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NobelGuide® treatment workflows

**Single-tooth/partially edentulous – SmartFusion workflow**
The NobelGuide treatment workflow for the partially edentulous patient allows the clinician to combine a surface scan of the mastercast and prosthetic tooth setup information with a (CB)CT scan of the patient (SmartFusion). This (CB)CT scan can be taken at any time in the diagnostic process, and there is no need for markers or a radiographic guide to be in place during the patient scan. With this combined data in NobelClinician, important intra-oral information such as the soft tissue contour and thickness can be visualized, and preliminary treatment plans can be refined and finalized according to the desired prosthetic outcome. The user can go straight to surgery or choose, at any point in the process, to order a surgical template for either guided pilot drilling or fully guided surgery. The surgical template is designed automatically with one click using the digitized surface scan of the mastercast and is no longer a replica of a radiographic guide.

**Edentulous – Radiographic guide workflow**
The NobelGuide treatment workflow for the edentulous patient uses the so-called (CB)CT double scan protocol. A radiographic guide is fabricated in the dental laboratory prior to the patient scan. This is done either as a PMMA duplicate of a new diagnostic tooth setup/wax-up or a metal-free optimized denture in which radiopaque markers are placed. The patient needs to be scanned wearing this radiographic guide in the correct position. A second scan is taken of the same radiographic guide alone. These two sets of data are imported into the NobelClinician Software allowing for a prosthetic-driven treatment planning. Once the treatment plan is finalized, the user can go straight to surgery or choose, at any point in the process, to order a surgical template for either guided pilot drilling or fully guided surgery. The surgical template is automatically created in NobelClinician, based on the shape information provided by the radiographic guide. The radiographic guide therefore has to be designed in the laboratory as a prosthetic reference but the shape will also be used for the surgical template. For optimal results it is advised to use the NobelGuide Calibration Object as reference for automatic segmentation of the scanned radiographic guide. This workflow can also be used for partially edentulous patients.

**Note:** The current manual includes the instructions for preparing the surgical template. Please refer to the implant-specific NobelGuide procedures manual for the surgical procedure for guided pilot drilling and fully guided surgery.

Download it from: nobelbiocare.com/resources
**Partially edentulous – SmartFusion**

- Clinical examination
  - (CB)CT scan
  - Dental cast / prosthetic setup scan

**Edentulous patients – Radiographic guide**

- Radiographic guide
  - (CB)CT double scan

**Planning with NobelClinician**

**Ordering and production of surgical templates**

**Guided surgery:** pilot drill or fully guided
Clinical examination and impression taking

The indication for a medical procedure must be established by the responsible clinician. This decision relies on essential findings from the entire interdisciplinary treatment team. Careful initial clinical diagnostics, including systemic and dental considerations, are the basis for proper indication setting.

**Systemic evaluation**
- Age, general health.
- Immune status including diabetes.
- Smoking.

**Clinical evaluation**
- Radiographic diagnostics.
- Caries activity.
- Presence of periodontal disease.
- Control of diseases prior to treatment.
- Patient cooperation including oral hygiene.

**Dental examination**
- Functional status (maximum intercuspidation, centric relation, occlusal interferences, anterior guidance).
- Indications for parafunction.
- Inter-arch relationships (prosthetic considerations).
- Esthetics.
- Tissue health, attached keratinized tissue.
- Clinical evaluation for edentulous space (visual / palpation).
- Diagnostic models, diagnostic wax-up.

**Additional considerations**

**1 Assess tissue stability**
All sites must be fully healed following extractions or dental grafting procedures to ensure stable surgical template support reference.

**Note:** Extraction and immediate implant placement of a single tooth is supported. For further details please refer to page 15

**2 Assess mouth opening**
A minimum mouth opening of 40 mm at implant sites is required to accommodate guided surgery tooling.
3 Assess patient smile line
Evaluate the transition zone and verify with the intended treatment (fixed or fixed-removable final prosthetic solution).

4 Evaluate intra-oral soft tissue
Assess the quality and quantity of soft tissue.

**Note:** Consider (mini-)flap elevation as an alternative to punching in situations with reduced or minimal attached keratinized tissue.

5 (CB)CT scanning
- Take a (CB)CT scan of the patient.
- Separate the jaws slightly using a wax plate or wooden spatula taking care not to distort the facial anatomy.
- Preliminary diagnostics and treatment planning can be done in NobelClinician to determine treatment options.

**Note:** See “Digitization with (CB)CT scan”, page 9 for more details.

6 Take impressions
- Take fully extended, definitive impressions of both jaws for dental cast and diagnostic setup.
- The impression quality must meet requirements of a definitive impression for the intended treatment using either PVS (Polyvinyl siloxane) or PE (Polyether) dental impression material.
- Record an accurate bite registration using registration plates or clinical bite index material.
- Impressions are then sent to the NobelProcera lab*

**Notes:**
- See “Dental cast and diagnostic setup”, page 14 for more details.
- Do not make changes to the remaining dentition, such as prepping teeth for new crowns, after impressions have been taken as the radiographic guide and surgical template will not fit the new dentition.

* The NobelProcera 2G System using NobelProcera software version 4.10 or higher must be used.
7 Order dental cast scan
Order the digitized scan of the dental cast and diagnostic setup from your NobelProcera lab in the NobelClinician Software. The request is sent via NobelConnect. Print order request from NobelClinician to include with impression when sent to dental lab.

**Note:** For details of how to place the order, please refer to the NobelClinician Software Instructions for Use.

8 SmartFusion technology
Download or import the lab-scanned dental cast and diagnostic setup data into NobelClinician and align to (CB)CT data using the SmartFusion technology. Check carefully if the alignment is correct.

**Note:** In case of doubt, contact your Nobel Biocare local technical support.

9 Finalise treatment plan
Finalise (prosthetic-driven) treatment plan and select surgery type (freehand, pilot drilling or fully guided) for each implant. Order surgical template, if applicable.

10 Treatment plan report
– Print the treatment plan report, regardless of chosen surgery method.
– The treatment plan report contains the details of the planned implant dimensions per implant site.

11 Surgery
For surgical template assisted surgery, the NobelGuide surgical guidelines or treatment plan report contains not only the planning details but the guided drill depths per implant site.

**Note:** See NobelClinician Instructions for Use for more details.
Digitization with (CB)CT scan

CT scanning

The NobelClinician Software requires (CB)CT data as axial slices in DICOM format (Digital Imaging and Communication in Medicine). DICOM is an open and widely used standard for communicating medical images. The standard includes a file format which is used by the NobelClinician Software. CT and CBCT scanners have export functions for DICOM files. Use single frame, uncompressed DICOM files.

Modern CT scanning equipment
– Multi-slice CT scanner (medical CT scanner typically used in radiology departments of hospitals and radiology imaging centers).
– Cone-beam (CB)CT scanner (dedicated dental CT scanner using a cone shaped x-ray beam).

Quality specifications and scan settings

1 Check for scanner compatibility requirements
NobelClinician Software is compatible with CT scanners and CBCT scanners provided these basic requirements are met:
– The field of view is large enough to image an entire jaw bone. Typically this means a minimal field of view with a diameter of 8 cm and a height of 7 cm.
– The resolution and related voxel size is a minimum of 0.5 mm in all directions, typically 0.3 mm.
– The diagnostic image quality is high enough for the clinician to appropriately read the CT image data.
– The CT scanner can export the axial CT slices as single-frame, uncompressed data.
– For (CB)CT scan protocols, see page 52.

Note: It is the responsibility of the clinician or the radiologist to generate CT images of optimal quality according to the standard routine and at as low radiation doses as possible. Use the "ALARA principle" (As Low As Reasonably Achievable).

1 Scan patient
– Scan the patient.
– Ensure the patient occlusal plane is positioned horizontally.
– Ensure quality of the scan with adequate resolution, optimized settings and reduced noise.

Notes:
– Take into consideration patient factors such as metallic restorations which result in streak artifacts and patient movement.
– It is recommended that the occlusion is separated slightly using a wax plate or wooden spatula in order to avoid obscuring important occlusal reference information by residual streak artifacts.
2 Export (CB)CT data
Export scan data as uncompressed single-frame DICOM files.

2 Scan complete dental arch
– Ensure that the entire dental arch is scanned including all teeth (prosthetic crowns).
– It is advised to separate the jaws slightly using a wax plate or wooden spatula, especially with heavily restored dentitions in order to clearly detect the occlusal relief.

Note: In order for the SmartFusion to work correctly in NobelClinician the (CB)CT data and NobelProcera scan data must include the same information on prosthetic crowns. Modification of restorations inbetween the (CB)CT scan, surface scan and surgery might negatively impact SmartFusion and/or result in a non-fitting surgical template.
3 Check for patient movement during (CB)CT scan
Movement artifacts introduce inaccuracies in the (CB)CT image, potentially leading to incorrect diagnosis. Indicators for movement of the patient during the scan include:
- CT: discontinuity the anatomy.
- CBCT: double anatomical boarders.
- If patient movement is identified, the scan must be repeated.

Movement of patient during CBCT scanning is evident by the “double line” effect

4 Streak artifacts
- Streak artifacts from radio-opaque tooth restoration material corrupt diagnostic information.
- The SmartFusion technology is robust and has been developed to handle (CB)CT data with streak artifacts, however, when severe artifacts arise, this might cause issues.

Note: Some (CB)CT scanners offer smaller volume only. These scanners should not be used for the NobelGuide workflows as the required “stitching” of additional scans can include errors for creating surgical templates.

Excess streak artifacts due to heavily restored dentition.
Diagnostic tooth setup for clinical try-in for the partially edentulous

The dental cast represents the clinical situation and it is on this scan data that the NobelClinician Software calculates the surgical template using the precision fit technology. The dental cast must contain the same occlusal landmark information as captured in the (CB)CT scan. The diagnostic setup represents the desired final restorative outcome and enables visualisation of this information during implant treatment planning.

1 **Produce master casts**
- Use the definitive impressions to produce the master casts.
- Mount master casts in an articulator using the bite registration.

2 **Define diagnostic tooth setup**
Use wax or denture teeth for tooth setup according to esthetic demands and functionality.

**Note:** Defining the intended final tooth setup is fundamental for prosthetic-driven implant planning.

3 **Create tooth setup base**
Use wax for base of diagnostic tooth setup that is designed for secure positioning during clinical try-in.
4 Process into acrylic
- Duplicate situation with putty material.
- Remove wax on stone model and putty material.
- Block-out undercuts on model and isolate.
- Process diagnostic setup into acrylic.

5 Finalize clinical try-in
- Clean and polish diagnostic tooth setup for clinical try-in.
- Modify and adjust where needed.

Warnings for fixed restorations:
- If in the esthetic zone, perform the clinical try-in without buccal flanges or artificial gingival material (buccal flanges at the clinical try-in can be clinically misleading). For diagnostic purposes, the true transition zone, “tooth to available soft tissue,” must be made visible to mimic the clinical situation.

Warning for fixed-removable restorations:
Perform the clinical try-in with buccal flanges to clinically review lip support if part of the intended design.
Dental cast and diagnostic setup scan

The dental cast and diagnostic setup must be scanned using the NobelProcera 2G System.

1 Dental cast
Pour dental cast with care, using type 4 CAD stone. The dental cast should represent the same clinical situation as captured in the (CB)CT scan.

The impression quality must meet requirements of a definitive impression for the intended treatment. An incorrect dental cast could lead to a poorly fitting surgical template.

Note: Minimally trim model to ensure all information will be captured in dental cast scan.

2 Diagnostic setup
Create removable diagnostic (prosthetic setup / wax-up) using
- CAD wax
- Acrylic
- CAD acrylic
- Any other material using CAD spray before scanning

3 Diagnostic setup scan
Secure the dental model in the NobelProcera 2G Scanner with the diagnostic setup in position. Scan the diagnostic setup according to the NobelProcera scan protocol.

Note: Do not move the dental cast in the scanner holder, the same position must be maintained for the dental cast scan.

4 Dental cast scan
Remove the diagnostic setup from the model taking care not to move the dental cast. Scan the dental cast according to the NobelProcera scan protocol.

Note: Ensure that the dental cast scan captures the entire arc of the model.
Extraction and immediate implant placement

**Single tooth treatment efficiency model.**
The NobelGuide treatment workflow for partially edentulous patients supports extraction and immediate implant placement of a single tooth. The selected tooth is removed from the dental cast and a removable prosthetic (diagnostic) setup can be added before the model is scanned. This modified dental scan information, is aligned with the (CB)CT data in the NobelClinician Software in order to finalize the treatment plan and if desired, order a surgical template to support either pilot drilling or fully guided surgery.

1 **Select tooth**
Mark tooth to be removed from the dental cast

2 **Remove tooth**
Carefully grind the selected tooth away using a laboratory bur.

  **Warning:**
  Take care not to damage any of the surrounding tooth structure.

3 **Diagnostic setup**
   - Continue with removable diagnostic setup if applicable
   - Scan dental cast and setup in the NobelProcera 2G Scanner.
Clinical examination and impression taking

The indication for a medical procedure must be established by the responsible clinician. This decision relies on essential findings from the entire interdisciplinary treatment team. Careful initial clinical diagnostics, including systemic and dental considerations, are the basis for proper indication setting.

**Systemic evaluation**
- Age.
- Immune status including diabetes.
- Smoking.

**Clinical evaluation**
- Caries activity.
- Presence of periodontal disease.
- Radiographic diagnostics.
- Control of diseases prior to treatment.
- Patient cooperation including oral hygiene.

**Dental examination**
- Functional status (maximum intercuspation, centric relation, occlusal interferences, anterior guidance).
- Indications for parafunction.
- Inter-arch relationships (prosthetic considerations).
- Esthetics.
- Tissue health, attached keratinized tissue.
- Clinical evaluation for edentulous space (visual / palpation).
- Diagnostic models, diagnostic wax-up.

**Additional considerations**

1 **Assess tissue stability**
All sites must be fully healed following extractions or dental grafting procedures to ensure stable radiographic guide/surgical template support reference.

2 **Assess mouth opening**
A minimum mouth opening of 40 mm at implant sites is required to accommodate guided surgery tooling.
3 Assess patient smile line
Evaluate the transition zone and verify with the intended treatment (fixed or fixed-removable final prosthetic solution).

4 Evaluate soft tissue
Assess the quality and quantity of soft tissue.

Note: Consider (mini-)flap elevation as an alternative in situations with reduced or minimal attached keratinized tissue.

5 Take impressions
Take fully extended, definitive impressions of both jaws for study models.

Notes:
– The impression quality must meet requirements of a definitive impression for the intended treatment using either PVS (Polyvinyl siloxane) or PE (Polyether) dental impression material.
– Record an accurate bite registration using registration plates or clinical bite index.
– Do not make changes to the remaining dentition, such as prepping teeth for new crowns, after impressions have been taken as the radiographic guide and surgical template will not fit the new dentition.
Preparation of radiographic guide

Prosthetic-driven planning
The radiographic guide (I) is used to simulate the intended tooth setup and soft tissue surface during the (CB)CT scan for later reference during digital diagnostics. This simulation enables prosthetic-driven planning (II).

A correct design of the radiographic guide is a prerequisite for a successful treatment. The intended outcome of the restoration is defined, evaluated and represented through the radiographic guide.

The radiographic guide is also the basis for the surgical template (III). It is important to meticulously check the intimate fit with the soft tissue and if applicable, remaining teeth.

General design requirements

1 Ensure minimum thickness
- Design the radiographic to have a minimum thickness of 2.5–3 mm of material in all areas.
- Ensure tooth anatomy is intact in areas to be restored.
- Ensure intimate fit with the supporting soft tissue and if applicable, the remaining teeth.

Notes:
- The surgical template will reflect the same dimensions as the digitized 3D radiographic guide in the software.
- Consider the optimal tooth setup of final tooth size and shape, position, occlusion, vertical dimension, esthetics, phonetics and lip support.
- The clinical try-in should mimic the design on the final restoration.
2 Check for proper extension and fit
- Extend the radiographic guide over the entire dental arch and back to the retro-molar area.
- Ensure optimal fit according to anatomy, including:
  - Palate (if applicable).
  - Gingiva and/or mucosa, including vestibular extension for optimal retention (stability reasons) and for placement of anchor pins to secure the surgical template.
- Create inspection windows for partial cases to ensure correct positioning of the radiographic guide during scanning and also of the eventual surgical template.
Radiographic guide for edentulous jaw

Existing prosthesis
The existing, optimized prosthesis can be used as long as it:
– Represents the intended tooth setup for planning
– Is optimized for intimate soft tissue contact (only use a hard underlining material with the same radiolucent properties as the prosthesis).
– Contains no radiopaque parts i.e., metal framework, mesh palate, metal attachments, etc.

However, it is recommended to start from a new clinically validated tooth setup and create a new radiographic guide using PMMA material.

1 Place radiographic markers
To facilitate the (CB)CT double-scan protocol and enable the subsequent correct matching of the two scans in the NobelClinician Software, six–eight spherical reference points must be incorporated into the radiographic guide.

– Plan marker positions with an even spread on the lingual/palatal and buccal/labial regions using a felt marker.
– Ensure markers are placed above the gingival plane in the maxilla and below the gingival plane in the mandible.
– Distribute markers as asymmetrically as possible, ensuring that they will not end up in the same (CB)CT planes (increases accuracy of registration).
– Use a rose head bur to carefully make marker holes.
– Create spherical holes 1 mm deep and with a 1–1.5 mm diameter.
– Fill holes with a radio-opaque material (preferred material is gutta percha).

Tip: Check compatibility of material for markers with your (CB)CT scanner (manufacturer, model and firmware version as well as scan protocols) as some devices require less radio-opaque materials than gutta percha. Contact Nobel Biocare Technical Helpdesk for clarification.

Caution:
– Avoid placing all markers in the same “axial” CT plane. Distribute across several planes.
– Ensure markers are placed randomly and well-distributed above the gingival plane.
– Avoid making the holes larger than indicated (larger volumes of gutta percha might cause artifacts and hamper the alignment process. As a rule of thumb, the spherical marker should be three times as big as the voxel size used for scanning).
– Avoid perforation of the radiographic guide with the markers.
2 Make radiographic index

– Secure the radiographic guide to the articulated models.
– Add bite index material between the radiographic guide and the opposing model and “bite” the jaws together to create a radiographic index.
– Radiographic indexes for edentulous and large span partially edentulous patients should be fabricated in the articulator.
– Try in the radiographic guide and radiographic index prior to the (CB)CT double scan.

Note: If the patient has only a few teeth in the opposing jaw and does not wear a partial prosthesis, be sure to fill up the edentulous area with enough occlusal index material to make contact with the alveolar ridge. This ensures a horizontal, well-balanced bite registration.
Fabrication of edentulous radiographic guide

Create new radiographic guide

1 Define diagnostic tooth setup
   – Use denture teeth for tooth setup according to esthetic demands and functionality.
   – Carefully consider the relationship between implant diameter and the width of chosen denture teeth (e.g., denture premolars are often too narrow to support implant prosthetics).

   Note: Defining the intended final tooth setup is fundamental for prosthetic-driven implant planning.

2 Confirm occlusion and duplicate
   – Confirm occlusion with articulated opposing model.
   – Use your standard techniques to accurately replicate the diagnostic tooth setup in PMMA material, preferably the clear kind. PMMA must not contain any radiopaque ingredients.

3 Trim radiographic guide
   – Carefully remove excess acrylic and any sharp edges.
   – Smooth and polish.
4 Place radiographic markers
To facilitate the (CB)CT double-scan protocol and enable the subsequent correct matching of the two scans in NobelClinician Software, six–eight spherical reference points must be added to the radiographic guide.

– Plan marker positions evenly spread on the lingual/palatal and buccal/labial regions using a felt marker.
– Ensure markers are placed above the gingival plane in the maxilla and below the gingival plane in the mandible.
– Distribute markers as asymmetrically as possible, ensuring that they will not end up in the same CBCT planes (this increases the accuracy of registration).
– Use a rose head bur to carefully make marker holes.
– Place spherical holes of 1 mm deep and 1–1.5 mm diameter.
– Fill holes with a radio-opaque material (preferred material is gutta percha).

**Tip:** Check compatibility of material for markers with your (CB)CT scanner (manufacturer, model and firmware version as well as scan protocols) as some devices require materials that are less radio-opaque than gutta percha. Contact the Nobel Biocare Technical Helpdesk for clarification.

**Caution:**
– Avoid placing all markers in the same “axial” CT plane. Distribute in several planes.
– Ensure markers are randomly and well-distributed above the gingival plane.
– Avoid making the holes larger than indicated (larger volumes of gutta percha might cause artifacts and hamper the alignment process. As a rule of thumb, the spherical marker should be three times as big as the voxel size used for scanning).
– Avoid perforation of the radiographic guide with the markers.
5 Make radiographic index
- Secure the radiographic guide onto the articulated models.
- Add bite index material between the radiographic guide and the opposing model and “bite” the jaws together to create a radiographic index.
- Radiographic indexes for edentulous and large span partially edentulous patients should be fabricated in the articulator.
- Try in the radiographic guide and radiographic index prior to the (CB)CT double scan.

Note: If the patient has only a few teeth in the opposing jaw and does not wear a partial prosthesis, be sure to fill up the edentulous area with enough occlusal index material to make contact with the alveolar ridge. This ensures a horizontal, well-balanced bite registration.
Diagnostic tooth setup for clinical try-in for the partially edentulous

The dental cast represents the clinical situation and it is on this scan data that the NobelClinician Software calculates the surgical template using the precision fit technology. The dental cast must contain the same occlusal landmark information as captured in the (CB)CT scan. The diagnostic setup represents the desired final restorative outcome and enables visualisation of this information during implant treatment planning.

1 Produce master casts
- Use the definitive impressions to produce the master casts.
- Mount master casts in an articulator using the bite registration.

2 Define diagnostic tooth setup
Use wax or denture teeth for tooth setup according to esthetic demands and functionality.

Note: Defining the intended final tooth setup is fundamental for prosthetic-driven implant planning.

3 Create tooth setup base
Use wax for base of diagnostic tooth setup that is designed for secure positioning during clinical try-in.
4 Process into acrylic
- Duplicate situation with putty material.
- Remove wax on stone model and putty material.
- Block-out undercuts on model and isolate.
- Process diagnostic setup into acrylic.

5 Finalize clinical try-in
- Clean and polish diagnostic tooth setup for clinical try-in.
- Modify and adjust where needed.

Warnings for fixed restorations:
- If in the esthetic zone, perform the clinical try-in without buccal flanges or artificial gingival material (buccal flanges at the clinical try-in can be clinically misleading). For diagnostic purposes, the true transition zone, “tooth to available soft tissue,” must be made visible to mimic the clinical situation.
- When converting the try-in to the radiographic guide, extend the flanges buccally for stability reasons.

Warning for fixed-removable restorations:
Perform the clinical try-in with buccal flanges to clinically review lip support if part of the intended design.
Fabrication of partially edentulous radiographic guide

1 Convert try-in to radiographic guide
- Place clinically validated diagnostic setup on duplicated master model.
- Cover model with a wax layer (minimal thickness of 2.5–3 mm).
- Extend over the palate, if applicable.
- Cover occlusion of the remaining dentition, extending at least 1–2 mm over the labial/buccal surface to provide stable support.
- Maintain occlusal surface detail or area to be restored.

2 Extend in vestibular areas
- Ensure adequate representation of the soft tissue border in edentulous areas to act as a planning reference and for repositioning purposes.
- Extend sufficiently to accommodate identifiable radiographic markers and anchor pins.

Caution:
- Ensure that the area where the anchor pin(s) will be planned has a large enough base of thick material for optimal retention of the anchor pin sleeve.
- Ensure the radiographic guide extends all the way back to the retromolar region.
- Make the radiographic guide using a homogenous and uniform acrylic (no radio-opaque material to be added, e.g. no barium sulfate). Avoid denture teeth with different radiolucent properties than the uniform acrylic.
The following illustrations show the creation of inspection windows. Inspection windows are small openings above selected teeth made in the radiographic guide to control correct fit and positioning of the radiographic guide during (CB)CT scanning.

3 Create inspection windows  
(partially edentulous situations only)  
– Place inspection windows over a cusp or corner of a tooth so the underlying dentition protrudes through.  
– Create 3–4 windows, evenly distributed over the entire arch.  
– Ensure two of the windows are located adjacent to the area to be restored.

Note: After digitization the windows are transferred to the CAD file used to fabricate the surgical template. This allows for verification of the surgical template’s support by the underlying dentition and to confirm the correct seating of the surgical template, both in the dental laboratory (when verifying the fit on the stone model and preparation of a surgical index in the articulator) and its position during surgery.

Caution: The inspection windows should be monitored throughout the surgery in order to verify correct seating of the surgical template.
**4 Create silicone matrix**

- Use lab putty to duplicate wax setup of radiographic guide.
- Ensure correct repositioning of putty and stone model.
- Remove wax, clean stone model and silicone matrix.

**5 Block out undercuts**

Use wax to block out undercuts:

- Cervical and interdental.
- Buccal in regions where flanges have been extended.
- Any soft tissue undercuts.

**6 Isolate model**

Isolate model to prevent the selected PMMA material from adhering to the model.
7 Duplicate radiographic guide
- Secure putty matrix to model.
- Mix PMMA material (preferably clear) according to the manufacturer’s instructions. Ensure material is compatible with that of the NobelGuide calibration object.
- Carefully fill space between the isolated model and the matrix.
- Harden according to the manufacturer’s instructions.

8 Trim radiographic guide
- Carefully remove excess acrylic and any sharp edges.
- Carefully remove radiographic guide from the duplicated master case.
- Remove undercuts.
- Smooth and polish.

Caution:
- Maintain the occlusal plane of the area to be restored.
- Confirm fit of radiographic guide on model.
- Ensure undercuts do not prevent easy seating of radiographic guide. Modify accordingly.
9 Place radiographic markers
To facilitate the (CB)CT double-scan protocol and enable the subsequent correct matching of the two scans in NobelClinician Software, 6–8 spherical reference points must be incorporated into the radiographic guide.

– Plan marker positions evenly on lingual/palatal and buccal/labial regions using a felt marker.
– Ensure markers are placed above the gingival plane in the maxilla and below the gingival plane in the mandible to avoid being “lost” in possible streak artifacts created by existing restorations.
– Use a rose head bur to carefully make marker holes.
– Place spherical holes of 1 mm deep and 1–1.5 mm diameter.
– Fill holes with a radio-opaque material (preferred material is gutta percha).

**Tip:** Check compatibility of material for markers with your (CB)CT scanner (manufacturer, model and firmware version) as some devices require less radio-opaque materials than gutta percha. Contact Nobel Biocare Technical Helpdesk for clarification.

**Caution:**
– Avoid placing all markers in the same “axial” CT plane. Distribute in several planes.
– Ensure markers are randomly and well-distributed above the gingival plane.
– Avoid making the holes larger than indicated (larger volumes of gutta percha might cause artifacts and hamper the alignment process).
– Avoid perforation of the radiographic guide with the markers.
10 Make the radiographic index

– The radiographic index is used to secure the radiographic guide in the correct position in the patient’s mouth during (CB)CT scanning.

– The radiographic index can be made chairside or in the laboratory on articulated models using occlusal index material.

**Note:** If the patient has only a few teeth in the opposing jaw and does not wear a partial denture, be sure to fill up the edentulous area with enough occlusal index material to make contact with the alveolar ridge. This ensures a horizontal, well-balanced bite registration.
Digitization with (CB)CT scan (double scan)

CT scanning

The NobelClinician Software requires (CB)CT data as axial slices in DICOM format (Digital Imaging and Communication in Medicine). DICOM is an open and widely used standard for communicating medical images. The standard includes a file format which is used by the NobelClinician Software. CT and CBCT scanners have export functions for DICOM files. Use single frame, uncompressed DICOM files.

Modern CT scanning equipment

– Multi-slice CT scanner (medical CT scanner typically used in radiology departments of hospitals and radiology imaging centers).
– Cone-beam (CB)CT scanner (dedicated dental CT scanner using a cone shaped X-ray beam).

Quality specifications and scan settings

Check for scanner compatibility requirements

NobelClinician Software is compatible with CT scanners and CBCT scanners provided these basic requirements are met:
– The field of view is large enough to image an entire jaw bone. Typically this means a minimal field of view with a diameter of 8 cm and a height of 7 cm.
– The resolution and related voxel size is a minimum of 0.5 mm in all directions, typically 0.3 mm.
– The diagnostic image quality is high enough for the clinician to appropriately read the CT image data.
– The CT scanner can export the axial CT slices as single-frame, uncompressed data.
– For (CB)CT scan protocols, see page 52.

Note: It is the responsibility of the clinician or the radiologist to generate CT images of optimal quality according to the standard routine and at as low radiation doses as possible. Use the "ALARA principle" (As Low As Reasonably Achievable).

1 Scan patient

The patient holds the radiographic guide in place by biting on the radiographic index as the scan is taken.
2 Scan radiographic guide

- Position the radiographic guide on a sponge or another foam-like material. Use paper tape to attached the radiographic guide if needed.
- Position the radiographic guide in approximately the same orientation as it was positioned in the patient scan.
- Scan the radiographic guide.

Warning: Ensure that the radiographic guide is scanned without the radiographic index.

Note: The field of view of the scanner has to be large enough to include the radiographic guide (and also the calibration object) with one scan.

3 Export (CB)CT data

Export both scans (patient with radiographic guide and the radiographic guide by itself) as uncompressed single-frame DICOM files.
Quality inspections

1 Verify correct position of radiographic guide
Check whether there is “air” between the radiographic guide and the patient gingiva. Air is visualized by dark (black) zones as illustrated. If these black zones show, it could indicate that the radiographic guide was incorrectly positioned during the (CB)CT scan. Please verify if this is the case. If so, then the patient requires a new scan with the radiographic guide correctly positioned with the radiographic index.

2 Check for patient movement during the (CB)CT scan
Movement artifacts introduce inaccuracies in the (CB)CT image, potentially leading to incorrect diagnosis. Indicators for movement of the patient during the scan include:
- CT: discontinuity in the anatomy.
- CBCT: double anatomical boarders.
- If patient movement is identified, the scan must be repeated.

Note: Some (CB)CT scanners offer smaller volume only. These scanners should not be used for the NobelGuide workflows as the required “stitching” of additional scans can include errors for creating surgical templates.

Movement of patient during CBCT scanning is evident by the “double line” effect.
Planning with NobelClinician® Software

NobelClinician – the key to successful treatments
Enhanced diagnostics, treatment planning, team collaboration and patient communication in one comprehensive application – NobelClinician Software

- Visualize the patient’s (CB)CT data together with the intra-oral situation thanks to NobelClinician’s SmartFusion technology.
- Digital treatment planning considering available bone and prosthetic needs.
- Convenient patient communication with the NobelClinician Communicator iPad® app.
- Easy collaboration between treatment partners with NobelConnect.
Technical considerations for anchor pins

**Guided Anchor Pins**

To establish secure fixation and stability of the surgical template at the start and during the surgical procedure, Guided Anchor Pins are used to anchor the surgical template. They can also serve as “lip retractor” and, in certain situations, as potential flap retractor.

When planning anchor pin positions, inclination and depth are important. Typically 4–5 anchor pins are placed in an edentulous jaw. In order to gain stable support and also to allow for temporary removal and exact repositioning of the surgical template during specific surgical procedures (mini-flap and flap protocols), the anchor pins must be placed in areas with adequate cortical bone. To minimize the risk of injuries due to penetration, bi-cortical anchorage of anchor pins must be avoided. Take the mouth opening into consideration. Placing anchor pins too distally may prevent the patient from opening their mouth wide enough to accommodate the drills and handpiece.

**Notes:**

- Short shaft anchor pins are also available and can be used to reduce this negative impact.
- To define the inclination, the relationship of the anchor pin and the surrounding soft tissues (position of the lips and the maximum opening of the mouth) should be taken into consideration. The inclination should allow for easy access and installation of the anchor pins.
- To control the insertion depth of the anchor pins, check that the anchor pin sleeve fits correctly in the radiographic guide. The most apical aspect of the sleeve should be positioned within the flange and away from the transition of the radiographic guide and gingiva to allow for the production of the surgical template.
Single tooth / partially edentulous workflow

Correct: optimal anchor pin position
The anchor pin sleeves should be placed close to the mucosa (0.5 to 1 mm), as represented by the digitized surface model scan of the intra-oral situation, but should not interfere or collide with the model.

Incorrect: anchor pin is not placed deep enough
The anchor pin is not anchored into the bone. While there is template material around the anchor pin sleeve, this anchor pin will not provide any fixation during surgery.

Incorrect: anchor pin is placed too deep
The anchor pin sleeve is protruding through the mucosa, represented by the digitized surface model scan of the intra-oral situation. The template will not fit into the patient’s mouth.
Edentulous workflow

Correct: optimal anchor pin position
Anchor pin sleeve is within the radiographic guide flange and the anchor pin is embedded in sufficient bone.

Incorrect: anchor pin is not placed deep enough
Anchor pin sleeve is not within the radiographic guide flange.

Incorrect: anchor pin is placed too deep
Anchor pin sleeve is protruding into the fitting surface of the radiographic guide. This will prevent correct seating of the surgical template.
Retention principles

- An adequate number of anchor pins must be placed with strategic positioning and orientation to secure the surgical template in the correct position.
- For edentulous jaws consider placing four or more anchor pins. Ensure mouth opening through lip retraction is not compromised.
- For single tooth situations do not use anchor pins to avoid any damage to surrounding structures. Retention is obtained by pressing the surgical template onto existing teeth. Verify continuously that the surgical template is correctly seated via the inspection windows.

**Note:** In situations where two or more neighboring implants are placed, regardless if it is a free-end situation or a situation with one or more distal teeth for support of the surgical template, it is recommended to use at least one anchor pin in this area.

Advanced usage

- Recommended with (mini-)flaps
- Consider mouth opening when planning in distal locations since lip retraction affects mouth opening
Surgical template production and verification

Surgical template in NobelClinician Software

The surgical template helps you to perform surgery exactly as planned.

1 Create surgical template in NobelClinician Software
The virtual surgical template created when finalizing the planning is a preview of what will be produced after ordering.

2 Inspect surgical template
Carefully review surgical template preview ensuring that all planned sleeves are sufficiently supported by the template material. For further information, please refer to the NobelClinician Instructions for Use.

3 Review all triggered warnings
Review the NobelClinician assistant warning section and adjust accordingly. For further information, please refer to the NobelClinician Instructions for Use.
Production and shipment

The NobelGuide surgical template is produced by Nobel Biocare.

The surgical template is shipped non-sterile in a protective bag which contains a moisture absorbent sachet. The surgical template is made from a material that is sensitive to moisture and excessive sunlight.

Notes:
- Store the surgical template together with the moisture absorbent sachet in the protective plastic bag in which it was delivered.
- Do not remove the moisture absorbent sachet.
- Store the surgical template in a dry, dark location.
- Do not expose the surgical template to direct sunlight.
- Surgery should be performed prior to the expiry date noted on the template label.

Storage and handling

The surgical template must be stored in the original bag in which it was delivered. The product must be stored in a dry place in the original packaging at room temperature and not exposed to direct sunlight. Incorrect storage may influence device characteristics leading to failure.

1 Examine surgical template

- Confirm that the treatment ID on the surgical template corresponds with the treatment ID (as detailed in the order manager in the NobelClinician Software) and virtual treatment plan in the NobelClinician Software.
- Ensure that the mechanical strength of the surgical template conforms to the recommended thickness of 2.5–3 mm.
- If required, reinforce outer surface by adding plates or layer of light-curer tray material (e.g. Triad®, Dentsply International Inc., USA).

Warnings:
- If adding material, be sure to leave the top of the sleeves untouched so that the reference level is maintained.
- Avoid distortion due to inadequate or incompatible material.
2 Inspect surgical template

– Inspect the guide sleeves to ensure they are free of excess material.
– Confirm the fit of the guided drill guides and if applicable, the guided drills into the guide sleeves.
– Confirm that the surgical template fits to the same dental cast scanned in the NobelProcera 2G Scanner and to the clinical situation.

Notes:

– If adjustment is required in close proximity to the guide sleeves, take care not to compromise the integrity of the guide sleeve.
– If the surgical template extends too far distally, carefully reduce the template by reducing the distal span by one tooth either side.
– When adjusting the surgical template, take care to avoid breakage and not to reduce the integrity of the fit to the patient anatomy.
Fabrication of stone model and surgical index

**Surgical Template**

The fully guided surgical template is the guide for placing implants as virtually planned. Using dedicated laboratory tooling, it can also hold implant replicas at intended positions allowing for the fabrication of a stone model containing these replicas prior to surgery. This allows for preparation of provisional prosthetic solutions which are to be finalized directly after surgery.

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**Surgical index**

The surgical index is used during surgery to correctly position the surgical template on the jaw before anchoring with Guided Anchor Pins.

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**Guided Cylinder with Pin**

A key component to produce a stone model is the Guided Cylinder with Pin. The guided cylinder (1) and pin (2) ensure the geometrical relation between the guided sleeve (3), which is included with the surgical template, and the implant replica (4).
Partially edentulous fully guided surgical template

1 Verify fit of surgical template
– Use the original stone model to verify the correct seating of the surgical template.
– Confirm via inspection windows, if applicable.

2 Section model
– Mark approximate implant locations on the model.
– Cut away section in order to make room for the implant replicas.

3 Mount implant replicas
– Connect the Guided Cylinder with Pin to the implant replicas through the sleeves in the surgical template.
– Replica and cylinder type are based on the implant system used in the digital treatment plan.

Warnings: When using an engaging abutment (i.e. a rotational lock abutment), care must be taken to correctly position the implant replicas:
– For implants with an external hex connection, rotate so that the side of the hex is parallel with the curvature of the jaw.
– For implants with an internal tri-channel connection, rotate so that a lobe of the internal connection is oriented buccally / labially.
– For implants with an internal conical connection, rotate so that internal hex is parallel to the buccal / facial wall.
4 Position guided anchor pins
Insert anchor pins into anchor pin sleeves, if applicable.

Note: Verify that the implant replicas are secured properly and that they also passively fit in the cut-away section of the stone model.

5 Add soft tissue mask
– Lubricate the bottom of the Guided Cylinder with Pin and the fitting surface of the surgical template with vaseline for easy dismounting of the soft tissue mask.
– Add the soft tissue mask.
– Use soft tissue mask or boxing wax on buccal side of the vestibular extensions to prevent die stone from locking to surgical template.

6 Reconstitute stone model
– Position the surgical template on the stone model.
– Use sticky wax to secure the correct position of the surgical template, as verified via the inspection windows.
– Fill the area to be restored with die stone.
– Verify correct seating of the surgical template via the inspection window throughout the stone-setting process.

7 Remove surgical template
Once the die stone is set:
– Remove the anchor pins.
– Remove Guided Cylinder with Pin using a Unigrip Screwdriver.
– Remove the surgical template.
8 Remove excess material
- Use a scalpel to trim any excess soft tissue mask material.
- Trim excess die stone material.

9 Mount model in articulator
- Mount in an articulator together with a stone model of the opposing jaw using a bite index.
- If required, use lab putty to make a surgical index.
- Add index material between the surgical template and the opposing model and “bite” the jaws together. Use enough material to create solid and strong index.

Note: If the patient only has front teeth in the opposing jaw and does not wear a partial prosthesis, build up the surgical index in the area where the teeth are missing to ensure contact with the alveolar ridge. This is to ensure that there is a horizontal, well-balanced bite index.

10 Store surgical template
- Disinfect surgical template and index before returning to the clinician.
- Ensure surgical template is returned to the protective bag in which it was delivered.
Edentulous fully guided surgical template

1 Mount implant replicas
   – Connect the Guided Cylinder with Pin to the implant replicas through the sleeves in the surgical template.
   – Replica and cylinder type are based on the implant system used in the digital treatment plan.

2 Position Guided Anchor Pins
   Insert anchor pins into anchor pin sleeves.

3 Add soft-tissue mask
   – Lubricate the bottom of the Guided Cylinder with Pin and the fitting surface of the surgical template with vaseline for easy dismounting of the soft tissue replica.
   – Add the soft tissue mask using a small nozzle.
   – Use soft tissue replica or boxing wax on buccal side of the vestibular extension to prevent die stone from locking to surgical template.

Note: Ensure material reaches right down to the Guided Cylinder with Pin to achieve an accurate replica of the soft tissue.

4 Apply isolation
   Protect surgical template against gypsum by using either gingiva mask or isolation material.
5 Pour model
Use die stone to pour the stone model.

6 Remove surgical template
Once the die stone has set:
- Remove anchor pins.
- Remove Guided Cylinder with Pin using a Unigrip Screwdriver.
- Remove the surgical template.

7 Remove excess material
- Use a scalpel to trim any excess soft tissue mask material.
- Trim excess die stone material.
8 Mount model in articulator
- Attach the radiographic guide as used for (CB)CT scan (or the duplicate denture ordered via the NobelClinician Software) onto the stone model.
- Mount the stone model in an articulator together with the model of the opposing jaw.
- Use the radiographic index to verify the correct occlusion.
- Replace the optimized prosthesis or duplicate denture with the surgical template and secure with anchor pins.

9 Make surgical index
- Use lab putty to make the surgical index.
- Add index material between the surgical template and the opposing model and “bite” the jaws together.
- Use enough material to create a solid and strong index.

Note: If the patient only has front teeth in the opposing jaw and does not wear a partial prosthesis, build up the surgical index in the area where the teeth are missing to ensure contact with the alveolar ridge. This is to ensure that there is a horizontal, well-balanced bite index.

10 Store surgical template
- Disinfect surgical template and index before returning to the clinician.
- Ensure surgical template is returned to the protective bag in which it was delivered.
Product information

NobelClinician Software
NobelClinician Software is a state-of-the-art 3D graphics application and is available for various operating systems both for Windows® and Mac® computers. For the latest information about NobelClinician, please contact your Nobel Biocare representative.

Computer guidelines
It is advised to install NobelClinician Software on computers with high-performing hardware components (CPU speed, graphics card memory and performance, RAM, monitor resolution, Internet access).

For the latest information on computer guidelines regarding NobelClinician Software, please contact your Nobel Biocare representative.

NobelGuide surgical template
The NobelGuide surgical templates are manufactured from a acrylate-based photopolymer material at Nobel Biocare’s industrial production facility.
Calibration procedure – radiographic guide

**Accuracy is crucial**
Accurate fit of the surgical template is crucial for predictable surgical results. These dimensions are defined through the radiographic guide which is digitized using (CB)CT technology. The crucial information for the surgical template comes from the second CT scan, which is the radiographic guide scan in the NobelGuide double-scan procedure.

**Every scanner is different**
The grey value (isovalue) representing the physical border of the radiographic guide is identified in the 3D volume of the scan. Based on this value, a 3D surface model is generated in NobelClinician Software.

Correct extraction (also termed “segmentation”) of this surface data from the 3D DICOM files is required to produce an accurate-fitting surgical template. As each (CB)CT scanner has an almost unique way to assign grey values to defined tissue, a thorough scanner-based interpretation is needed to identify the correct grey value (isovalue).

**Unique NobelGuide calibration procedure**
The unique NobelGuide calibration object consists of polymethyl-metacrylate (PMMA), which is a material typically used for the fabrication of radiographic guides. This high-precision object allows NobelClinician Software to identify the correct grey value (isovalue) for the radiographic guide scan for each scanner by analyzing the reference scan made with the calibration object.

NobelClinician Software also automatically manages these calibration scans and recommends when to apply the information learned. It is important that the reference scan is acquired in the very same way and with the very same scanner settings used for the radiographic guide scan.

The NobelGuide calibration procedure is easy and makes your guided surgery even safer. If the analysis of the calibration scan fails with a specific scanner, please contact your Nobel Biocare expert for assistance in identifying and addressing the root cause of the failure in your specific setup.
1 Position calibration object

- Check whether the object is damaged or not. If it is broken or scratched, it cannot be used.
- Position the sponge horizontally in the CBCT scanner.
- Position the calibration object on top of the sponge.

2 Scan

- Make a scout view.
- Verify whether it is in the middle of the field of view.
- Make sure it is entirely imaged.
- Perform the scan as if it is the radiographic guide.

3 Export DICOM files

- Make axial reconstructions. The slices must not be tilted in any way.
- Verify whether the scan is of a high quality.
- Export the axial slices as single-frame uncompressed DICOM files. Each DICOM file should contain one axial slice.

Calibration instructions

- A reference scan needs to be performed every 6 months or when there is maintenance on the scanner itself (mechanical or upgrade of the scanner software by the manufacturer).
- Replace the calibration object when it is broken or damaged.
- Store the calibration object in a dark, dry place in the package in which it was delivered. It cannot be cleaned with hot water, only with a slightly moist towel if needed.
Cone-beam (CB)CT protocol

Patient scan
Follow the manufacturer’s instructions to scan the patient. The size of a cubic voxel should be within the range of 0.25–0.5 mm. During reconstruction, no tilting of the axial slices is allowed.

Radiographic guide and calibration object scan
Follow the manufacturer’s instructions to scan the radiographic guide or the NobelGuide calibration object. The size of a cubic voxel should be within the range of 0.25–0.5 mm. During reconstruction, no tilting of the axial slices is allowed.

Notes:
– Extra care is needed in order not to overshoot the detector. Therefore, use a lower kV and mA for the radiographic guide scan, and also for the NobelGuide calibration scan.
– When scanning the NobelGuide calibration object, the exact same scan settings and reconstruction settings should be used as for the radiographic guide scan.

Multi-slice CT protocol

Scan settings
Spiral CT
No gantry tilt
Tube voltage 120 kV
Effective tube current 90 mAs
Collimation (number of detectors ×) smallest detector width (mm) Collimation × 0.7
Feed per rotation

Reconstruction settings
Reconstruction interval Half detector width (typically 0.5 mm or smaller)
Reconstruction kernel A sharp bone filter is preferred

Note: When scanning the NobelGuide calibration object, the exact same scan settings and reconstruction settings should be used as for the radiographic guide scan.

Single-slice CT protocol

Scan settings
Spiral CT
No gantry tilt
Tube voltage 120 kV
Effective tube current 100 mAs
Collimation 1 mm
Feed per rotation 1 mm/rotation
Gantry rotation speed 1 rotation/s

Reconstruction settings
Reconstruction interval 0.5 mm
Reconstruction kernel A sharp bone filter is preferred

Note: When scanning the NobelGuide calibration object, the exact same scan settings and reconstruction settings should be used as for the radiographic guide scan.
Cleaning and sterilization

**Sterile components**

The devices delivered sterile have a “Sterile” marking on the label. See current cleaning and sterilization guidelines for details: nobelbiocare.com/sterilization

**Note:** Implants should never be resterilized.

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**Implants**

Implants are delivered sterile and are for single-use only. Do not use implants if the packaging has been damaged or previously opened.

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**Twist and Twist Step Drills, Counterbores and Screw Taps**

Twist Drills, Twist Step Drills, Counterbores and Screw Taps are delivered sterile and are for single use only.

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**Abutments and plastic copings**

Multi-unit Abutments, Snappy Abutments, QuickTemp Abutments, Immediate Temporary Abutments and their respective plastic copings are delivered sterile and are for single use only.
Non-sterile components

Care and maintenance of reusable instruments is crucial for successful treatment. Well-maintained instruments not only safeguard your patients and staff against infection, but are also essential for the outcome of the total treatment. See current cleaning and sterilization guidelines for details: nobelbiocare.com/sterilization.

NobelGuide surgical templates

The NobelGuide Surgical Template is delivered non-sterile. This is because pre-processing in the dental laboratory is needed for:
- prefabrication of the master cast to contain implants replicas (at the planned implant locations). This step is optional and is done in order to prepare the provisional restorations prior to surgery.
- Confirmation of fit of the surgical template to the partially edentulous model.
- Creation of surgical index.

In the laboratory:
Use ultrasonic cleaning with water and mild detergents. Rinse thoroughly with water, dry well and return to the protection bag in which it was delivered.

In the clinic:
Immediately prior to surgery: disinfect the surgical template in a high level disinfectant, according to the manufacturer’s instructions (e.g. Chlorhexidine solution). Rinse thoroughly with sterile water and dry well, but not longer than 40 minutes.

Caution: Do not use heat or autoclave the surgical template.

Abutments and plastic copings

Some abutments made of titanium, gold alloy, and plastic (PEEK) are delivered non-sterile. For more information refer to the label on the specific abutment. It is recommended to sterilize the abutment prior to placing it in the oral cavity. For sterilization, see current cleaning and sterilization guidelines: nobelbiocare.com/sterilization

Notes:
- If modifications have been made to the abutment, clean the abutment prior to sterilization.
- Non-sterile plastic copings should not be resterilized, as they are for single use only.
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