**USS Fracture System**

**Table of Contents**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview of USS Universal Spine System</td>
<td>2</td>
</tr>
<tr>
<td>Implants</td>
<td>4</td>
</tr>
<tr>
<td>Principle of fracture clamps</td>
<td>5</td>
</tr>
<tr>
<td>Indications/Contraindications</td>
<td>7</td>
</tr>
<tr>
<td>Surgical technique</td>
<td>8</td>
</tr>
<tr>
<td>Fractures with intact posterior wall</td>
<td>10</td>
</tr>
<tr>
<td>Fractures with fractured posterior wall</td>
<td>12</td>
</tr>
<tr>
<td>Assembling the cross-link system</td>
<td>16</td>
</tr>
<tr>
<td>Techniques depending on fracture type</td>
<td>19</td>
</tr>
<tr>
<td>Reduction of spondylolisthesis</td>
<td>20</td>
</tr>
<tr>
<td>Notes for the surgeon</td>
<td>21</td>
</tr>
<tr>
<td>Cleaning of instruments</td>
<td>22</td>
</tr>
<tr>
<td>Bibliography</td>
<td>23</td>
</tr>
</tbody>
</table>

---

**Warning**

This description is not sufficient for immediate application of the instrumentation. Instruction by a surgeon experienced in handling this instrumentation is highly recommended.
USS Universal Spine System – indication-specific modules for fractures, deformities and degenerative diseases

Every traumatic or pathological alteration of different areas of the spine requires special implants and instruments. The USS modules have been developed to meet the varying requirements, with one basic instrument set for all modules. The following table gives an overview of the USS modules/basic implants, their indications and benefits/special features.

<table>
<thead>
<tr>
<th>USS Fracture System</th>
<th>Indications</th>
<th>Contraindications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>– fractures</td>
<td>– should not be used above T6</td>
</tr>
<tr>
<td></td>
<td>– tumours, infections</td>
<td>– in fractures with severe anterior vertebral body disruption, an additional anterior support or column reconstruction with bone graft or cage is required</td>
</tr>
<tr>
<td></td>
<td>– post-traumatic deformities</td>
<td></td>
</tr>
<tr>
<td>USS Variable Axis Screws (USS VAS)</td>
<td>– degenerative diseases</td>
<td>– fractures and tumours with loss of anterior support, with the VAS as stand-alone implant</td>
</tr>
<tr>
<td>USS Side-opening Pedicle Screws Rod Ø 5.0 or 6.0 mm</td>
<td>– degenerative diseases</td>
<td>– fractures: controlled reduction cannot be performed with pedicle screws</td>
</tr>
<tr>
<td></td>
<td>– thoracolumbar and lumbar scoliosis</td>
<td>– fractures: pedicle screws can only be used to supplement anterior column reconstruction with bone graft or cage</td>
</tr>
<tr>
<td></td>
<td>– tumours, infections</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– fractures with anterior support</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– multisegmental fractures with segmental fixation</td>
<td></td>
</tr>
<tr>
<td>USS Side-opening Hooks Rod Ø 5.0 or 6.0 mm</td>
<td>– deformities of the thoracic spine</td>
<td>– fractures (multisegmental instrumentation is recommended)</td>
</tr>
<tr>
<td></td>
<td>– thoracic fractures and tumours</td>
<td></td>
</tr>
<tr>
<td>USS Basic Implants</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Specific implants

<table>
<thead>
<tr>
<th>Fractures</th>
<th>Deformities</th>
<th>Degenerative diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td>USS Fracture System</td>
<td></td>
<td></td>
</tr>
<tr>
<td>USS Basic Instrument Set</td>
<td></td>
<td></td>
</tr>
<tr>
<td>USS Fracture Clamps</td>
<td>USS Hooks, Rod Ø 5.0 or 6.0 mm</td>
<td>USS Variable Axis Screws (VAS)</td>
</tr>
<tr>
<td>USS Schanz Screws (Ø 5.0/6.2/7.0 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>USS Side-opening Variable Axis Screws (VAS) (Ø 6.2/7.0/8.0 mm; ±25° polyaxiality)</td>
<td>Due to the ±25° polyaxiality of the flexible screw heads, the screw-to-rod assembly adapts to the anatomy before being locked at a given angle.</td>
<td></td>
</tr>
<tr>
<td>USS Side-opening Pedicle Screws, (Ø 5.0/6.0/7.0 mm; Ø 4.0 mm for limited indications)</td>
<td>The side-opening implants can be adapted to the anatomically pre-contoured rod, which allows segmental correction in scoliosis surgery.</td>
<td></td>
</tr>
<tr>
<td>USS Side-opening Pedicle and Lamina Hooks</td>
<td>The side-opening implants can be adapted to the anatomically pre-contoured rod, which allows segmental correction in scoliosis surgery.</td>
<td></td>
</tr>
<tr>
<td>USS Rods (Ø 6.0 mm, length 50–500 mm)</td>
<td>Hard rods for fractures and deformities, soft rods for degenerative diseases</td>
<td></td>
</tr>
<tr>
<td>USS Cross-link</td>
<td>Increased rotational stability</td>
<td></td>
</tr>
<tr>
<td>USS Rod Connector, open and closed</td>
<td>Angulation of ±25° in relation to the vertical rod</td>
<td></td>
</tr>
<tr>
<td>USS Parallel Connectors and Extension Connectors</td>
<td>Lateral adjustment of pedicle screws and hooks to the vertical connector (e.g. in scoliosis surgery)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Three-dimensional adaptation of side-opening screws in anatomically difficult situations, for example at L5/S1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connection and extension of Ø 6.0 mm rods</td>
<td></td>
</tr>
</tbody>
</table>

**Specific Implants**

- USS Fracture Clamps
- USS Schanz Screws (Ø 5.0/6.2/7.0 mm)
- USS Side-opening Variable Axis Screws (VAS) (Ø 6.2/7.0/8.0 mm; ±25° polyaxiality)
- USS Side-opening Pedicle Screws, (Ø 5.0/6.0/7.0 mm; Ø 4.0 mm for limited indications)
- USS Side-opening Pedicle and Lamina Hooks
- USS Rods (Ø 6.0 mm, length 50–500 mm)
- USS Cross-link
- USS Rod Connector, open and closed
- USS Parallel Connectors and Extension Connectors

**Benefits/Special features**

- With the fracture system, the angle between the jaws can be adjusted by ±18°, thus allowing a controlled anatomical correction in the sagittal plane. The system is therefore particularly suitable for reduction of fractures.
- Due to the ±25° polyaxiality of the flexible screw heads, the screw-to-rod assembly adapts to the anatomy before being locked at a given angle.
- The side-opening implants can be adapted to the anatomically pre-contoured rod, which allows segmental correction in scoliosis surgery.
- The side-opening implants can be adapted to the anatomically pre-contoured rod, which allows segmental correction in scoliosis surgery.
- Hard rods for fractures and deformities, soft rods for degenerative diseases
- Increased rotational stability
- Angulation of ±25° in relation to the vertical rod
- Lateral adjustment of pedicle screws and hooks to the vertical connector (e.g. in scoliosis surgery)
- Three-dimensional adaptation of side-opening screws in anatomically difficult situations, for example at L5/S1
- Connection and extension of Ø 6.0 mm rods
Transpedicular Schanz Screw with dual core
Thread length 35–55 mm
- Ø 5.0 mm (X96.711–715)
- Ø 6.2 mm (X96.721–725)

Fracture clamp for rods
- Ø 6.0 mm, low-profile (X98.831)

Fracture clamp for rods
- Ø 6.0 mm, for cranial end (X98.833)

Rod Ø 6.0 mm, hard
- lengths 50, 75 and 100 mm (X98.102–104)
- lengths 125 and 150 mm (X98.105–106)

Cross-Link Clamp for Rods
- Ø 6.0 mm, preassembled (X98.813)

Rod Ø 3.5 mm for Cross-link Stabilizer
- length 40 mm (X96.930)
- length 50 mm (X96.950)
- length 60 mm (X96.970)
- length 70 mm (X96.980)
- length 80 mm (X98.120)

Fixation Ring for Rods
- Ø 6.0 mm (X98.911)

Transpedicular Schanz Screw with dual core and double thread, for reduction of spondylolisthesis
Thread length 40–50 mm
- Ø 6.2 mm (X96.776–778)
- Ø 7.0 mm (X96.796–798)
Controlled reduction due to the free angular play of ±18°
(fracture clamp for cranial end: +9°–18°)
Indications for posterior instrumentation in

- Fractures: unstable fractures of the thoracic, lumbar and lumbosacral spine and fractures associated with unacceptable deformities. (Discoligamentous disruptions or previous laminectomies do not constitute contraindications.)
- Tumours/infections
- Posttraumatic deformities
- Spondylolisthesis

Contraindications

The USS Fracture System should not be used above T6 on the spinal column since the pedicles at this point are too narrow and cannot therefore ensure a sufficiently secure screw purchase.

Additional anterior defect filling is required in comminuted fractures and ventral defects (particularly compression fractures).

- Preoperative CT scan
- 19-year-old male
- Unstable burst fracture of L1

- Preoperative X-ray
- Postoperative X-ray
- Fusion of T12/L2
- Transpedicular defect filling of L1
1 Locate and open pedicles

Locate the pedicles. Open the pedicles using the Pedicle Awl (388.550) to a depth of 10 mm and the Pedicle Probe (388.540). The pedicle probe has markings at 10, 20 and 30 mm for checking the depth of pedicle/vertebral body penetration. Do not penetrate the anterior wall of the vertebral body. Using the hook of a depth gauge, probe the drilled channel to check that the channel is fully intact and that the spinal canal has not been opened.

2 Insert Kirschner wires

Insert 2 mm Kirschner wires and check that they are correctly positioned under the image intensifier (A/P, lateral and orthograde).

3 Replace Kirschner wires with Schanz screws

Insert the Schanz screws using the T-Handle (395.380) or Universal Chuck (393.100).

The Schanz screws should be inserted under lateral image intensifier control. The tips of the Schanz screws must not penetrate the anterior cortex.

4

Assemble USS fracture clamps and rod

Select the appropriate rod length. Take any necessary distraction into account when determining the length of the rod.

Place the clamps on the Schanz screws, push the rod through both clamps and push the entire construction toward the spine.

A slight resection of the spinal process will cause the assembly to lie close to the lamina.

Note: The rod comes to rest medially.

4a

Assembly with USS fracture clamp for the cranial end (optional)

The fracture clamp X98.833 can also be used for the cranial end. Since this clamp is firmly fixed to the rod, only one clamp can be used on each side. This clamp prevents the rod from jutting out at the cranial end, thereby protecting adjacent mobile segments. The cranial fracture clamp is fixed to the vertical rod using the 6.0 mm Socket Wrench (388.140).
**Principle of kyphosis correction with intact posterior wall**

Pressing the Schanz screws together dorsally lordoses the adjacent vertebrae around the pivot point (red circle) of their facing posterior edges. The clamps on the rod move toward the centre. The fracture clamps must be able to slide freely along the rod, otherwise kyphosis correction will not be achieved.

**Principle of kyphosis correction with the cranial clamp with an intact posterior wall (optional)**

The use of the cranial fracture clamp allows correction of 10° in each case by moving the caudal clamp 10 mm (guide distance).
5a

Locate socket wrench on both caudal Schanz screws and lordose the spine

Tilt both posteriorly projecting caudal screws cranially to lordose the spine. Secure the clamps/Schanz screws in the desired position using the 11 mm Socket Wrench (394.701).

Note: It is absolutely essential that the blue-marked 11 mm Socket Wrench (394.701) is used for the low-profile fracture clamps.

6a

Locate socket wrench on both cranial Schanz screws and lordose the spine

Repeat the above procedure for the cranial Schanz screws: Tilt in the caudal direction to complete the lordosing operation and secure in the desired position.
Principle of kyphosis correction with fractured posterior wall

Since a reduction produced by pressing the Schanz screw ends together produces undesirable compression on the destroyed posterior wall of the vertebral body, with the associated risk of fragment dislocation into the spinal canal, every clamp on the rod must be secured by a fixation ring (X98.911). This shifts the centre of rotation (red circle) to the level of the rod.

5 mm gaps between the fixation rings and the clamps allow kyphosis correction of 10 degree in each case (guide value).

Principle of kyphosis correction with the cranial clamp with fractured posterior wall (optional)

The use of the cranial fracture clamp allows correction of 10° in each case by moving the caudal clamp 10 mm (guide distance). A fixation ring must be used as a stop.
5b

Mount fixation rings according to the degree of lordosing

Pick up fixation rings using the Hexagonal Screwdriver (314.070) and the Holding Sleeve (388.363), locating the holding sleeve on the head of the set screw. Secure the fixation rings between the fracture clamps according to the desired degree of lordosing.

6b

Locate socket wrench and lordose the spine

Locate the 11 mm socket wrench and create the corresponding lordosis by tilting the Schanz screws as described under 5a and 6a.
7

Fix the clamps on the rods
Using the 6 mm Socket Wrench (388.140), tighten the set screws to fix the fracture clamps on the vertical rods.

Note: If the cranial clamp is used, the caudal fracture clamps are fixed to the vertical rods by tightening the set screws with the 6 mm socket wrench.

8

If required: Distraction with the spreader forceps under image intensifier control
Using the 6 mm socket wrench, loosen the set screws on the fracture clamps for the relevant vertebra and perform careful distraction if this is necessary to complete the anatomical reduction and restore the original level of the fractured vertebral body.

Note: If the cranial clamp is used, distraction can only be performed with the caudal clamp.

9

Remove fixation rings
When reduction is complete, tighten the set screws and remove the fixation rings.
Trim Schanz screws using the bolt cutter

When reduction is complete and the assembly has been secured, trim the Schanz screws to the required length using the Bolt Cutter (Handles 391.780/790 and Bolt Cutting Head 391.771).

Using the bolt cutter

Assemble the bolt cutter and place in the neutral position (you should be able to see through the 5 mm hole). Position the handles, one on top of the other, on the bolt cutting head like the hands of a clock. Slide the bolt cutting head over the Schanz screw.

Pull the handles apart to an angle of approximately 45° until the Schanz screw audibly breaks.

Return the handles to the original position and move the bolt cutting head to the next Schanz screw. The previously cut screw shaft will fall out during this operation.

**Note:** If the cut screw shaft does not fall out of its own accord, it can be pushed out using the Straight Cancellous Bone Impactor (394.570) or the shaft of another Schanz screw. If this is not possible, the bolt cutting head will have to be dismantled and the screw shaft pushed out of the inner bolt.

Always dismantle the bolt cutting head for cleaning purposes, see Cleaning Instructions, page 22.
Cross-links are transverse stabilizers that link the two vertical rods, thereby increasing the stiffness of the construct significantly. They are recommended for unstable fractures and multisegmental constructs.

11

Pick up first cross-link clamp

Assemble the Small Hexagonal Screwdriver (314.070) and the Holding Sleeve with Catches (388.363). To pick up the pre-assembled Cross-Link Clamp (X98.813), insert the hexagonal screwdriver into the set screw on the clamp, push down the holding sleeve and clip the catches onto the sleeve of the pre-assembled clamp.

12

Mount first cross-link clamp

Pull the holding sleeve back slightly, place the clamp onto the rod and release the holding sleeve.

13

Insert cross-link rod

The special design of the cross-link sleeve with its two recesses on the top allows the cross-link rod to be angled up to ±20° to suit the anatomical situation.

Determine the appropriate length of the 3.5 mm cross-link rod. If necessary, cut the rod to length using the Rod Cutting and Bending Device (388.750).

Hold the clamp with the small hexagonal screwdriver and introduce the 3.5 mm cross-link rod through the hole in the cross-link clamp (1). If necessary, use the Holding Forceps (388.450) to introduce the cross-link rod. Tighten the set screw of the cross-link clamp with the small hexagonal screwdriver (2).
14

Mount second cross-link clamp
Repeat the procedure described in step 11 for the second clamp on the opposite rod. Introduce the 3.5 mm cross-link rod through the second clamp so that it protrudes by 5 mm beyond the clamp. Tighten the set screw with the small hexagonal screwdriver.

15

Distract cross-link assembly (optional)
Loosen one of the set screws. Place the Holding Forceps (388.450) next to the clamp and use the Spreader Forceps (388.410) to exert distraction. Retighten the set screw with the small hexagonal screwdriver.
Check all set screws on the system

When the system is fully assembled, check that all screws are securely tightened.
Fracture of the posterior elements of the spine or disruption with distraction

In these indications, the USS Fracture System is used as a tension-band wiring system. Reduce the fracture as described under 5a/6a, then perform appropriate compression using the fixation rings and the Compression Forceps (388.422).

Complete disruption of the anterior and posterior elements of the spine with rotation

In these indications, the USS Fracture System is used as a neutralization system. If necessary, perform compression using the fixation rings and the Compression Forceps (388.422). For added stability, the additional use of one or two cross-link stabilizers to produce a frame construction is recommended.

Persisting wedge vertebra after reduction

If a fractured vertebra retains its wedge shape after reduction because the disc is torn and lordosing of the adjacent vertebrae causes the intervertebral space to gape, but does not straighten the vertebral body, then subsequent kyphosing can be expected. Within a few years the disc will agglomerate and the correction will be lost.

In order to prevent this, a ventral intervertebral bone graft spondyloodesis with bone graft is recommended in a second procedure.
1. **Insert transpedicular Schanz screws**

Insert the Transpedicular Schanz Screws with Double Thread (X96.776–778 or X96.796–798) into the displaced vertebra (cranial) as described in steps 1-3 on page 8. Normal Schanz screws are inserted into the caudal vertebra. Assemble USS fracture clamps and rods as described in step 4 (page 9). Secure caudal fracture clamps to the rod.

2. **Perform reduction**

Slide the USS Reduction Sleeves (388.931) and Knurled Nuts (388.932) over the Schanz screws with double thread. Turn the nuts on both sides until the desired reduction is achieved.

3. **Tighten fracture clamps**

Remove the USS knurled nuts and tighten the fracture clamps using the 11 mm Socket Wrench (394.701).

4. **Fix fracture clamps on the rods and trim Schanz screws**

Remove the USS reduction sleeves. Fix the USS fracture clamps using the 6 mm socket wrench as described in step 7 (page 14). Trim the Schanz screws with the bolt cutter as described in step 10 (page 15).
Preoperative planning
Evaluation by imaging methods is essential for assessing spinal pathology.

Image intensifier control
This is essential during the operation in order to avoid lesions of the spinal canal, nerve root damage and vascular injuries.

Filling defective vertebral bodies
Any bone defect in the vertebral body should be filled with autologous bone or – if significant defects affecting the spinal mechanics are present – with a bone graft. This will both prevent any corresponding loss of correction and minimize the risk of implant fractures.

Assembly across several segments
For the management of fractures, the Schanz screws are implanted in the adjacent cranial and caudal vertebral bodies. Normally this stabilization across two mobile segments is sufficient. Non-traumatic indications or tiered fractures may require bridging of additional vertebrae. In such cases, the formation of a frame construction with cross-links is recommended.

Postoperative management
Early mobilization is permissible, provided a three-point corset is worn postoperatively to prevent flexion and extension.

Implant removal
After fracture consolidation (9–12 months), removal of the implant is recommended in order to minimize any impairment of the paravertebral muscles. The implant should not be removed if tumours are present.

The clamps are loosened using the 11 mm Socket Wrench (394.701), while the set screws are loosened with the 6 mm Socket Wrench (388.140). The rod and clamps can then be removed from the Schanz screws.

Next, grasp the ends of the Schanz screws with the screw forceps or the T-handle and pull the screws out.
Cleaning the bolt cutting head

Dismantle the Bolt Cutting Head (391.771) into its three parts, clean by hand and rinse in the washer. Next, i.e. before steam sterilization, place a drop of Synthes Special Oil (Oil Dispenser 519.970) on the bolt and reassemble the three parts as follows:

– insert the bolt in the sleeve
– slide the nut over the hexagonal end of the bolt
– fully tighten the nut

Turn the bolt several times in the sleeve in order to distribute the oil uniformly. The neutral position is easy to feel.


