The total solution for simple and complex spine pathology

MATRIX Spine System – Perforated

Surgical Technique
Warning
This description alone does not provide sufficient background for direct use of DePuy Synthes products. Instruction by a surgeon experienced in handling these products is highly recommended.

Processing, Reprocessing, Care and Maintenance
For general guidelines, function control and dismantling of multi-part instruments, as well as processing guidelines for implants, please contact your local sales representative or refer to:
http://emea.depuysynthes.com/hcp/reprocessing-care-maintenance
For general information about reprocessing, care and maintenance of Synthes reusable devices, instrument trays and cases, as well as processing of Synthes non-sterile implants, please consult the Important Information leaflet (SE_023827) or refer to:
http://emea.depuysynthes.com/hcp/reprocessing-care-maintenance
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The Synthes MATRIX Spine System is a universal set of instruments and implants that cover degenerative, deformity, MIS and Trauma indications.

**Unique Dual Core/Double Lead Screw Design**
- Fast and controlled insertion
- Increased pull-out resistance due to optimal bone purchase
- Improved handling thanks to atraumatic tip and self-tapping thread

**PrimeLock – Screwdriver – Screw Interlock**
- Toggle free screw insertion
- Precise and controlled screw placement
- Direction of screw insertion possible
Modularity – Click-on before or after Insertion
- Customized inventory possible
- For better visualization of the anatomical structure
- Multiple screw head removal and replacement without removing the pedicle screw from the pedicle

Augmentation – Aging Spine Treatment
- Improved screw anchoring and vertebral body support due to cement cloud
- Six radial openings for 360° cement distribution
- Augmentation after final screw positioning

Snap-on Swiveling Transverse Connector
- Offers fast and simple in-situ placement
- Simple anatomical adjustment possible

1 Becker et al (2008)
Implants

**Perforated Pedicle Screw**
- Six radial openings for 360° cement distribution
- Increased visual access to the anatomical structures
- Allows for improved access to the surgical field
- Dual Core/Double Lead thread designed to securely anchor the screw in cortical and cancellous bone
- Threaded T25 Stardrive recess designed to deliver torque effectively

**Click-on Polyaxial and Reduction Screw Head**
- The polyaxial head of the implant is designed for rod reduction
- To ease intraoperative planning, the polyaxial heads can be removed and replaced without removing the pedicle screw from the pedicle
- The reduction head allows for 15 mm rod reduction

**Rods**
- 5.5 mm diameter in pure titanium and harder cobalt chrome
- A choice of straight and curved options to help ease intraoperative construct assembly and technique maneuvers
- Offered in a variety of lengths from 30 mm to 500 mm
Locking Cap
- Square thread design minimizes cross threading under high reduction loads
- T25 Stardrive recess designed to reduce the risk of damage at high loads
- 1-step locking cap allows for complete fixation in one step (polyaxiality and run on rod)
- Available flat or with guidance

Transverse Connector
- The snap-on transverse connector is preassembled and requires only final positioning and tightening
- The jaws of the transverse connector swivel and are spring loaded
- The telescoping body is arched to accommodate grafts and anatomical structures and is available in a range of lengths
- The locking screws use a T15 Stardrive which minimizes drive stripping while final tightening

Instruments
- Ergonomically designed handles
- Intuitive, easy to use
- Suitable for open as well as minimally invasive approaches
- Convenient, interchangeable options
## Augmentation Options – Overview

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<th>a Simple Adapter</th>
<th>b Needle Adapter Kit</th>
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<td>Open approach</td>
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<td>(●)</td>
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<tr>
<td>Minimal invasive approach with MATRIX MIS</td>
<td>–</td>
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<td>•</td>
</tr>
</tbody>
</table>
| Characteristics               | • Tactile feedback of recess connection  
• Direct application of cement  
• Applied volume readable on syringe | • Easy handling, manoeuvre through soft tissue  
• Can be connected prior to screwing on the syringe, independent of cement preparation  
• Same interface to screw recess as simple adapter | • Guide sleeve connects to distractor tip  
• Distractor tip forms firm connection (PrimeLock) between instrument and bone screw, minimizing risk of cement leakage  
• Assembly of guide sleeve for MATRIX augmentation and locking needle adapter is independent of cement preparation |
The four principles to be considered as the foundation for proper spine patient management underpin the design and delivery of the Curriculum: Stability – Alignment – Biology – Function.² ³

**Stability**
Stabilization to achieve a specific therapeutic outcome

**Alignment**
Balancing the spine in three dimensions

**Biology**
Etiology, pathogenesis, neural protection, and tissue healing

**Function**
Preservations and restoration of function to prevent disability

² Aebi et al (1998)  
³ Aebi et al (2007)
Indications and Contraindications

The MATRIX perforated screws are an addition to the MATRIX System, a posterior pedicle screw and hook fixation system (T1–S2) intended to provide precise and segmental stabilization of the spine in skeletally mature patients. MATRIX perforated pedicle screws may be inserted traditionally as solid MATRIX screws and with Kirschner wire guidance as MATRIX cannulated screws including a minimally invasive approach with MATRIX MIS. MATRIX perforated screws direct Verteceem V+ through lateral perforations to augment the pedicle screw in the vertebral body. Augmentation of pedicle screws with cement increases pedicle screw anchoring in vertebral bone, especially in cases of diminished bone quality.

**Indications**
- Degenerative disc disease
- Spondylolisthesis
- Trauma (i.e. fracture or dislocation)
- Tumor
- Stenosis
- Pseudoarthrosis
- Failed previous fusion
- Deformities (i.e. scoliosis, kyphosis and/or lordosis)
- Osteoporosis when used concurrently with Verteceem V+

**Contraindications**
- In fractures and tumors with severe anterior vertebral body disruption, an additional anterior support or column reconstruction is required.
- Osteoporosis when used without augmentation
- Severe osteoporosis

**Contraindications related to Verteceem V+**
Please refer to the corresponding surgical technique for the Verteceem V+ system.
Preoperative Planning

Preoperative planning includes evaluation and assessment of the patient with regard to the specifications of the bone cement used for augmenting MATRIX perforated screws (see Vertecem V+ System surgical technique).

Proper imaging equipment must be used to determine correct implant dimensions in relation to the anatomy.

The decision whether or not to augment MATRIX perforated screws can be taken intraoperatively, based on tactile feedback upon pedicle preparation and screw insertion. If screws are augmented, bilateral screw augmentation is recommended.

Also consider reinforcing the adjacent vertebrae by a vertebroplasty technique. In cases of advanced osteoporosis in the thoracic spine, cement reinforcement can be applied like the extension of an internal fixation in order to prevent junctional kyphosis.

**Note:** Do not reinforce more than six vertebrae with bone cement in one session. The injected cement pushes bone marrow into the blood circulation and can cause fat embolism. The amount of cement that is injected in one session should therefore be limited to about 25 ml or even less if a patient shows severely compromised cardiopulmonary function.

**Note:** Handling knowledge of Vertecem V+ is required. Image intensifier control is highly recommended while injecting cement.
Kirschner Wire Handling

• Ensure the Kirschner wires remain securely in position throughout the entire duration of the procedure. The tip of the Kirschner wire should be monitored by image intensifier to ensure it does not penetrate the anterior wall of the vertebral body and damages the vessels situated in front.
• Ensure the Kirschner wires do not slip out before the screws are inserted. The Kirschner wires are long enough to be held in place by hand during pedicle preparation and soft tissue dilation.
• Insert the screw until the tip of the screw is beyond the posterior wall of the vertebral body and remove the Kirschner wire in order to avoid uncontrolled further advancing.

Technique Tip: Bi-planar fluoroscopy with two C-arms allows a safer, easier and quicker radiographic assessment during the surgical procedure.

Note: Pay attention when using cannulated instruments in combination with Kirschner wires (e.g. screwdrivers, awls etc.). Ensure that the exit point for the Kirschner wire in the instrument is not covered to avoid pinching of the glove.
Open Approach

This surgical technique contains supplementary instructions on handling Perforated MATRIX pedicle screws. For handling standard MATRIX pedicle screws please refer to the MATRIX Spine System – Degenerative surgical technique and for cannulated screws the MATRIX Spine System – MIS surgical technique.

Screws may be placed both unassembled and preassembled. If screws need to be placed preassembled, please follow assembly technique as described on page 29 prior to screw placement.

1. Prepare pedicles and insert screws

Options a and b (compare “Options” page 6)
Open and prepare pedicles and insert screws as defined in chapter screw insertion of the MATRIX Spine System – Degenerative surgical technique. Alternatively, screw placement with Kirschner wire can be performed as described in the MATRIX Spine System – MIS surgical technique.

<table>
<thead>
<tr>
<th>Instruments</th>
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</thead>
<tbody>
<tr>
<td>01.632.220 Set for Basic Instruments, for MATRIX 5.5</td>
</tr>
<tr>
<td>01.616.106 Set, perforated for No. 01.637.003, for Matrix MIS, sterile</td>
</tr>
</tbody>
</table>

Note: Sufficient preparation of the screw channel is necessary to remove bone residuals.

Select appropriate screw lengths. Choose screws with the maximum possible diameter and length to achieve maximum stability.

The MATRIX Perforated screw must enter in approximately 80% of the vertebral body (1).
**Option c (compare “Options” page 6)**

<table>
<thead>
<tr>
<th>Instruments</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>03.632.085</td>
<td>Retaining Sleeve, detachable, for Matrix 5.5</td>
</tr>
<tr>
<td>03.632.073</td>
<td>Screwdriver Shaft, T25, cannulated, long</td>
</tr>
<tr>
<td>03.632.083</td>
<td>Distractor Tip, for Bone Screws, for Matrix 5.5</td>
</tr>
<tr>
<td>03.620.061</td>
<td>T-Handle with Ratchet Wrench and with Torque Limiter, 10 Nm</td>
</tr>
<tr>
<td>03.637.001</td>
<td>Guide Sleeve for Matrix perforated Pedicle Screw</td>
</tr>
</tbody>
</table>

Slide detachable retaining sleeve over long cannulated T25 screwdriver shaft. Slide the distractor tip over the screwdriver shaft tip and press firmly into the detachable retaining sleeve (1).

Insert the tip of the screwdriver shaft into the bone screw interface. Make sure that the tip of the screwdriver shaft is fully seated in the recess of the bone screw interface. Turn the green knob clockwise.

Insert the pedicle screw.

To release the detachable retaining sleeve from the distractor tip, pull the green knob towards the handle. Remove the screwdriver and retaining sleeve. The distractor tip will stay on the screw (2).

**Note:** Do not grasp the green knob during screw insertion as this will detach the screw from the holding sleeve.
Sufficient preparation of the screw channel is necessary to remove bone residuals.

Select appropriate screw lengths. Choose screws with the maximum possible diameter and length to achieve maximum stability.

The MATRIX Perforated screw must enter in approximately 80% of the vertebral body (3).

Insert the guide sleeve over the distractor tip and push down firmly until tactile feedback (4).

**Important:** Thoroughly rotate the lateral arms of the guide sleeve clockwise to ensure that the distractor tip is fully engaged with the screw. For later augmentation only the Locking Needle Adapter Kit with Luer-Lock should be used with the Guide Sleeve for MATRIX Perforated Screw.
2. Assess proper screw placement

**Instrument**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>02.648.001</td>
<td>Cleaning Stylet for perforated Pedicle Screws</td>
</tr>
</tbody>
</table>

Assess the cortical shell for perforations in the vertebral body.

**Note:** In case of any perforation, special caution is required when bone cement is applied. Cement leakage and its related risks may compromise the physical condition of the patient.

The MATRIX Perforated screw must enter in approximately 80% of the vertebral body (1).

**Notes:**

- If the screws are too short, the bone cement might be injected too close to the pedicle. It is required that the screw perforations are located in the vertebral body, close to the anterior cortical wall. For this reason 35 mm screws should be placed in the sacrum only.
- If the screws are too long, or placed bi-cortically, the anterior cortical wall may be penetrated and cement leakage might occur.

Use the cleaning stylet to clear the cannula for proper cement injection (2, 3). Visualize the stylet position under image intensifier control (4).
1. Prepare cement

**Implant**

| 07.702.016S  | Vertecem V+ Cement Kit, sterile |

Hold the Vertecem V+ Cement Kit upright and gently slit with the finger tip at the top of the mixing device in order to ensure no cement powder sticks to the cartridge and transportation lid.

**Note:** During preparation, mixing and injection make sure to always handle the mixing device by gripping the blue part located directly below the transparent cartridge. If the transparent part is used as gripping surface, the excess body heat provided by the users hand might result in a shorter working time than intended.
Open the glass ampoule by breaking off its neck with the plastic cap 1. Then remove the transportation lid (seen in picture above) from the mixing device and dispose of it. Pour the full content of the ampoule 2 into the mixer and close it tightly with the separate mixing and transfer lid 3. Make sure that both the mixing lid and the small sealing plug on top of it are securely tightened.

**Notes:**
- Entire content must always be mixed.
- Using only one part of the components is not permitted.
- See also the quick step preparation technique on the inner packaging of the Vertecem V+ Cement Kit.

Grip the mixer by the blue part 1. Start mixing the Vertecem V+ cement by pushing and pulling the handle 2 from endpoint to endpoint 3 for 20 seconds (1–2 strokes per second). Perform the first few mixing strokes slowly with an oscillating-rotating movement (2 and 4 combined). Once properly mixed, the handle 2 must be left in its outmost position.
2. Fill Injection syringes

**Instrument**

| 03.702.215S | Vertecem V+ Syringe Kit |

Once the cement has been mixed using the Vertecem V+ Cement Kit remove the sealing plug and connect the stop cock. Use the side without the funnel when connecting the stop-cock to the mixer.

The handle in the initial position is turned 90° away from the mixer and the “off” sign is on the opposite side from the funnel. Ensure a tight fit between the stop-cock and mixing device, but avoid breakage of the stop-cock due to the application of excessive torque.

First, the air has to be removed from the system. Hold the cement mixer in a vertical position and gently turn its handle clockwise.

**Note:** Turn the handle clockwise to extrude cement from the mixer, do not push.

You will see the piston of the mixer advancing in the transparent cartridge and a steady flow of cement moving into the stop-cock. As soon as the cement is visible at the funnel end of the stop-cock, close the stop-cock by turning the handle (“off”) toward the mixer (90°).
Attach a syringe to the stop-cock (funnel side). We highly recommend using the 2 cc syringes first.

Open the stop-cock by turning the handle (90° turn), back to its original position.

Use slow, controlled turning movements on the mixer handle to fill the syringe. As soon as the syringe is filled turn the valve of the stop-cock again (90°) towards the mixer. The “off” sign is directed toward the mixer, stopping the cement flow.

**Note:** To transfer cement, simply rotate the handle. Do not push.
Disconnect the full syringe and attach the next one. Continue until all syringes are filled. Always fill all syringes.
3. Injection Preparation

Place the C-arm in a lateral position to monitor the extrusion of the cement into the vertebral body.

Note: Additional image intensifier control in the AP projection is recommended.
3a. Simple Adapter

07.702.216.02S Simple Adapter
for perforated Pedicle Screws,
with Luer-Lock, 2 pieces, sterile

Attach simple adapter onto the syringe.

Connect the syringe with the adapter to the screw and press down firmly. Make sure the adapter is fully introduced into the screw recess.

**Note:** Ensure that the adapter is firmly seated in the screw recess.

**Note:** Care should be taken when replacing of syringes is necessary, as cement can be left in the Stardrive of the screw. If simple adapter is used, only Vertecem V+ 2 cc syringes should be used to inject cement in order to avoid disconnecting and reconnecting of the syringe.
3b. Needle Adapter Kit

03.702.224.02S Needle Adapter Kit for perforated Pedicle Screws, with Luer-Lock, sterile

Connect the needle adapter to the screw and press down firmly.

Turning clockwise, attach the pre-filled syringe onto the Luer-Lock.

Note: Ensure that the needle adapter is firmly seated into the screw recess.

3c. Guide Sleeve and Locking Needle Adapter

07.702.217.02S Locking Needle Adapter Kit for perforated Pedicle Screws, with Luer-Lock, sterile

Introduce the locking needle adapter into the guide sleeve, locking it in with a slight push 1 and then with a clockwise turn 2 (1).

Turning clockwise, attach the pre-filled syringe onto the Luer-Lock (2).

Note: Ensure that the locking needle adapter is properly locked in.
4. Injection Procedure

1. Make sure that the syringes with the adapters are firmly connected with the pedicle screws to be augmented prior to cement application (see option a, b and c).

2. Inject as much cement as required until it slowly starts to extrude from the perforations of the screw.

   **Note:** Ensure that no cement leakage occurs outside the intended area. Immediately stop the injection if leakage occurs.

3. Continue to add cement to each screw using continuous image intensifier control. A growing cloud pattern should form. If a spider web-like pattern forms, wait approximately 30 to 45 seconds or proceed with another screw and return to the present screw later.

4. If more cement is needed or the injection pressure is too high, switch to the 1 ml syringes. Start again with the first screw. Augmentation is complete when each screw has been augmented with a total cloud volume of approximately 2 to 3 ml.

   **Note:** Care should be taken when replacing of syringes is necessary, as cement can be left in the Stardrive of the screw.

5. After injection is made using the locking needle adapter or the needle adapter, the cement in the adapter can be utilized using the corresponding plunger.

   **Notes:**
   - Remove the syringe or plunger from the locking needle adapter and insert the cleaning stylet to create a recess for cement backflow. Confirm that the tip of the cleaning stylet protrudes through the tip of the adapter.
   - When using the simple adapter, do not remove or replace syringes immediately after injection. The longer the syringe remains connected to the screw, the lower the risk of undesired cement flow.
**Precaution:** The cement flow follows the path of least resistance. Therefore it is mandatory, during the whole injection procedure, to maintain real-time image intensifier control in the lateral projection. In case of unexpected cloud forming patterns or if the cement is not clearly visible, the injection must be stopped immediately.

**Warning:** Any cement remaining in the screw drive must be removed with the cleaning stylet while it is still soft (or has not hardened yet). This will ensure that future revision surgeries remain possible.

**Note:** Wait until the cement has cured before removing adapters and continuing with the instrumentation (about 15 minutes after last injection).
Place Screwheads

**Instruments**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>03.632.046</td>
<td>Reamer for Pedicle Screws, for Matrix 5.5</td>
</tr>
<tr>
<td>03.632.073</td>
<td>Screwdriver Shaft, T25, cannulated, long</td>
</tr>
<tr>
<td>03.632.037</td>
<td>Positioning Instrument for Polyaxial Screw Heads, for Matrix 5.5</td>
</tr>
<tr>
<td>68.632.125</td>
<td>Loading Station for Matrix 5.5</td>
</tr>
</tbody>
</table>

Slide reamer over screwdriver shaft. Engage tip of screwdriver shaft in unassembled pedicle screw. Ream until the black line is visible on the shaft. This indicates that there is enough room for the implant head.

**Note:** Care should be taken when reaming the most superior and inferior level to protect the facet joints.

To pick up a screwhead, align the positioning instrument for polyaxial screw heads to the rod slot features on the polyaxial head implant and press down.

Place the positioning instrument with the polyaxial head over the perforated pedicle screw and press down. To ensure the polyaxial head is securely attached to the now assembled pedicle screw, gently lift up on the positioning instrument and angulate the polyaxial head.

To release the positioning instrument, press the button located at the distal end of the instrument.
Precautions:
- Before placing a polyaxial head onto the perforated screw, ensure that the cement has completely cured.
- Always use image intensifier control when placing polyaxial heads to ensure that the screw does not advance. If the screw advances, wait for the cement to cure.

Notes:
- If the polyaxial head does not successfully attach to the head of the unassembled pedicle screw, additional reaming or screw height adjustment may be required to ensure sufficient space exists to allow free mobility of the head.
- It is possible to reassemble the same screw using a new head each time to a maximum of three times.
Continue with the steps “Insert Rod”, “Insert Locking Cap” and “Perform Final Tightening”, from the MATRIX Spine System – Degenerative surgical technique.

**Note:** Prior to performing correction maneuvers ensure that the cement is fully hardened.

**Warning:** Distraction/compression might lead to loosening of the augmented screws resulting in construct failure.
This surgical technique option contains instructions on handling Perforated MATRIX pedicle screws using a minimally invasive approach with the MATRIX MIS Instrumentation System.

For handling cannulated screws please refer to the MATRIX Spine System – MIS surgical technique.

### Instruments

<table>
<thead>
<tr>
<th>Code</th>
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</thead>
<tbody>
<tr>
<td>01.616.106</td>
<td>Set, perforated for No. 01.637.003, for Matrix MIS, sterile</td>
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<tr>
<td>03.632.085</td>
<td>Retaining Sleeve, detachable, for Matrix 5.5</td>
</tr>
<tr>
<td>03.637.001</td>
<td>Guide Sleeve for Matrix perforated Pedicle Screw</td>
</tr>
<tr>
<td>07.702.217.02S</td>
<td>Locking Needle Adapter Kit for perforated Pedicle Screws, with Luer-Lock, sterile</td>
</tr>
<tr>
<td>68.632.125</td>
<td>Loading Station for Matrix 5.5</td>
</tr>
<tr>
<td>03.632.037</td>
<td>Positioning Instrument for Polyaxial Screw Heads, for Matrix 5.5</td>
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<tr>
<td>02.648.001</td>
<td>Cleaning Stylet for perforated Pedicle Screws</td>
</tr>
</tbody>
</table>

Sufficient preparation of the screw channel is necessary to remove bone residuals.

Perform screw placement with Kirschner wire as described in the MATRIX Spine System – MIS surgical technique (036.001.190).
Preassemble the screws as follows:

1. Select appropriate screw lengths. Choose screws with the maximum possible diameter and length to achieve maximum stability.

The MATRIX perforated screw must enter in approximately 80% of the vertebral body (1).

2. Place the screw and a polyaxial screwhead into the loading station. Align the positioning instrument for polyaxial screw heads to the rod slot features on the polyaxial head implant and press down.

Place the positioning instrument with the polyaxial head over the pedicle screw and press down. To ensure the polyaxial head is securely attached to the now assembled pedicle screw, gently lift up on the positioning instrument and angulate the polyaxial head.

To release the positioning instrument, press the button located at the distal end of the instrument.
3. Press the slim retraction blades for mini-open technique onto the pedicle screw until they snap together (1).

To connect the slim retraction blades for percutaneous technique to the screw, snap the first blade onto one side of the pedicle screw (2).

Then snap a second blade onto the opposite side of the pedicle screw.

**Note:** To avoid glove damage, do not hold the retraction blades near the bottom of the deflecting tab.

**Note:** Check by push and pull of the retraction blade/screw construct to ensure a secure attachment.

Slide detachable retaining sleeve over long cannulated T25 screwdriver shaft. Slide the distractor tip over the screwdriver shaft tip and press firmly into the detachable retaining sleeve.

Insert the tip of the screwdriver shaft into the bone screw interface. Make sure that the tip of the screwdriver shaft is fully seated in the recess of the bone screw interface. Turn the green knob clockwise.
Insert the pedicle screws as described in chapter “Screw Insertion” from the MATRIX MIS surgical technique (036.001.190) (1).

The MATRIX perforated screw must enter in approximately 80% of the vertebral body.

Assess proper screw placement as described in chapter Open Approach in step 2 on page 14 (2).
Release the detachable retaining sleeve from the distractor tip by pulling the green knob towards the handle. Remove the cannulated screwdriver and retaining sleeve (3).
Insert the guide sleeve over the distractor tip and push down firmly until tactile feedback (1).

**Important:** Thoroughly rotate the lateral arms of the guide sleeve clockwise to ensure that the distractor tip is fully engaged with the screw.

Use the cleaning stylet through the guide sleeve to clear the cannula for proper cement injection. Visualize the stylet position under image intensifier control.

**Note:** Only the locking needle adapter kit with Luer-Lock should be used with the guide sleeve for MATRIX perforated screws.

Introduce the locking needle adapter into the guide sleeve, locking it in with a slight push and a clockwise turn (2). Prepare the cement and fill the injection syringes as described in the chapter Cement Handling.

Turning clockwise, attach the pre-filled syringe onto the Luer-Lock.

**Note:** Ensure that the locking needle adapter is properly locked in.

Inject the cement under image intensifier control as described in step 4 in chapter Cement Handling (3).

Remove the syringe or plunger from the adapter and insert the cleaning stylet to create a recess for the cement backflow (4).

**Note:** Wait until the cement has cured before removing adapters and continuing with the instrumentation (about 15 minutes after last injection).
Lift the guide sleeve from the distractor tip by placing two fingers underneath the lateral arms and the thumb on the rotating top. Pull your fingers towards the top and release the guide sleeve without effort.

The toothed rack retractor for MATRIX can be used leaving the distractor tips in place.

**Note:** Prior to performing correction maneuvers ensure that the cement is fully hardened.

**Warning:** Distraction/compression might lead to loosening of the augmented screws resulting in construct failure.

To remove the distractor tips, use the detachable retaining sleeve and screwdriver assembly.

**Note:** Do not use the guide sleeve to remove the distractor tip.

Continue with chapter “Rod Introduction”, “Rod Reduction and Locking Cap Introduction” and “Retraction Blade Removal” from the MATRIX MIS surgical technique.
Cement leakage
A major risk performing screw augmentation is cement leakage. By respecting the steps of the surgical technique the complication rate is minimized.

Cement injection might cause fat embolism due to bone marrow being pushed into the blood circulation. Therefore the amount of cement that is injected during surgery should be limited to approximately 25 ml and less if the patient shows severe compromised cardiovascular function. Furthermore, systemic reactions during cement injection can occur as a consequence of cement monomer release.

If significant leakage occurs, the procedure has to be stopped. Return the patient to the ward and assess the patients’ neurological situation. In case of compromised neurological functions an emergency CT scan should be performed to assess the amount and location of the extravasation. If applicable, an open surgical decompression and cement removal may be performed as an emergency procedure.

Extravasation
In order to minimize the risk of extravasation, it is strongly recommended to follow the described surgical technique, i.e.:
- Use a Kirschner wire for pedicle screw placement
- Use a high-quality C-arm in lateral position
- Use highly viscous and radiopaque cement (Synthes’ Vertecem V+)

Additionally, image intensifier control in the AP projection is recommended.

Leakage into the spinal canal
Stop the injection. If the cement amount is very small, you may proceed as described in chapter Cement Handling.

Fracture
The risk of a fracture at adjacent levels appears to be increased after cement reinforcement. Patients and their doctors should therefore be made aware that if new pain occurs, a new fracture may have occurred. Radiological control should be performed and, if necessary, further reinforcement should be considered – in such cases also including the adjacent vertebrae. All patients with osteoporotic fractures should be evaluated and treated by an osteologist or their family doctor and, if applicable, receive systemic treatment with vitamin D and bisphosphonates.

Pregnancy
There is no safety data regarding the use of Vertecem V+ in children, during pregnancy or during lactation. There is inadequate information to determine whether this material might affect fertility in humans or produce teratogenic or other adverse effects on the fetus.

Screw size
Preoperative planning and selection of the appropriate screw length and diameter is important. In the average lumbar spine ø 6.0 mm screws are recommended, as scientific papers report a higher rate of pedicle perforation using ø 7.0 mm screws.

Placement of pedicle screw
MATRIX perforated screws should be placed in approximately 80% of the vertebral body.

Notes and Warnings

Leakage outside the vertebra
If leaking outside the vertebra is recognized, the injection has to be stopped immediately. Wait for 45 seconds. Slowly continue with the injection. Due to faster curing in the vertebral body, the cement occludes the small vessels and the filling can be accomplished. Amounts of cement of approximately 0.2 ml are recognizable. If filling cannot be performed as described, stop the procedure.
### Perforated MATRIX pedicle screws

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>04.637.535S–04.637.555S</td>
<td>Pedicle Screw Matrix Ø 5.0 mm, perforated, length 35–55 mm, Titanium Alloy (TAN), sterile</td>
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<tr>
<td>04.637.635S–04.637.665S</td>
<td>Pedicle Screw Matrix Ø 6.0 mm, perforated, length 35–65 mm, Titanium Alloy (TAN), sterile</td>
</tr>
<tr>
<td>04.637.735S–04.637.765S</td>
<td>Pedicle Screw Matrix Ø 7.0 mm, perforated, length 35–65 mm, Titanium Alloy (TAN), sterile</td>
</tr>
</tbody>
</table>

All screw lengths available in 5 mm increments. Available sterile packed only.
**Instruments**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>07.702.016S</td>
<td>Vertecem V+ Cement Kit, sterile</td>
</tr>
<tr>
<td>03.702.215S</td>
<td>Vertecem V+ Syringe Kit</td>
</tr>
<tr>
<td>07.702.216.02S</td>
<td>Simple Adapter for perforated Pedicle Screws, with Luer-Lock, 2 pieces, sterile</td>
</tr>
<tr>
<td>03.702.224.02S</td>
<td>Needle Adapter Kit for perforated Pedicle Screws, with Luer-Lock, 2 pieces, sterile</td>
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<tr>
<td>07.702.217.02S</td>
<td>Locking Needle Adapter Kit for perforated Pedicle Screws, with Luer-Lock, sterile</td>
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<tr>
<td>Code</td>
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<tr>
<td>68.632.125</td>
<td>Loading Station for Matrix 5.5</td>
</tr>
<tr>
<td>02.648.001</td>
<td>Cleaning Stylet for perforated Pedicle Screws</td>
</tr>
<tr>
<td>03.632.037</td>
<td>Positioning Instrument Polyaxial Screw Heads, for Matrix 5.5</td>
</tr>
<tr>
<td>03.632.083</td>
<td>Distractor Tip, for Bone Screws, for Matrix 5.5</td>
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<tr>
<td>03.632.085</td>
<td>Retaining Sleeve, detachable, for Matrix 5.5</td>
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<tr>
<td>03.637.001</td>
<td>Guide Sleeve for Matrix perforated Pedicle Screw</td>
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<tr>
<td>03.632.073</td>
<td>Screwdriver Shaft, T25, cannulated, long</td>
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</tbody>
</table>
Bibliography


