Cone Beam

Implant Planning Manual

(Everything you want to know about CBCT planning)
Implant surgical guides using Cone Beam Computed Tomography is the most advanced process of predictably planning dental implant placement. ROE Dental Laboratory’s Dental Implant Planning Service is a nationally recognized all-inclusive, turn-key solution to supporting dentists in surgical guidance. We offer treatment planning, diagnostic work-up and evaluation, CBCT technical support, live on-line meetings, surgical guides, surgical reports, and final restorations. By selecting ROE to support your practice, you chose an experienced team that has completed thousands of successful cases.

Significant advancements in cone beam planned surgical guides during the past few years have allowed surgical guidance to be more affordable and accessible. With our service you can create surgical guides for any type of treatment from single unit placement to immediate-load “All-on-4”. We accommodate all implant systems and provide surgical guides that accommodate your existing armamentarium and all guided surgical kits. This manual will lead you through the CT process, beginning with guide choice.

Choose guide type

The first step in the process is to choose the type of surgical guide and the planning software to be utilized. There are four basic designs from which to choose. All planning software systems can accommodate tooth or tissue supported guides, however bone supported guides placed on a fully flapped ridge can only be created with two of our software choices, SimPlant and BlueSkyPlan.

<table>
<thead>
<tr>
<th>Guide Type</th>
<th>Hamaguchi</th>
<th>Bone Anchored/Tissue Supported w/ stabilization pins</th>
<th>Bone Supported/Bone Anchored fully flapped</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tooth Supported partially edentulous</td>
<td>Tooth Supported partially edentulous</td>
<td>Bone Anchored/Tissue Supported w/ stabilization pins</td>
<td>Bone Supported/Bone Anchored fully flapped</td>
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<tr>
<td>Tissue Supported edentulous</td>
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</table>

Choose the software

Once the guide type is selected you will need to decide which software is the best choice for your particular case. Cost, return-time, guided surgery kit compatibility, and case sophistication are all factors to consider. The chart below lists the related features of the each of our four software choices.

<table>
<thead>
<tr>
<th>Software</th>
<th>Cost</th>
<th>Return Time after Case Plan is Approved (days)</th>
<th>Guided Surgery Kit Compatibility</th>
<th>Software Sophistication</th>
</tr>
</thead>
<tbody>
<tr>
<td>SimPlant</td>
<td>$$$</td>
<td>7-10</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>BlueSkyPlan</td>
<td>$</td>
<td>3</td>
<td>Limited</td>
<td>Good</td>
</tr>
<tr>
<td>iDentBio</td>
<td>$</td>
<td>3</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Nobelguide™</td>
<td>$$$</td>
<td>7</td>
<td>Only Nobel</td>
<td>Good</td>
</tr>
</tbody>
</table>
The choice of software affects the materials and steps involved in the process. The chart below provides an overview of the requirements as they relate to the software selected. Please note that two of the systems, SimPlant and BlueSkyBio, allow us to use the more efficient and cost effective no-scan appliance technique. This details of this technique are explained on page 8.

<table>
<thead>
<tr>
<th>Select a software</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Accurate models or impressions</td>
</tr>
<tr>
<td>Scan Appliance Technique</td>
<td></td>
</tr>
<tr>
<td>SimPlant</td>
<td>X</td>
</tr>
<tr>
<td>BlueSkyBio</td>
<td>X</td>
</tr>
<tr>
<td>iDent</td>
<td>X</td>
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<tr>
<td>Nobelguide™</td>
<td>X</td>
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<tr>
<td>No Scan Appliance Technique</td>
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<td>X</td>
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<tr>
<td>BlueSkyBio</td>
<td>X</td>
</tr>
</tbody>
</table>

**What is a scan appliance and when is it required?**

A scan appliance (a.k.a. radiographic guide) is a rigid acrylic appliance which fits over the existing teeth and tissue. It represents the teeth to be restored and includes radiopaque markers for registering the appliance in the CT. The proper fabrication of the scan appliance is the critical first step CT planning.

In most situations the final surgical guide is a digital duplicate of the scan appliance, so design and fit are crucial. To ensure surgical guides fit at the time of surgery, final impressions and master casts must be precise.

As mentioned above, proper design of the scan appliance is essential. Material thickness, proper placement of radiopaque markers, density of material, and adequate tooth and tissue coverage for guide sleeves are all important. Scan appliance protocols are available through our website www.dentalimplantplanning.com, however it is our experience that better outcomes are achieved when our they are fabricated through our laboratory. Turnaround time is 4 laboratory days.

Scan appliances are not always needed. When a case involves 5 teeth or less, and there are minimal metal-based restorations present, a scan appliance can be avoided, lowering the cost and simplifying the process. It is important to note that NobelGuide and iDent always require scan appliances.
Scan Appliance Technique - Indications & Protocols:

When is a Scan Appliance required?

- **Reconstructive cases** - For surgeries involving the restoration of significant dentition, particularly in the anterior segment, it is beneficial to have the tooth position verified intraorally with a scan appliance.

- **Edentulous cases** – Without a scan appliance, implant position may not coordinate with final tooth position and may compromise the definitive restoration.

- **Avoiding excessive scatter** - Metal restorations cause scatter. Excessive scatter requires the use of a scan appliance. The amount of scatter can be determined from a preliminary CT or existing radiograph.

**Software choices** - BlueSkyPlan, SimPlant, iDent, NobelGuide

What are the steps required when a Scan Appliance will be utilized?

**Step 1. Restorative Doctor:** Provide quality master casts, full-arch maxillary and mandibular silicone impressions, a bite registration, study model and completed CT Order Form.

**Step 2. ROE Dental Laboratory:** Create a diagnostic wax-up of the proposed final tooth position. Once approved a CT scan appliance is fabricated. If the patient has an existing denture with desired tooth position, it can be used as the scan appliance (see page 10). If the denture is ill-fitting a hard-reline is necessary.

**Step 3. Restorative Doctor:** Try-in the scan appliance to verify the fit. Once approved scan the patient following the specific protocol. If the fit is not ideal, adjust accordingly or capture new impressions and remake the scan appliance.

**Step 4. Imaging Location:** Record CT scan – a specific protocol must be followed for each planning software. If you have any concerns about this process, we suggest calling ROE while the patient is still in the office to confirm the accuracy of the scan. Upload the DICOM to ROE through www.dentalimplantplanning.com.

**Step 5. ROE Dental Laboratory:** Preplan case using planning software ensuring implant locations meet surgical and restorative requirements.

**Step 6. Specialist, restorative dentist, and laboratory:** Attend a live, interactive online meeting (go.mikogo.com) to modify and approve the surgical plan for guide fabrication. The placing doctor completes and returns the signed CT Order Form, which contains the drill sequence.

**Step 7. ROE Dental Laboratory:** Create the surgical guide and drilling report.
Scan Appliance – Fabrication Instructions:

Impression Material & Models
Whether you make the radiographic guide yourself or using the laboratory, the impression is the critical first step in the process. This will ultimately affect the overall accuracy of the surgical guide that is created. We recommend VPS or similar material to be used to take the impression. You must take an impression that captures the peripheral borders and full palate on the maxilla and the peripheral borders and retro-molar pad areas on the mandible. The vestibule must be clear and undistorted. The entire impression should be free of pulls and bubbles. If the model is not accurate the fit of the radiographic guide will be compromised.

Guide Material
The radiographic guide should be fabricated from clear orthodontic acrylic. Do not use vacuform or any other non-rigid material. These material are too thin and do not exhibit the proper density for scanning.

Making the Guide
A diagnostic wax-up is used to fabricate the radiographic guide. The crowns should be distinctly represented on the facial/buccal and occlusal aspects of the guide. Facialy, the crowns of the guide adjacent to existing teeth should adjoin the guide via a diagonal span of acrylic. The guide should cover the occlusal surface of the full arch. The guide should extend over gums on the lingual/palatal side. The flange should be at least 3 mm thick. The replacement teeth on the guide should touch tissue in edentulous areas. The guide should not have any gaps between the gingiva and the guide. It is important to be aware that the surgical guide will be an exact duplicate of the radiographic guide. The only changes in shape will be the tunnels made by the software for the implant sites.

Radiopaque Markers
The appliance should have eight, 1.5mm round gutta-percha radiopaque markers placed into the appliance (#5 bur). These markers are utilized in the data merging process following the CT scan. We suggest six randomly placed on the palate and two within the labial flanges. To eliminate the possible effects of scatter, markers should be placed 10mm away from any metal restorations.

Proper Fit
Because the surgical guide will be an exact duplicate of the radiographic guide, the guide should fit securely on the patient’s teeth and/or tissue. If the guide does not fit securely, the guide must be remade. The guide does not need to have perfectly balanced occlusion. Cotton rolls or a radiolucent bite must be used to separate the arches during the scan.
Duplicating an Existing Prosthesis

The patient’s existing denture, or duplicate of the denture, may be used as the scan appliance\(^1\). Six gutta-percha markers are placed on the lingual/palatal side of the prosthesis and two within the buccal flanges. If the denture does not fit properly it is recommended that a hard acrylic reline is performed. This will ensure an ideal fit of the surgical guide. If you or the patient prefers not to add the markers to the patient’s current denture, a putty flask of the denture can be sent to us for duplication. A simple flashing technique is shown below. This minimizes in-office work and the need for the patient to spend time without their denture.

\(^1\) unless a SimPlant bone-supported guide is to be used. A choice is available between a special dual density scan appliance or the no-scan-appliance technique – the latter is inadvisable on edentulous patients as tooth position will not be validated.

### Steps to Duplicating a Full Denture

1. **Silicone Material**
2. **Accelerant**
3. **Knead together**
4. **Force into intaglio surface**
5. **Force into ridge area**
6. **Cut edges straight (optional)**
7. **Ease cast separation**
8. **Apply to silicone**
9. **Wax balls for spruing**
10. **More silicone**
11. **Force Silicone into palate**
12. **Complete the silicone flask**
13. **Silicone flask complete**
14. **Separate and remove denture**
15. **Send to Lab**
NO-Scan-Appliance Technique - Indications & Protocols:

When can the No-Scan-Appliance Technique be utilized?

Non-edentulous treatment plans that replace five or less teeth per arch are candidates for the no-scan-appliance technique. A contraindication to this technique is if a patient has multiple metal-based restorations in the arch being restored - metal creates scatter rendering a difficult or impossible registration.

The no-scan-appliance technique uses the virtual placement of teeth, or a scan of a functional diagnostic wax-up, to determine tooth position for virtual surgical planning. The scanned model image is superimposed over the conebeam data rendering accurate hard and soft tissue surfaces in the software from which your clinical decisions can be made. Currently this technique is only available with BlueskyPlan and SimPlant.

Software choices – BlueSkyPlan & SimPlant

What are the steps required if the No-Scan-Appliance protocol is used?

**Step 1. Restorative doctor or specialist:** Provide master casts or full-arch maxillary and mandibular silicone impressions, bite registration, study model, and completed CT Order Form.

**Step 4. Imaging Location:** Record CT scan – a specific protocol must be followed for each planning software. If you have any concerns about this process, we suggest calling ROE while the patient is still in the office to confirm the accuracy of the scan. Upload the DICOM to ROE through www.dentalimplantplanning.com.

**Step 3. ROE Dental Laboratory:** Preplan case using planning software ensuring implant locations meet surgical and restorative requirements.

**Step 4. Specialist, restorative dentist, and laboratory:** Attend a live interactive online meeting (go.mikogo.com) to modify and approve the surgical plan for guide fabrication. The placing doctor completes and returns the CT Order Form which contains the drill sequence and case-approval to ROE.

**Step 5. ROE Dental Laboratory:** Create the surgical guide and drilling report.
CT Scan: General Instructions

General Overview:

In order to fabricate a CBCT based surgical guide we require uncompressed DICOM3 data from a Cone Beam CT or Medical CT. The records and type of scan we require depend upon the software and the technique to be utilized. The cone beam settings and scanning instructions mostly remain consistent regardless of the type of scan (variances in the box to the right). The models or impressions should be of high quality because the accuracy of the surgery depends upon these initial records. The restorative tooth position must be determined using an existing appliance - a denture tooth setup, or a virtual or diagnostic wax-up. This should be approved by the restoring dentist and/or the patient. In order to begin the diagnostic process complete our CT Order Form with explicit instructions on the restorative goals and requirements.

General scanning instructions:

- Set the table height so that the mandible or maxilla is centered in the scan field.
- All slices must have the same field of view and table height.
- Scanning with a field of view that is too large can compromise the resolution of the reformatted images. Scanning with a field of view that is too small can cause the jaw to not fit in all the axial images.
- Not overlapping the axial slices can reduce the quality of the reformatted images.
- Scan all slices of the study in the same direction.
- Scan with the same slice spacing; the slice spacing must be less than or equal to the slice thickness. The slice thickness should not be larger than 1 mm.
- All of the remaining teeth/scan prosthesis should be completely visible in the images up to the occlusal plane.
- The gantry tilt should be 0 degrees.

Reconstruction of the images:

- Use a proper image reconstruction algorithm to get sharp, reformatted images to clearly locate internal structures such as the alveolar nerve. Use the sharpest reconstruction algorithm available (usually described as a bone or high resolution algorithm). Only axial images are required. No dental reformatting of the images is needed.
CT Scan: Capturing the CT

When a scan appliance will be used, two scans are required, one of the patient with the appliance seated and one of the scan appliance alone. If surgical guides will be made on both arches, each arch should be scanned separately to prevent the fiducial markers from interfering with one another. If the patient is edentulous, to stabilize the appliance and prevent movement, separate the arches with cotton rolls.

**Preparation of the patient**
- Remove any non-fixed metal dentures or prosthesis in addition to any jewelry that might interfere with the region to be scanned. Non-metal dentures may be worn during the scanning.
- If the patient has a scan prosthesis (radiographic template), it should be worn.
- Make the patient comfortable and instruct him/her not to move during the procedure. Normal breathing is acceptable, but any other movement, such as tilting and turning the head can cause motion artifacts that compromise the reformatted images, requiring the patient to be rescanned.

**Aligning the patient**
- For correct alignment, the transaxial CT slice plane should be parallel to the occlusal plane of the upper jaw (see figure 2). The gantry tilt is 0°. Ideally, you should determine the occlusal plane using the patient’s scan prosthesis. If the patient does not have a scan prosthesis, use the existing teeth to align the patient.
- Stabilize the relationship of the jaws during the scan.
- Scan patient with arches opened using cotton rolls or a bite registration index (figure 2).

**Scanning instructions**

**Positioning for the mandible**
- Position the first slice just below the inferior border of the mandible. Position the last slice just above the lower teeth, or in the absence of teeth, set the last slice just above the superior border of the mandibular ridge. If the patient is wearing a scan prosthesis, position the last slice just above the prosthesis. It is critical you include the entire prosthesis in the scanned study and that no teeth or prosthesis are visible in the last slice.

**Positioning for the maxilla**
- Position the first slice just below the upper teeth. In the patient is edentulous, and is wearing a scan prosthesis, position the first slice just below the prosthesis. It is critical you include the entire prosthesis in the scanned study. Position the last slice 4 to 5 mm above the floor of the nasal cavity. If planning for zygoma implants, the last slice must be positioned in the middle of the orbita, called the sutura.

**Positioning and Scanning the Scan Appliance Separately (without patient)**
- The scan appliance should be placed on Styrofoam (Polystyrene), foam, or on the guide holder specifically designed for this purpose and supplied by the Cone Beam manufacturer (figure 3). The packaging foam included in ROE Dental Laboratory case boxes works well. The appliance should be positioned in the same orientation as scanned in the patient’s mouth.
Instructions for using CT Scan Appliance when the case will involve extractions at the time of implant placement:

When a scan appliance is required and the case involves the immediate extraction of teeth at the time of surgery, a modified technique must be utilized. ROE has developed a special scan appliance that reduces the traditional two appointment scan to just one. The following 6 steps explain the process.

1. Separate the primary scan appliance from any removable section(s) attached to the appliance. The separate sections will represent the areas involving the immediate extraction of teeth at the time of implant placement. *Figure 4*

2. Seat the primary scan appliance containing the gutta percha fiducials in the patient’s mouth, without the separate sections. Separate the appliance from the opposing teeth using two cotton rolls.

3. Request that the patient stay motionless and follow the manufacturer’s instructions to capture the 1st of 2 CBCT images, as previously discussed.

4. Remove the appliance from the patient’s mouth and glue (included) the removable scan appliance section(s) back to the primary scan appliance (patient does not need to be present henceforth). *Figure 5*

5. After the glued sections have completely dried, scan the appliance alone as previously discussed. The appliance should not be placed directly on the chin rest. It must be placed on styrofoam or a foam block, such as the padding inside a ROE shipping box. The appliance should be oriented within the table in the same position as the patient scan.
Data Export & Upload:

1. Export the data from within your CT scanner’s software to an area of your computer that is accessible. We suggest that a folder is created on the desktop with individual folders inside – one for each patient with sub folders for the scan(s) (Figure 6).

2. Export the patient’s uncompressed DICOM 3 multi-file volume to this folder (named ‘patient’). Do not export viewers, iCAT visions, single file, compressed, or DICOMDIR. These file types are not usable.

3. Repeat the process above for the dataset that contains the scan of the radiographic appliance only (folder named ‘appliance’), if the scan appliance protocol was used.

4. When both arches are being planned for implants, scan them separately and save in them in separate labeled folders.

5. Place all folders into one master folder with the patient’s name.

6. Zip the master folder by right clicking it, scroll down and click Send To Compressed (Zipped) Folder (figure 7). This will create a Zipped folder (looks like the original with a zipper on the front). It will be located in the same area as the original folder (figure 3).

7. Visit ROE’s website www.dentalimplantplanning.com. Click the Upload button, and follow the instructions. Click Browse, search for the zipped folder (should be on your desktop in the folder you created). Double click on this folder and click Send on the web page.

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**Figure 6** – A sample of the file structure that should be saved and uploaded to ROE.

**Figure 7** – To upload your DICOM, the containing folder must be zipped. Right click on the folder and curser down to ‘Send to’, curser to the right and click ‘Compressed (zipped) folder. A new folder will be created next to the original folder. When you browse from our web site www.dentalimplantplanning.com you will double-click on this zipped folder to attach.
Immediate Implant Provisionalization

CBCT Guided surgery allows for immediate provisionalization of implants to be accomplished with increased accuracy and efficiency. In most situations, once a surgical guide is created, ROE Dental Laboratory can reverse-engineer analog placement into the model with the surgical guide and surgical report. We work with all kits that offer a laboratory component for accurate provisionals. However, an implant model can be created in almost any situation for abutment selection and provisional fabrication offering varying levels of accuracy. Please contact us to discuss the specifics of your case.

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