and she wanted a fast but also aesthetically pleasing permanent restoration. Radiographic analysis of the alveolar region showed a good bone height in the mesiodistal axis but only 5mm of width in the buccolingual axis.
were designed. Surgical guide was made using a 3D printer, while the abutment and crown were made with zirconia via Arum milling machine.

Thus, the surgical guide, customized abutment and crown were all prepared before the procedure. BMD of the implant site indicated a D2 bone density level and drilling sequence was predetermined like Image 28.

After applying local anesthesia, the surgical guide was placed on the tooth. The procedure took place under flapless method using the surgical kit developed by DIO Implant. A 2.5 mm-diameter drill was used in accordance with the drilling sequence. Once the implant had been placed, the implant’s insertion torque measured 35Ncm. DIO Implant’s 3.8 mm x 13 mm UF Implant Fixture was used for the procedure. The total procedure took around five minutes. Stability level, immediately following the procedure, measured -2 on the peri-implant. Once the initial implant had been stabilized, customized abutment and crown (made using zirconia) was placed and fixed on the implant.

The post-operation radiographs confirmed that implant had been placed with some room from neighboring teeth and its roots.

CT image was taken to measure the success of the procedure - which confirmed that the implant was safely placed with just 1.1 degree of error within the bone.

Conclusion
1. The entire procedure, from initial diagnosis to the final prosthesis, was done using digital system, without impression taking. It took just two visits to the medical facility to successfully restore the defected maxillary right central incisor using implant.

2. If the width of the alveolar is significantly narrow, just enough for the implant, the flapless procedure method and highly precise surgical guide and surgical kit can be utilized to safely place the implant.

3. Proper use of flapless procedure with right surgical guide and kit can reduce need for undertaking GBR.
Computer-Guided Flapless Implant Surgery (First)

Abstract
In a computer-guided flapless implant surgery, all of the necessary information is determined pre-surgery. The Cone Beam Computed Tomography (CBCT) and computer planning software are used to capture the shape of the mouth, including alveolar, membrane and teeth in a 3D image. This image is used to determine the position, direction and height of the implant and this information helps design the surgical guide.

Surgical Equipment
Surgery guide-led, flapless implant procedure requires the following equipment: Soft Tissue Punch drill, Bone flattening drill, Guide drill, Final drill, drill tube, implant connector, and abutment profile drill.

Soft Tissue Punch Drill
A Soft tissue punch drill is used to drill a cylindrical shape into the gum in the flapless implant procedure.

Soft tissue punch drill continues to remove the soft tissue until it hits the surface of the bone underneath, thus does not need a separate stop feature.

Bone flattening drill
If the surface of the alveolar crest is either pointed, slanted or irregular, the drill can slip when it hits the bone, even with the use of the surgical guide.

In a flapless procedure, the implant can be placed, according to plan, without having to expose alveolar bone. In this procedure, selecting the surgical equipment is also very important. Two factors must be considered when making this decision: precision and convenience. Precision refers to the level of precision of both the drill and the implant placed. Convenience refers to the level of convenience for both the user of the equipment (practitioner) and the recipient (patient). Both precision and convenience must be taken into account when selecting the surgical equipment. Moreover, since the surgical equipment/kit must be compatible with the surgical guide, the practitioner must make sure that the surgical guide and kit is developed from the same company as the one that developed the implant.

Using a drill with a smaller blade diameter has two advantages. Firstly, smaller-sized opening means the membrane tissue around the implant is closer to the surface of the abutment, which has a hemostatic effect. Secondly, the wound tends to heal faster and leaves fewer scars. Soft tissue punch drill is shaped like a cylinder to match the surgical guide's guiding sleeve (so that the drill can be inserted into the sleeve and move according to the surgical guide). The blade has a circular shape, 3mm in diameter. Using a drill with a secondary blade within the circular 3mm blade can remove the incised gum parts as the gum is cut in a circular shape.

This can lead to displacement during drilling and also during implant placement.

So there is a need for an additional step to smooth the surface and to prevent the slipping of the drill or implant. In the flap method, bone mucosa flap is exposed to flatten the alveolar surface.

However, in a flapless procedure, bone flattening drill is able to flatten the surface of the alveolar crest without exposing the membrane flap.

The drill also is shaped like a cylinder to fit the surgical guiding sleeve. In addition, there is a scale on the drill so the practitioner can identify the depth during drilling.
The drill has a horizontal cutting blade to be able to flatten the surface of the alveolar crest.

Guide drill
Guide drill is used to make the first hole on the bone's surface. This drill has a spear-like sharp blade and a cylindrical body to match the drill tube.

The Surgical guide helps guide the drill during the procedure. Guide drill's purpose is to create the initial precise location and direction for the subsequent drills to follow. It also has a stop feature on the body to prevent drilling beyond a certain depth. To use the Guide drill, firstly, matching drill tube is inserted into the surgical guide's guiding sleeve, then Guide drill is inserted into the tube.

The drill is organized by height and diameter.

Guide drill tends to be more effective and precise in establishing the initial path than the 2mm twist drill. However, it is ineffective to make an actual socket for the implant placement. A final drill is much more effective for that.

Final drill
This drill drills a hole in the bone necessary for placing the fixture. Drill is organized by height and diameter.

Image 18: Spoon-shaped Drill Tube
While offering convenience when holding, a spoon-shaped drill tube can actually alter the drill tube's angle during drilling and if it is used for rearmost teeth region, the patient's cheek can disturb the procedure. Alternatively, the drill tube with a short handle has two advantages. Firstly, the handle can be positioned either on the lingual or buccal side. Secondly, once the tube has been inserted into the guiding sleeve, it is unnecessary to continue holding onto the handle during the procedure.

Drill tube
Drill tube is inserted into the guiding sleeve to guide the drill's direction during the procedure.

The tube is made with titanium and has a stop function (height: 1mm) at the top. The tube's diameter matches the drill being used. The drill tube also comes with a handle to help insert it into the guiding sleeve. The shape and height of the drill tube differs according to the manufacturing company.

However, its disadvantage is that with the short-handle drill tube, there is a chance that the tube can be dropped into the patient's mouth during the procedure. Therefore, it is a good practice to tie a string on the handle.
It features a scale to identify the depth of the implant. For example, if the surgical guide is 9mm in height, implant connector has a scale 9mm above the implant. In addition, implant connector has a hexagonal marker.

Through the act of matching the markers on the surgical guide and the one on the implant connector, the hexagonal marker helps to match the direction of the placed implant to the one that was planned during the diagnosis stage. The diameter of the implant connector is usually smaller than the diameter of guiding sleeve and it depends on the manufacturing company.

Simply add more space on the side not facing the surgical guide and design the connector so that if it cannot be removed by hand, it can be removed using another equipment. For example, design the implant connector it so that a crown remover can be used to remove it from the surgical guide.

Computer-Guided Flapless Implant Surgery (bottom)

Abutment profile drill
Abutment profile drill is used to remove any piece of the bone that may interfere when the scan body is placed on the fixture or abutment.
Bone interference is one of the major reasons why the abutment does not fully connect with the fixture.

This issue arises when the fixture is inserted deeper into the alveolar surface than originally planned and, thus, when the abutment (which is larger than the fixture) tries to connect on the top of the fixture, the bone surrounding this area can prevent clean connection. This is why the abutment profile drill is utilized to remove any alveolar bone that interferes on the surface.

Surgical Procedure

1. Equip the Surgical Guide
   Position the surgical guide on the mouth and make sure it is stable.

2. Soft Tissue Punch
   Following the surgical guide, insert the soft tissue punch drill and start drilling until the drill touches the bone. Remove a 3mm-cylindrical shape from the gum along the alveolar crest.

3. Drilling alveolar crest
   If the CBCT scan shows any signs of pointed or slanted or irregular shape along the alveolar bone surface, bone flattening drill can be used to flatten the surface. The necessary depth of drill is determined using CBCT as a guide. Then the bone flattening drill is used to drill up to that depth.

4. Guide drill
   Insert the drill tube into the surgical guide’s guiding sleeve, and then insert the Guide drill into the drill tube. Begin creating the first hole on the bone’s surface (Image 40). If the CBCT image shows a flat alveolar crest surface, then it is possible to skip the Guide drill and move straight to the Ø 2.0 mm drill.

5. Ø 2.0 mm initial drill
   The first drill used is the Ø 2.0 mm drill. The drill tube is inserted into the surgical guide’s guiding sleeve. The Ø 2.0 mm drill is inserted into the opening on the drill tube.
If Guide drill was used previously, then this drill can follow the hole created by the Guide drill to the point where the drill's stop scale meets the top of the surgical guide. The reason for using a drill tube when using a Ø 2.0 mm drill is because by doing so, the drilling can be guided from the early stages.

If the drill tube is not used, then the drill can only be guided in the later stages by following the initial cylindrical shape left by the earlier drills.

Therefore, it is a good idea to use the drill tube from the early stages to increase the precision level. Subsequent drills that follow the Ø 2.0 mm drill, does not need to be used in conjunction with the drill tube since the larger-sized drills can simply follow the initial opening and increase the hole as it continues to drill. One thing to keep in mind when using a drill tube is since the drill's blade touches the drill tube's skin, the practitioner must be careful not to destroy the tube while drilling. For this reason, the practitioner must get a feel of the surgical guide's direction with the drill and drill in that direction. In addition, if it is difficult to position the drill within the drill tube because of the patient's smaller oral opening, a shorter (5mm) Ø 2.0 mm drill can be used or the drill can be inserted into the drill tube before sliding the drill tube into the surgical guide's guiding sleeve. If the shorter drill is used, do not try to drill until initial depth is achieved. Subsequent drills that do not require use of drill tube can establish that depth as needed.

6. Subsequent drilling
The drilling sizes that were determined during the simulation stage can be used in the order of increasing size. These subsequent drills can also be drilled without the assistance of a drill tube, but rather, follow the path from the earlier drills. Subsequent drills are directed by the cylindrical opening left by previous drills, and they are drilled until the stop level is achieved.

7. Additional Drilling
For lower jaw area with bone marrow density of D1 or D2, and especially for compact bone areas, profile drill is used additionally to create a socket size similar to the size of the fixture.

This step is necessary to insert the fixture up to the determined depth without applying excessive torque.

Before and after drilling, and during drill switching, socket must be cleansed as much as possible.

This act of cleansing the socket during drill switches is important as the heat from the drills can cause osteonecrosis, especially since there are limited opportunities for it to occur during procedures involving surgical guides. If a number of implants are being planted, the implants must be inserted after all the drilling has been completed. This is because during inserting implants, surgical guide's position can change due to implant connector's pressure.
8. Establishing abutment profile

If the fixture was inserted beyond alveolar surface, abutment profile drill is inserted into the surgical guide until it hits the stop level to create a shape similar to the abutment profile.

During this stage, make sure the implant connector and fixture is connected completely and accurately. Implant can be inserted as it is being spun using a torque wrench or contra-angle handpiece. If there is enough opening, use the contra-angle handpiece first to insert the fixture and then use the torque wrench to adjust the vertical depth and hexagon's position based on the simulation.

This step also helps remove any alveolar bone pieces that may interfere once the abutment or scan body is connected.

9. Placing the implant

Before placing the implant, firstly clean the socket and make sure the area is completely free of any soft tissue. Pick up the implant using implant connector and insert the fixture into the bone along the surgical guide.

Thus, match the implant placement depth between surgical guide and the scale on the implant connector, then using the markers on the surgical guide and the implant connector, match the fixture's hexagon position with the implant's hexagon position.

The reason for using contra-angle handpiece before the torque wrench to insert the fixture is that rather than relying on the hand when using torque wrench, the motor of the contra-angle handpiece can help insert a certain way without shaking. Remove the connector once the implant has been placed. If excessive torque is applied on the fixture during placing the implant, internal hexagon can be damaged, which makes it difficult to remove implant connector from the fixture. It can also alter the position of placement, which can lead to the connector getting stuck on the wrong angle along the surgical guide. If this occurs, use the crown remover to connect with the implant connector to help remove it from the fixture.

If there is a need to adjust the abutment and the tooth, it can be done inside the mouth. If immediate loading is not desired, occlusal (bite) adjustment can take place to prevent contact with antagonist tooth.

10. Immediate prosthetic restoration or fitting healing abutment

If the implant secured its initial fixed position, immediate prosthetic restoration can take place by fixing the customized temporary PMMA abutment and crown (which were designed and manufactured presurgery) on the fixture.

If the initial fixed position has not been established, mount the healing abutment instead. Make sure that healing abutment has an additional height of about 1.0 mm above the membrane region. This is because the mucous membrane can swell up to 0.7 mm post-surgery. If the swelling covers up the healing abutment, switch the abutment with the one with more height. Diameter of the healing abutment should be about 1mm larger than the diameter of the soft tissue punch to allow surrounding mucous membrane a closer contact with the healing abutment.