Fracture Fixation for Spine

USS Fracture System

Surgical Technique

DePuy Synthes

PART OF THE Johnson&Johnson FAMILY OF COMPANIES

Image intensifier control

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

Table of Contents

Implants

Transpedicular Schanz Screw with dual core

Length 180/35 mm
- ∅ 5.0 mm (496.711–715)*
- ∅ 6.2 mm (496.721–725)*
- ∅ 7.0 mm (496.791–795)*

Fracture Clamp for Rods

- ∅ 6.0 mm, low profile (498.831)*

Fracture Clamp for Rods

- ∅ 6.0 mm, for cranial end (498.833)*

Rod ∅ 6.0 mm, hard

- length 50, 75 and 100 mm (498.102–104)*
- length 125 and 150 mm (498.105–106)*

Cross-Link Clamp for Rods

- ∅ 6.0 mm, preassembled (498.813)*

Cross-Link Rod ∅ 3.5 mm

- length 40 mm (496.930)*
- length 50 mm (496.950)*
- length 60 mm (496.970)*
- length 70 mm (496.980)*
- length 80 mm (498.120)*

Fixation Ring for Rods

- ∅ 6.0 mm (498.911)*

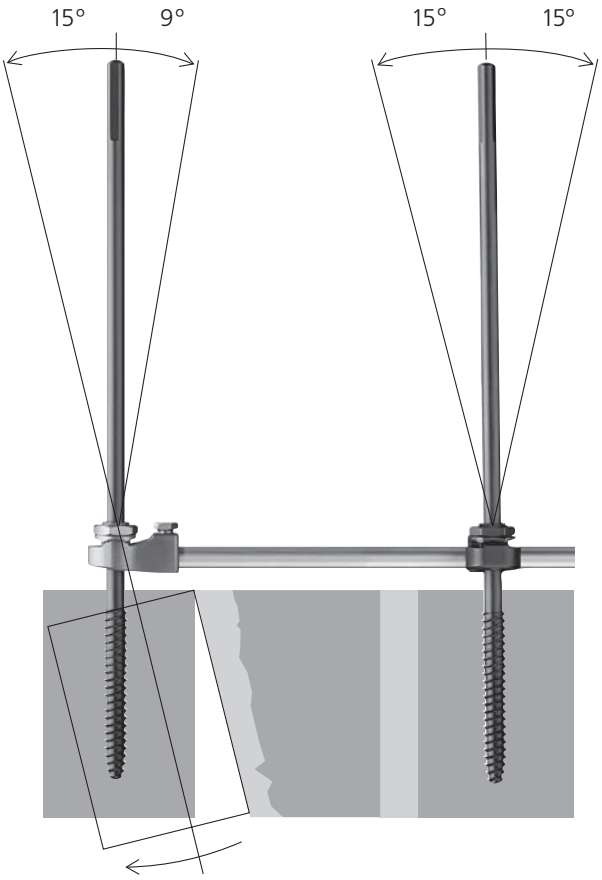
Transpedicular Schanz Screw with dual core and double thread

Thread length 40–50 mm
- ∅ 6.2 mm (496.776–778)*
- ∅ 7.0 mm (496.796–798)*

* All Implants are also available sterile packed. Add suffix "S" to article number.

Principle of fracture clamps

Controlled reduction due to the free angular play of ±15° (fracture clamp for cranial end: +9°/–15°)

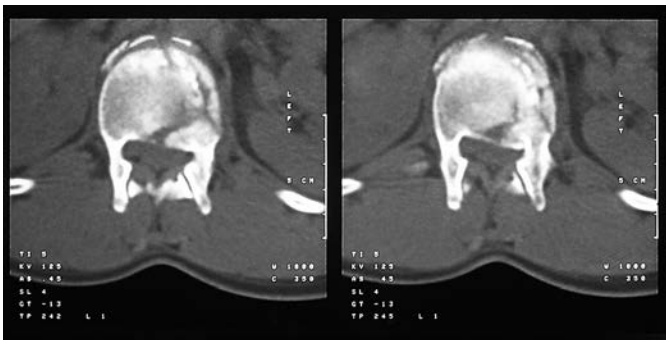


Indications/Contraindications

Intended use
The USS Fracture system is a posterior thoracolumbar pedicle screw fixation system intended to provide precise and segmental stabilization of the spine in skeletally mature patients. The application area in patients suffering from trauma or tumor disease is usually at the thoracolumbar junction (T12/L1), but can be extended from T6 down to the sacrum (S1).

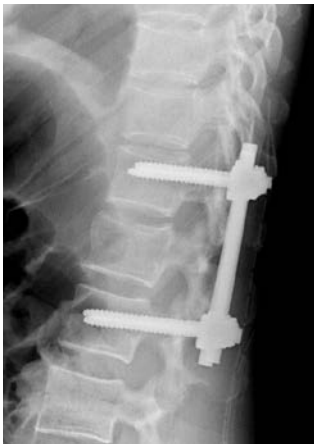
Indications
- Fractures: unstable fractures of the thoracic, lumbar and lumbo sacral spine and fractures associated with unacceptable deformities. (Discoligamentous disruptions or previous laminectomies do not constitute contraindications.)
- Tumours/infections
- Posttraumatic deformities
- Spondylolisthesis

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.
- In fractures and tumors with severe anterior vertebral body disruption, an additional anterior support or column reconstruction is required
- Osteoporosis



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

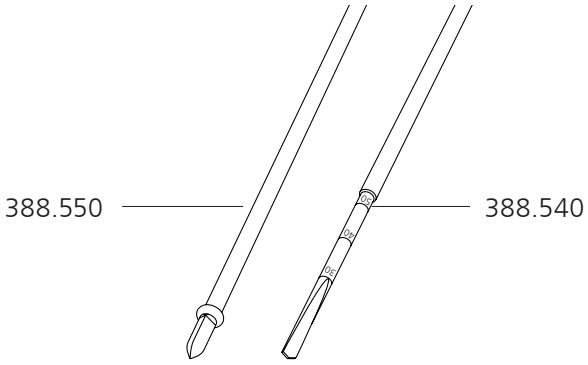
- Preoperative X-ray



- Postoperative X-ray
- Fusion of T12/L2
- Transpedicular defect filling of L1

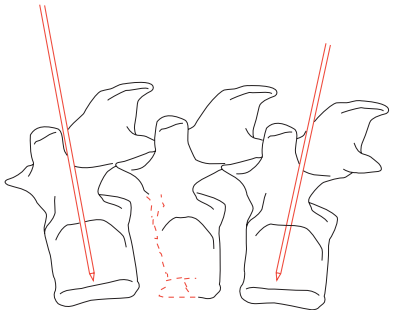
1. Locate and open pedicles

Locate the pedicles.[1] Open the pedicles using the Pedicle Awl ∅ 4.0 mm (388.550) to a depth of 10 mm and the Pedicle Probe ∅ 3.8 mm (388.540). The pedicle probe has markings at 30, 40 and 50 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

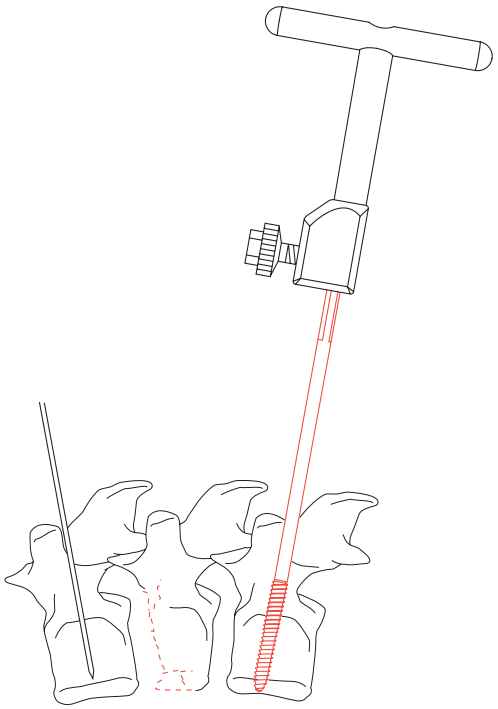
Insert 2 mm Kirschner Wires and check that they are correctly positioned under the image intensifier (A/P, lateral and orthograde).



3. Replace Kirschner Wires with Schanz screws

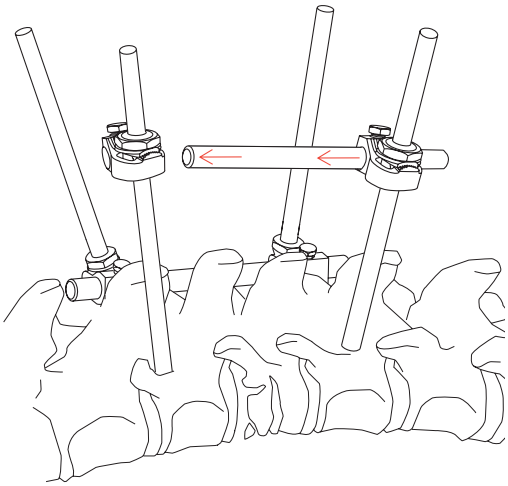
Insert the Schanz screws using the T-Handle (395.380) or Universal Chuck (393.100).

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



[1] Aebi et al. (1998), 102sq.

4. Assemble USS fracture clamps and rod



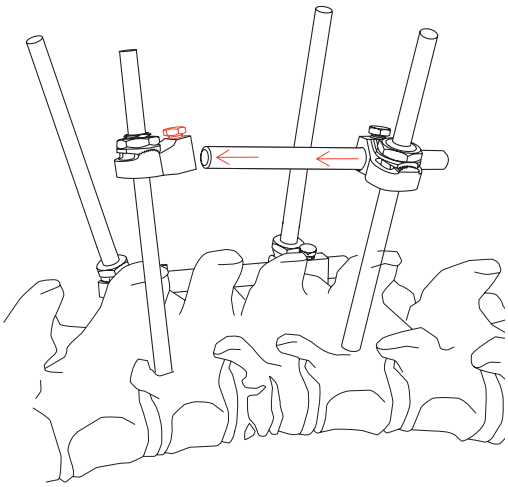
Select the appropriate rod length. Take any necessary distraction into account when determining the length of the rod.

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

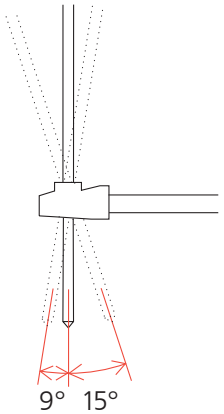
A slight resection of the spinal process will cause the assembly to lie close to the lamina.

Note: The rod comes to rest medially.

4a. Assembly with USS fracture clamp for the cranial end (optional)



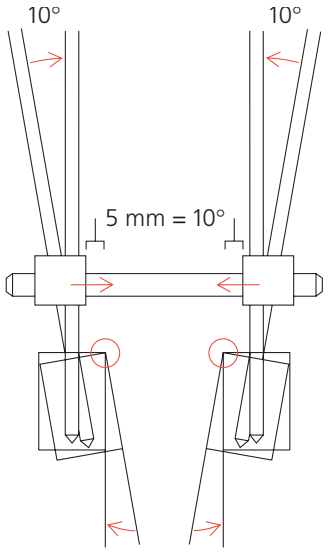
The Fracture Clamp for Rods 498.833 can also be used for the cranial end. Since this clamp is firmly fixed to the rod, only one clamp can be used on each side. This clamp prevents the rod from jutting out at the cranial end, thereby protecting adjacent mobile segments. The cranial fracture clamp is fixed to the vertical rod using the Socket Wrench 6.0 mm (388.140).



Fractures with intact posterior wall

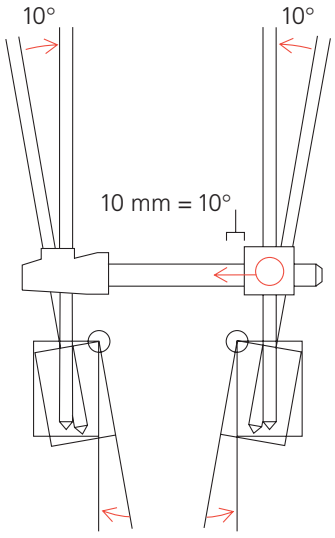
Principle of kyphosis correction with intact posterior wall

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)

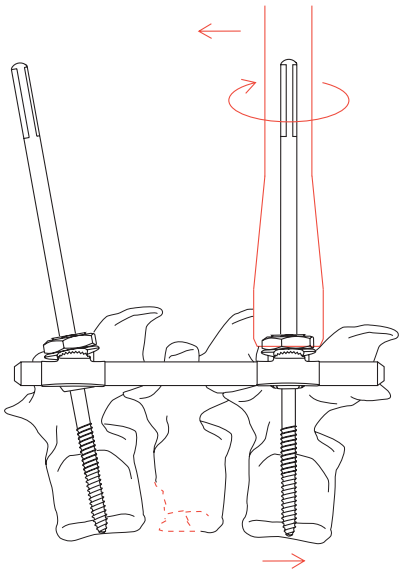
The use of the cranial fracture clamp allows correction of 10° in each case by moving the caudal clamp 10 mm (guide distance).



5a. Locate Socket Wrench on both caudal Schanz screws and lordose the spine

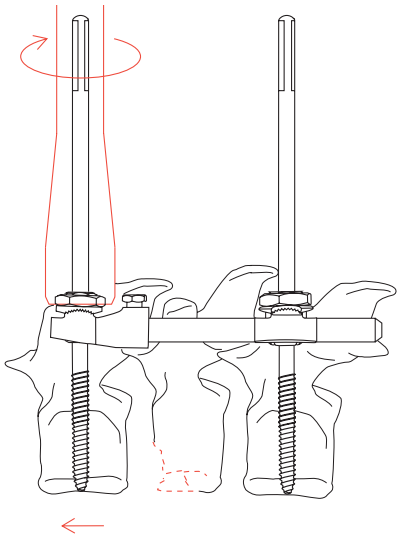
Tilt both posteriorly projecting caudal screws cranially to lordose the spine. Secure the clamps/Schanz screws in the desired position using the Socket Wrench ∅ 11 mm (394.701).

Note: **It is absolutely essential that the blue-marked Socket Wrench ∅ 11 mm (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.

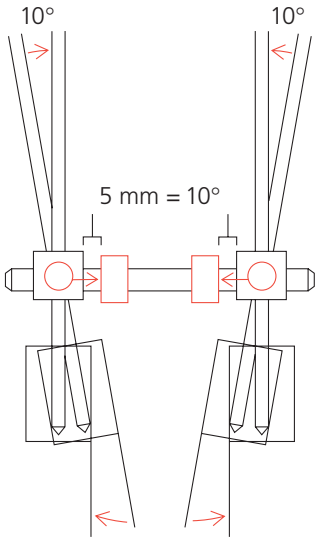


Fractures with fractured posterior wall

Principle of kyphosis correction with fractured posterior wall

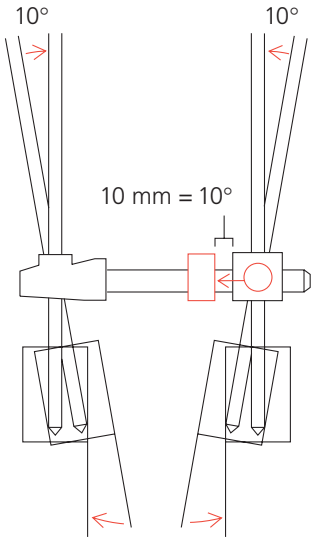
Since a reduction produced by pressing the Schanz screw ends together produces undesirable compression on the destroyed posterior wall of the vertebral body, with the associated risk of fragment dislocation into the spinal canal, every clamp on the rod must be secured by a Fixation Ring for Rods ∅ 6.0 mm (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).



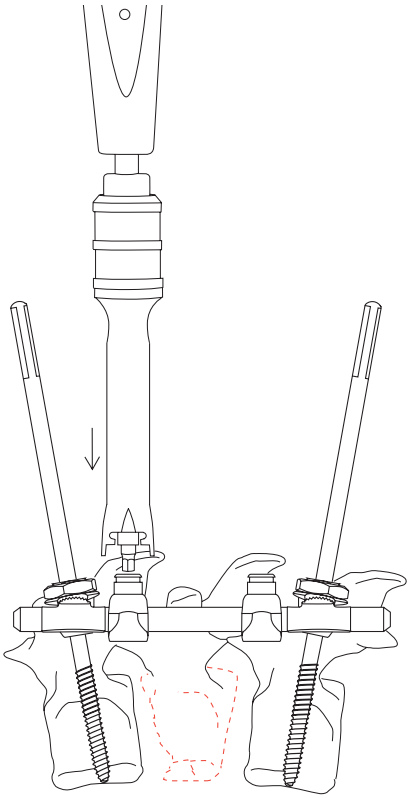
Principle of kyphosis correction with the cranial clamp with fractured posterior wall (optional)

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.



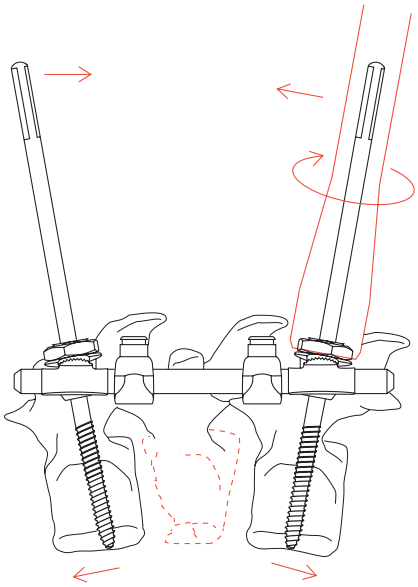
5b. Mount fixation rings according to the degree of lordosing

Pick up fixation rings using the Screwdriver, hexagonal (314.070) and the Holding Sleeve with Catches (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

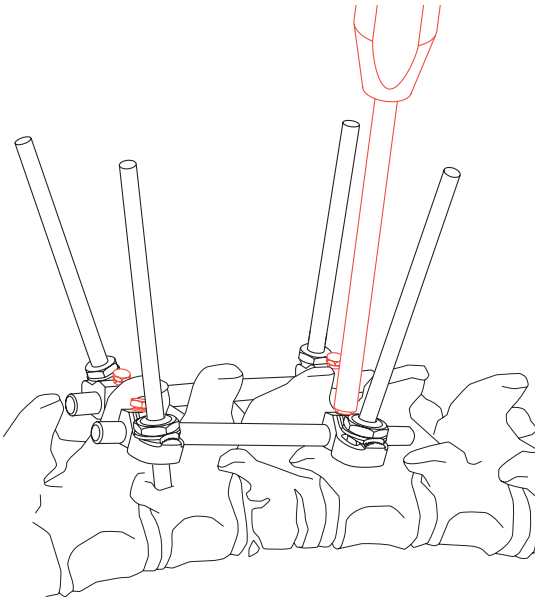
Locate the Socket Wrench ∅ 11 mm and create the corresponding lordosis by tilting the Schanz screws as described under 5a and 6a.



7. Fix the clamps on the rods

Using the Socket Wrench 6.0 mm (388.140), tighten the set screws to fix the fracture clamps on the vertical rods.

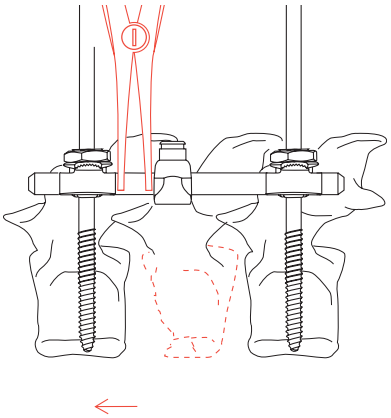
Note: **If the cranial clamp is used, the caudal fracture clamps are fixed to the vertical rods by tightening the set screws with the Socket Wrench 6.0 mm.**

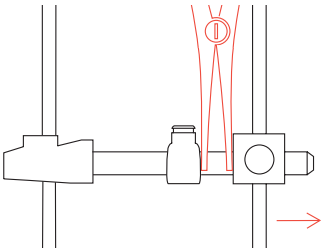


8. If required: Distraction with the Spreader Forceps under image intensifier control

Using the Socket Wrench 6.0 mm, 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.

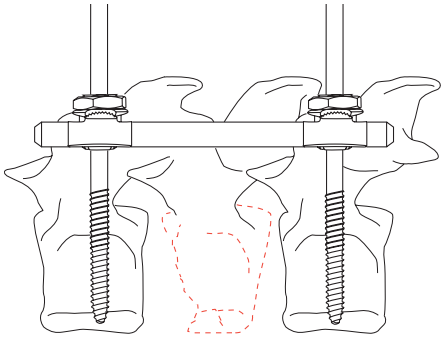
Note: **If the cranial clamp is used, distraction can only be performed with the caudal clamp.**





9. Remove fixation rings

When reduction is complete, tighten the set screws and remove the fixation rings.



10. Trim Schanz screws using the Bolt Cutter

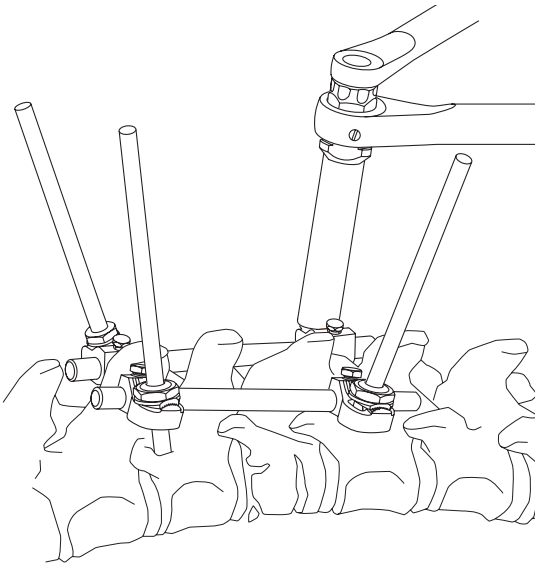
When reduction is complete and the assembly has been secured, trim the Schanz screws to the required length using the Bolt Cutter (Handle 391.780/790 and Bolt Cutting Head ∅ 5.0 mm 391.771).

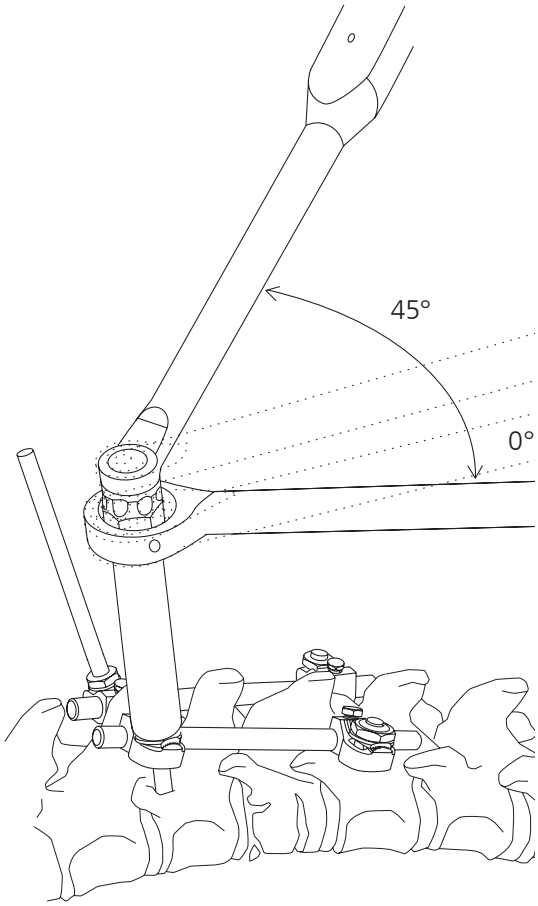
Using the Bolt Cutter
Assemble the Bolt Cutter and place in the neutral position (you should be able to see through the 5 mm hole). Position the handles, one on top of the other, on the bolt cutting head like the hands of a clock. Slide the bolt cutting head over the Schanz screw.

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 Cancellous Bone Impactor, straight (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.



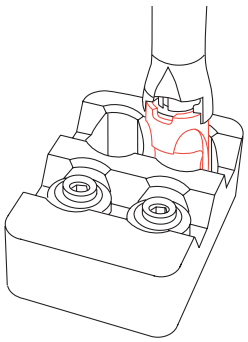


Assembling the cross-link system

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.

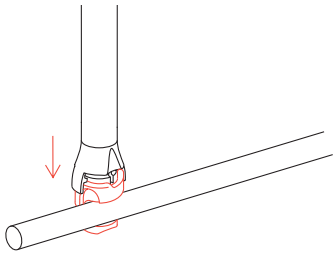
1. Pick up first Cross-Link Clamp

Assemble the Small Screwdriver, hexagonal (314.070) and the Holding Sleeve with Catches (388.363). To pick up the preassembled Cross-Link Clamp for Rods ∅ 6.0 mm (498.813), 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 preassembled clamp.



2. Mount first Cross-Link Clamp

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

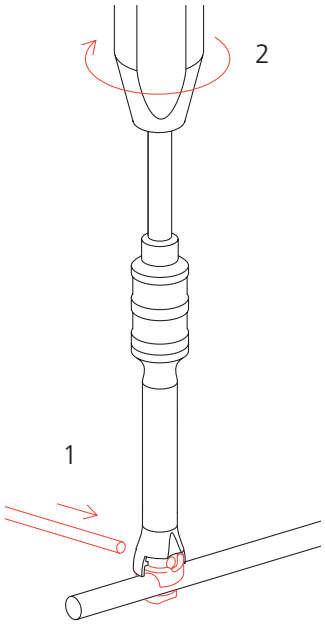


3. Insert cross-link rod

The 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.

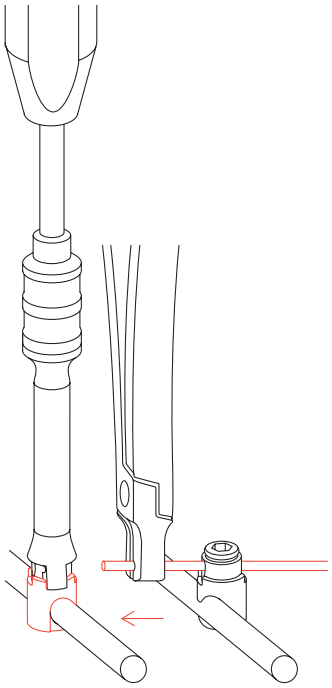
Determine the appropriate length of the ∅ 3.5 mm cross-link rod. If necessary, cut the rod to length using the USS Rod Cutting and Bending Device (388.750).

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 for USS Rods ∅ 3.5/4.5 mm (388.450) to introduce the cross-link rod. Tighten the set screw of the Cross-Link Clamp with the small hexagonal screw-driver (2).



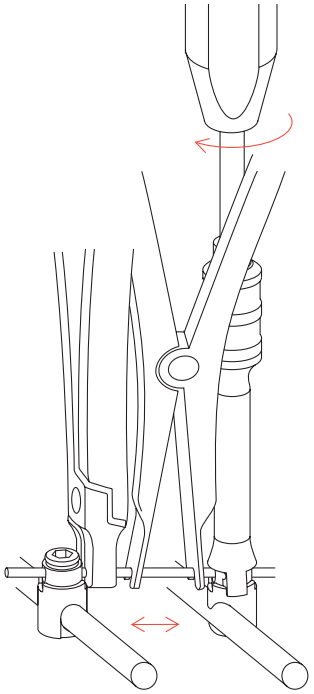
4. Mount second Cross-Link Clamp

Repeat the procedure described in step 1 (page 14) 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.



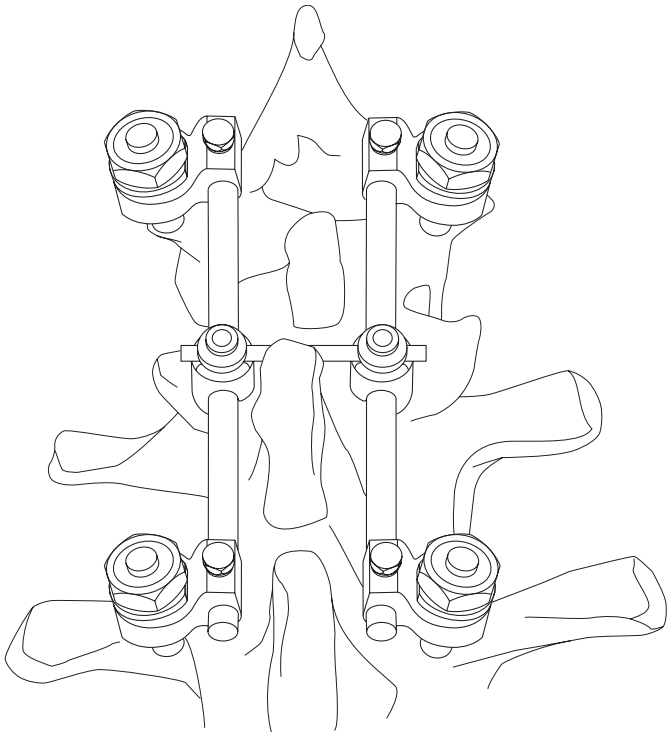
5. Distract cross-link assembly (optional)

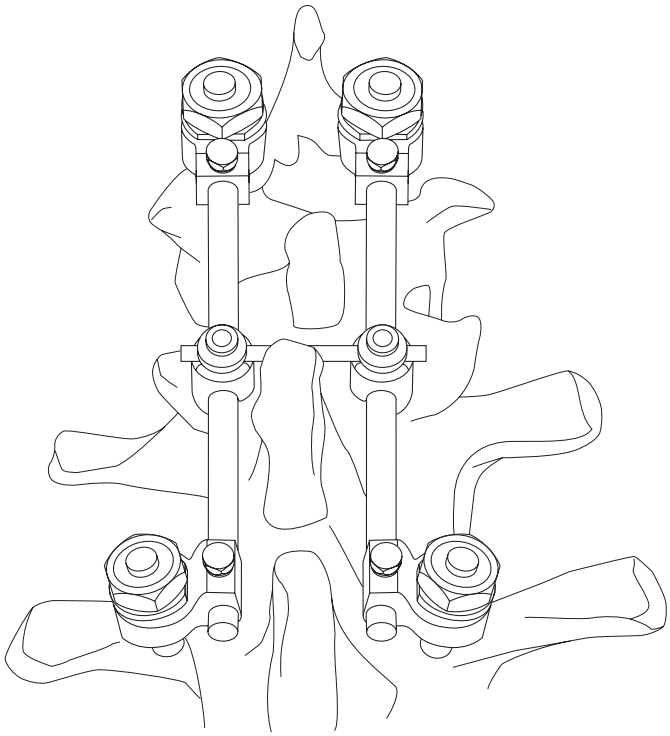
Loosen one of the set screws. Place the Holding Forceps for USS Rods ∅ 3.5/4.5 mm (388.450) next to the clamp and use the Spreader Forceps for Pedicle Screws (388.410) to exert distraction. Retighten the set screw with the small hexagonal screwdriver.



6. Check all set screws on the system

When the system is fully assembled, check that all screws are securely tightened.





Techniques depending on fracture type

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

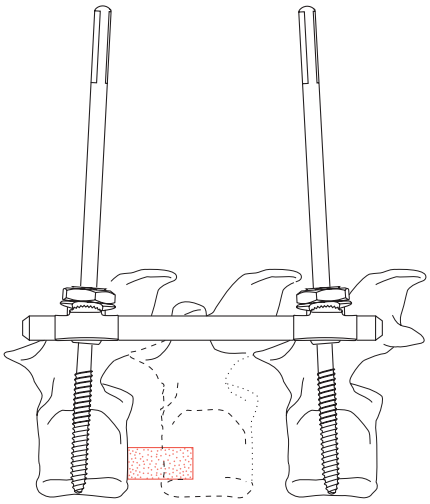
In these indications, the USS Fracture System is used as a neutralization system. If necessary, perform compression using the fixation rings and the Compression Forceps (388.422).

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.

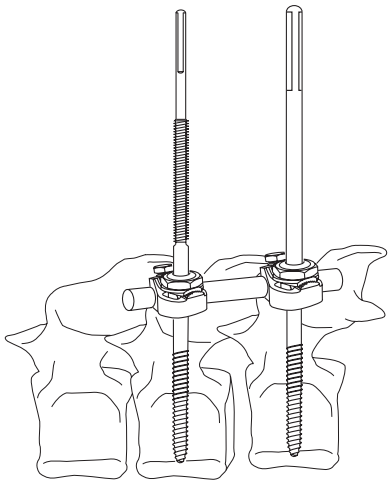
In order to prevent this, a ventral intervertebral bone graft spondylodesis with bone graft is recommended in a second procedure.



Reduction of spondylolisthesis

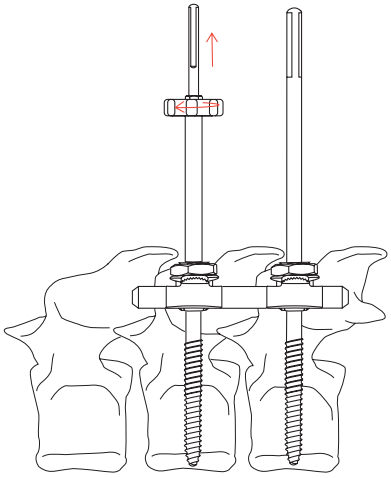
1. Insert Transpedicular Schanz Screws

Insert the Transpedicular Schanz Screws with dual core and double thread (496.776–778 or 496.796–798) into the displaced vertebra (cranial) as described in steps 1–3 on page 5. Normal Schanz screws are inserted into the caudal vertebra. Assemble USS fracture clamps and rods as described in step 4 (page 6). Secure caudal fracture clamps to the rod.



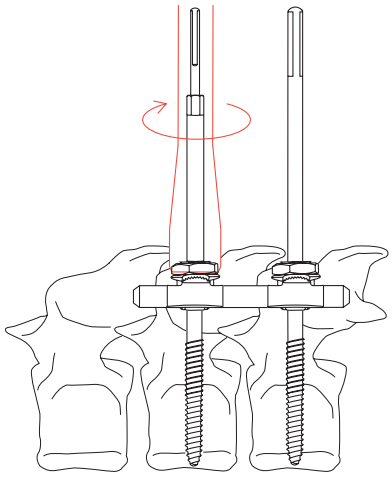
2. Perform reduction

Slide the USS Reduction Sleeve (388.931) and USS Nut, knurled (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 Nuts, kurled and tighten the fracture clamps using the Socket Wrench ∅ 11 mm (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 Socket Wrench 6.0 mm as described in step 7 (page 11). Trim the Schanz screws with the Bolt Cutter as described in step 10 (page 13).

Notes for the surgeon

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 may prevent any corresponding loss of correction and reduce 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 reduce any impairment of the paravertebral muscles. The implant should not be removed if tumours are present.

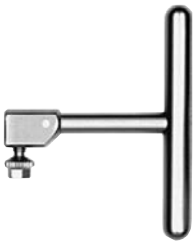
The clamps are loosened using the Socket Wrench ∅ 11 mm (394.701), while the set screws are loosened with the Socket Wrench 6.0 mm (388.140). The rod and clamps can then be removed from the Schanz screws.

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

Instruments

314.070	Screwdriver, hexagonal, small, 2.5 mm, with Groove	
388.140	Socket Wrench 6.0 mm, with straight handle	
388.363	Holding Sleeve with Catches, for No. 314.070	
388.410	Spreader Forceps for Pedicle Screws, length 330 mm	
388.422	Compression Forceps, length 335 mm, for Pedicle Screws	
388.450	Holding Forceps for USS Rods ∅ 3.5/4.5 mm, length 295 mm	

388.540	Pedicle Probe ∅ 3.8 mm with Canevasit Handle, length 230 mm, for Pedicle Screws ∅ 5.0 to 7.0 mm	
388.550	Pedicle Awl ∅ 4.0 mm with Canevasit Handle, length 230 mm, for Pedicle Screws ∅ 5.0 to 7.0 mm	
388.750	USS Rod Cutting and Bending Device	
388.931	USS Reduction Sleeve, for Nos. 296.750 and 496.750	
388.932	USS Nut, knurled, for No. 388.931	
391.771	Bolt Cutting Head ∅ 5.0 mm, long, cutting height 2 mm, for Nos. 391.780 and 391.790	

391.780	Handle ∅ 13.0 mm for Bolt Cutting Head, length 455 mm	
391.790	Handle ∅ 24.0 mm for Bolt Cutting Head, length 455 mm	
393.100	Universal Chuck with T-Handle	
394.570	Cancellous Bone Impactor, straight	
394.701	Socket Wrench ∅ 11.0 mm, cannulated, length 300 mm, for USS Fracture Clamps	
395.380	T-Handle for Steinmann Pins and Schanz Screws	

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