Aesculap® S4® Cervical System

Posterior Occipital Cervical Thoracic Stabilization System
Surgical Technique

Aesculap Spine

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SHARING EXPERTISE

Aesculap® S4® Cervical System

Meeting the Challenge – Posterior Cervical Spine Surgery

S4® C

The special needs of the cervical spine make posterior cervical stabilization a challenging procedure. High construct stability[1] combined with minimal implant size make the S4® Cervical System the partner to rely on.

By combining the small yet stable design of the screw construct[2] with simple instrumentation, S4® Cervical System has shown its performance in more than 10.000 cases.

The S4® Cervical System fulfills these aims with its four key features:

- **Small** size
- **Stable** construct
- **Simple** insertion
- **Safe** procedure

The S4® Cervical System efficiently transfers these features to its wide implant and instrument versatility to meet the special needs of the cervical and thoracic spine.

S4® mall

- Undercut thread for miniature size of the screw head, especially important in small bony structures
- Wide screw angle and low profile for adaptation of the construct to patient anatomy
- Minimal access instruments for subcutaneous approach

S4® table

- Unique S4® closure mechanism with undercut thread stabilizes polyaxial construct
- Special shaped seat inside the screw body creates pressure vessel effect
- Provides high overall biomechanical stability[1]

[1] *Grupp T. Evaluation of the mechanical behaviour of the Aesculap® S4® C Occipital plate spinal system in a vertebrectomy model according to ASTM F1717 and ASTM F2706. Test No.: V682, V683-A, V684-A [Internal test reports - unpublished]. Tuttlingen: Aesculap AG Biomechanical Research Laboratory; July 2006 & January 2007.*

[2] *Grupp T. Evaluation of the mechanical behaviour of the Aesculap® S4® Cervical Screw in a single component test setup according to ASTM F2193. Test No.: V619 [Internal test report - unpublished]. Tuttlingen: Aesculap AG Biomechanical Research Laboratory; July 2009.*

S4® imple

- Specialized instruments for easy screw and hook placement in various anatomical situations
- Color-coded implants and instruments for ease of use
- Guiding instruments for minimal access and soft tissue and nerve root protection

S4® afe

- Small implant volume, overall biomechanical strength[1], and easy access instruments help to achieve a fast and efficient surgical procedure and excellent patient outcome[3]

[3] *Stulik J, Nesnidal P, Kryl J, Vyskocil T, Barna M. Kyphotic deformities of the cervical spine. 28th Annual Meeting of the AANS/CNS Section on Disorders of the cervical Spine and peripheral Nerves. March 2012 Orlando, Florida.*

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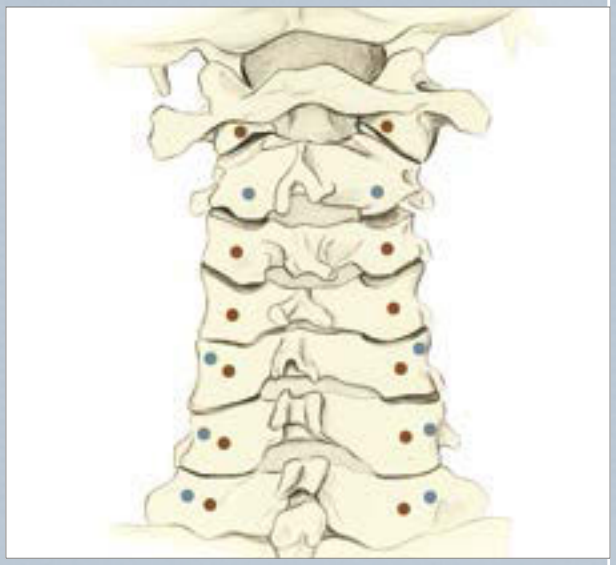
1. Screw Entry Points and Trajectory

1.

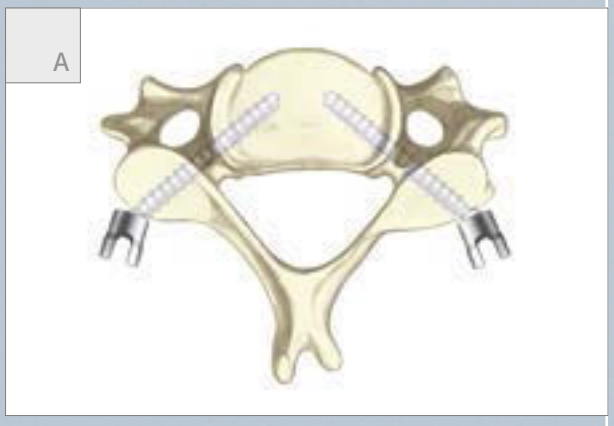
Depending on the anatomy, different entry points for the Polyaxial Screws might have to be chosen.

The entry point for Lateral Mass Screws (red) is more medial than the entry point for Pedicle Screws (blue).

For precise planning of the entry points please see section 2.1 "Pre-Operative Planning" of this surgical technique.



A – Pedicle Screw
Pedicle Screws go from lateral to medial through the pedicle.



B – Lateral Mass Screw
Lateral Mass Screws go from medial to upper lateral.

2. Pre-Operative Planning and Exposure

2.1 Pre-Operative Planning

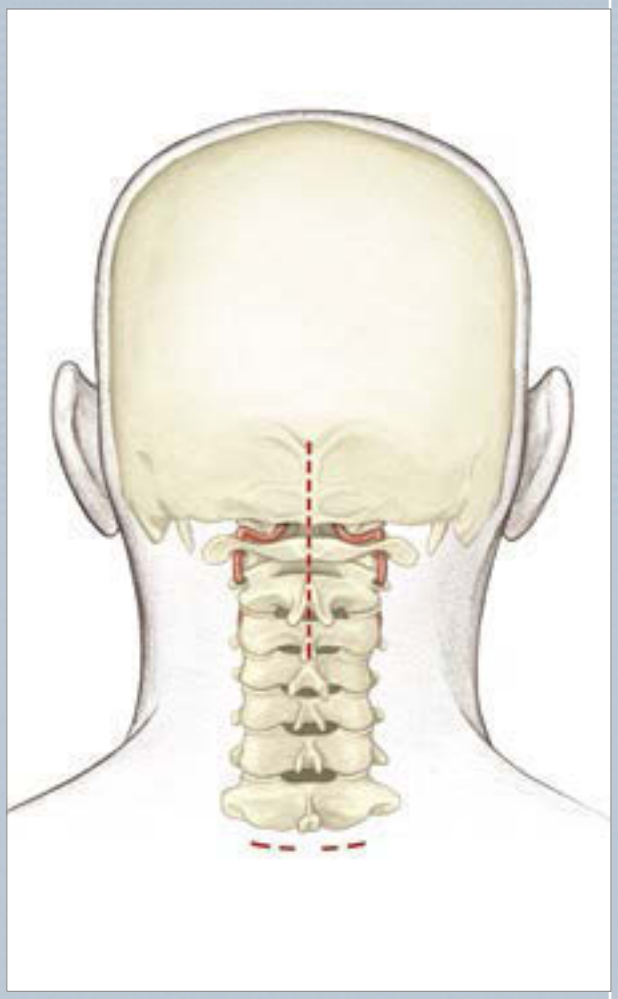
A detailed discussion of the factors involved in the strategy of cervical and upper thoracic posterior segmental instrumentation is beyond the intent of this document and is available in current published articles.
Consideration as to obtaining a CT for the pre-operative planning should be made.
CT helps to examine anatomical variation, confirm pedicle orientation, and provides an indication of suitable implant sizes for maximum safety and stability. The entire construct should be planned pre-operatively, identifying all the system components required for the final construct. Also the CT data can later be utilized for upload in a navigation system.

2.2 Patient Positioning

The patient is placed on the operating table in a prone position with the head supported in a holder. Whenever it is safe to do so, position the spine in physiological alignment. Accurate positioning is especially important when fixing the occiput to the cervical and thoracic spine. Confirm proper alignment using an image intensifier or radiograph prior to draping. The neck and shoulders are prepared and draped in the usual manner.

2.3 Exposure

A cross table lateral x-ray is taken to confirm the appropriate position. The initial incision is made in the midline and taken down through the subcutaneous tissue, e.g. with electrocautery, to expose the area of the cervical and upper thoracic spine to be stabilized.
A wide exposure extending to the lateral aspect of the facet joints in the cervical spine and the transverse processes in the thoracic spine is achieved. Extend the exposure to the external occipital protuberance (EOP) if the fusion will include the occiput.



Attention:
Care must be taken to avoid injury to the spinal cord, nerve roots and vertebral arteries as well as to the interspinous ligaments and the facet capsules at adjacent levels that will not be fused. This procedure should be modified according to specific surgical requirements.

3. Polyaxial Screw Fixation

3.1 Screw Hole Preparation

To prepare for the Polyaxial Screws, remove all soft tissue and prepare the site.

Center Punch
The Center Punch may be used to open the cortex. A raised edge is provided on the Center Punch to indicate when the ideal depth has been reached.

Alternatively, a 1 – 2 mm drill hole can be made using a small decortication burr.

Attention:
Never insert the Center Punch beyond the raised edge.

Center Punch – FW041R

Drilling
Set the desired depth to be drilled on the variable Drill Guide by rotating the inner sleeve.
The variable Drill Guide offers a range of up to 35 mm. Fixed 12 mm & 14 mm Drill Guides are also available. The same Drill Guide can be used for the ø 3.5 mm and the ø 4.0 mm screws.

Select the appropriate drill bit and attach it to the desired drill handle.
The ø 2.4 mm drill is required for the ø 3.5 mm Polyaxial Screws.
The ø 2.9 mm drill is required for the ø 4.0 mm Polyaxial Screws.

The positive stop of the drills is color-coded to match the screw head color of the screw being used. The silver drill stop is used for the ø 3.5 mm screws and the purple stop is used for the ø 4.0 mm screws. Each drill is sterile packed for single use.

Insert the required drill into the guide up to the positive stop and verify the exposed length of the drill. Position the guide at the desired entry site and advance the drill until the stop is reached.

- *Drill, ø 2.4 mm (ø 3.5 mm screws) – FW051SU*
- *Drill, ø 2.9 mm (ø 4.0 mm screws) – FW052SU*
- *Twist Drill Handle (standard) – FJ839R*
- *Tear Drop Drill Handle (optional) – SC436R*
- *Variable Drill Guide Short – FW053R*
- *Fixed Drill Guide, 14 mm – FW049R*
- *Fixed Drill Guide, 12 mm (optional) – FW669R*

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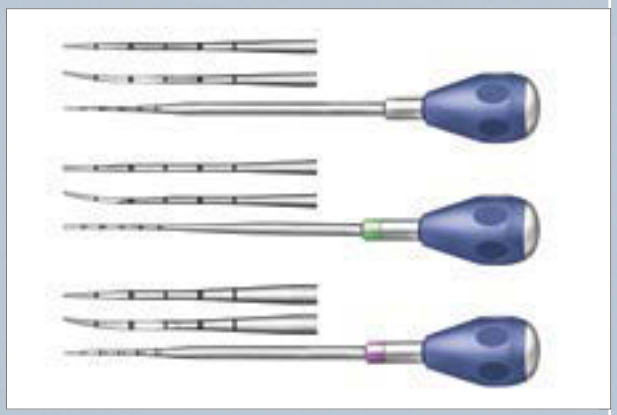
3. Polyaxial Screw Fixation

3.1

Bone Probe
Alternatively, pedicle preparation can be performed with bone probes.
The probes are available in blunt and sharp, straight and curved. All probes are equipped with a scale to determine the depth measurement in the bone.
In addition to the probes with the tip diameter of 2.4 mm the system also offers 2.9 mm bone probes for thoracic pedicle preparation.

Note:
- Cervical probes with diameter 2.4 mm are dedicated for 3.5 mm screws
- Thoracic bone probes diameter 2.9 mm are dedicated for 4.0 mm screws



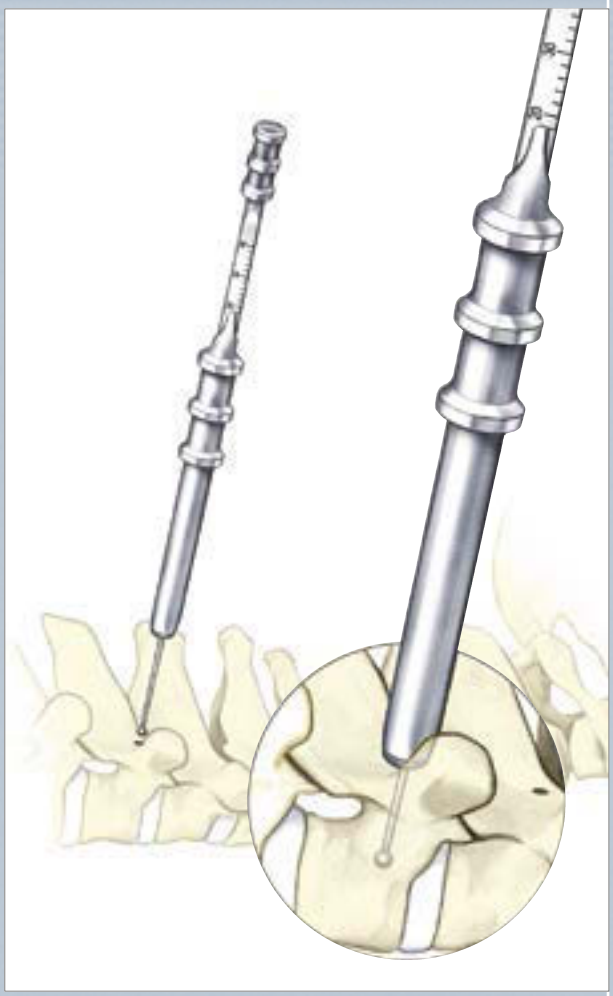
- *Bone Probe Blunt Curved (Ø 2.4 mm) – FW677R*
- *Bone Probe Blunt Straight (Ø 2.4 mm) – FW676R*
- *Bone Probe Curved (Ø 2.4 mm) – FW675R*
- *Bone Probe Straight (Ø 2.4 mm) – FW674R*
- *Bone Probe Thoracic Curved (Ø 2.9 mm) – FW679R*
- *Bone Probe Thoracic Straight (Ø 2.9 mm) – FW678R*

Optional technique
Pedicle markers are available to check the position and orientation of the screw holes radiographically.

- *Pedicle Marker Angled – FW145R*
- *Pedicle Marker Round – FW144R*

Confirming Depth
Confirm the depth of the drilled hole and the integrity of the wall using the Sounder.
The Depth Gauge is marked in 2 mm increments and can be used to measure the desired depth of the hole by using the retractable sleeve.

The depth displayed reflects the actual screw thread length to be used as well as the depth of the hole, e.g. 24 mm depth gauge reading represents not only 24 mm drill depth but also 24 mm polyaxial screw selection.



- *Pedicle Depth Gauge – FW042R*
- *Sounder – FW044R*

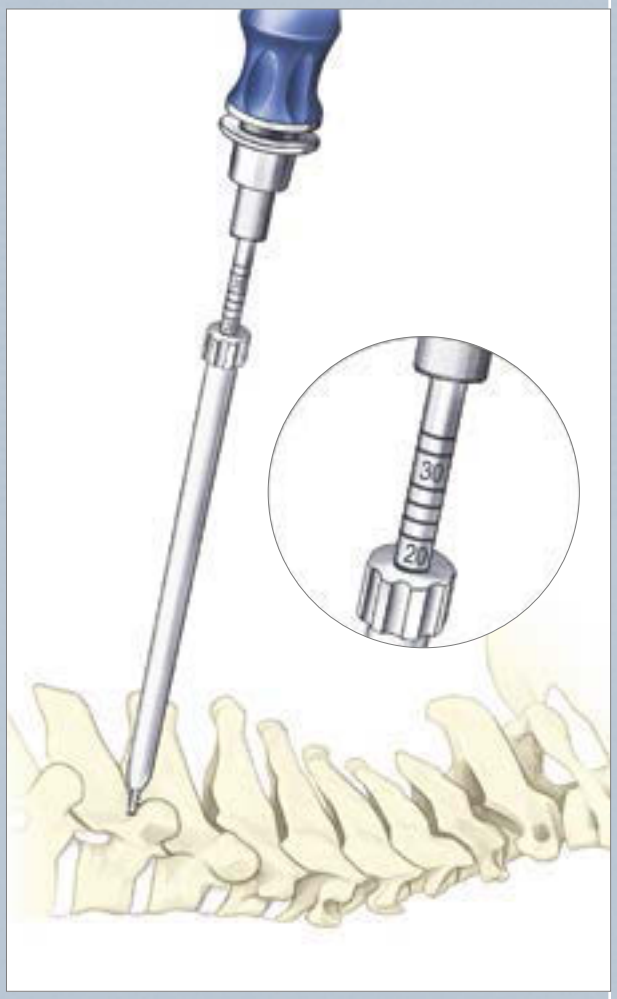
3. Polyaxial Screw Fixation

3.1

Tapping
The next step is to tap the pre-drilled hole. Although the screws are equipped with a self-tapping tip, to ensure optimal bone purchase of the screws, tapping is recommended for the first 3 mm in unicortical screw placement or through the second cortex in bicortical screw placement screws.
The tap does not need to be inserted through the drill sleeve. It is equipped with a self-retracting sleeve which prevents the risk of damaging surrounding tissue during tapping.

For the ø 3.5 mm Polyaxial Screw, the ø 3.5 mm tap is used.
For the ø 4.0 mm Polyaxial Screw, the ø 4.0 mm tap is used.

The taps, like the drills, are color-coded in accordance to the screw size. The appropriate tap is inserted manually into the pre-drilled hole. While maintaining the appropriate trajectory, tap the hole. In the same manner, the remaining holes are drilled and tapped.



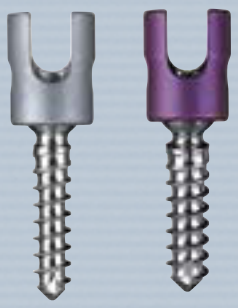
- *Screw Tap, ø 3.5 mm – FW046R*
- *Screw Tap, ø 4.0 mm – FW047R*
- *Ratchet Handle – FW165R or*
  Non-ratchet Handle – FW067R

3.2 Screw Selection

S4® Cervical provides a variety of screw choices:

ø 3.5 mm and ø 4.0 mm Polyaxial Screws:

- Lengths beginning at 10 mm and extending to 30 mm in 2 mm increments
- +/-35° conical angulation
- Silver screw head for ø 3.5 mm
- Purple screw head for ø 4.0 mm

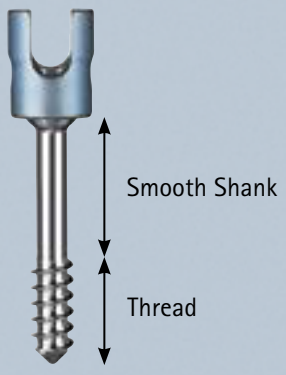


ø 4.0 mm Favored Angle Screws:

- Lengths beginning at 10 mm and extending to 56 mm in 2 mm increments
- +/-35° regular angulation
- +/-55° additional angulation in the cephalad and caudal directions for the "SX screw line" and 45° for the "SW screw line"
- Gold screw head

ø 4.0 mm Smooth Shank Screws:

- Lengths beginning at 16 mm thread (18 mm, 20 mm, 22 mm, 24 mm and 26 mm) and 8 mm smooth shank (up to 18 mm)
- +/-35° conical angulation
- Blue screw head



3. Polyaxial Screw Fixation

3.3 Screw Insertion

With the pedicles or lateral mass prepared and the proper screw length determined, the appropriate screws are inserted into the pre-drilled holes, using the Threaded Screwdriver or alternatively the Self-Retaining Screwdriver. To attach the screwdriver to the Handle, pull back on the spring mechanism of the handle and insert the screwdriver into the opening, release the spring to lock the screwdriver onto the handle. Give a tug on the screwdriver to ensure it is locked securely onto the handle.

Threaded Screwdriver
Insert the Threaded Screwdriver into the screw hex. To affix the Threaded Screwdriver to the screw, rotate the blue handle clockwise until the screwdriver thread engages the screw head.

Note:
Tighten until resistance is felt. Do not overtighten as this can cause difficulty disengaging the screwdriver after screw placement. Overtightening can also cause locking of the screw tulip and thus impede polyaxial movement.

After insertion of the screw, rotate the blue handle counterclockwise to release the Threaded Screwdriver.

Note:
To ensure maximum polyaxiality with the screw, do not tighten the screw completely down to the bone. Leave a small gap below the head to allow rotation and angulation of the screw head.

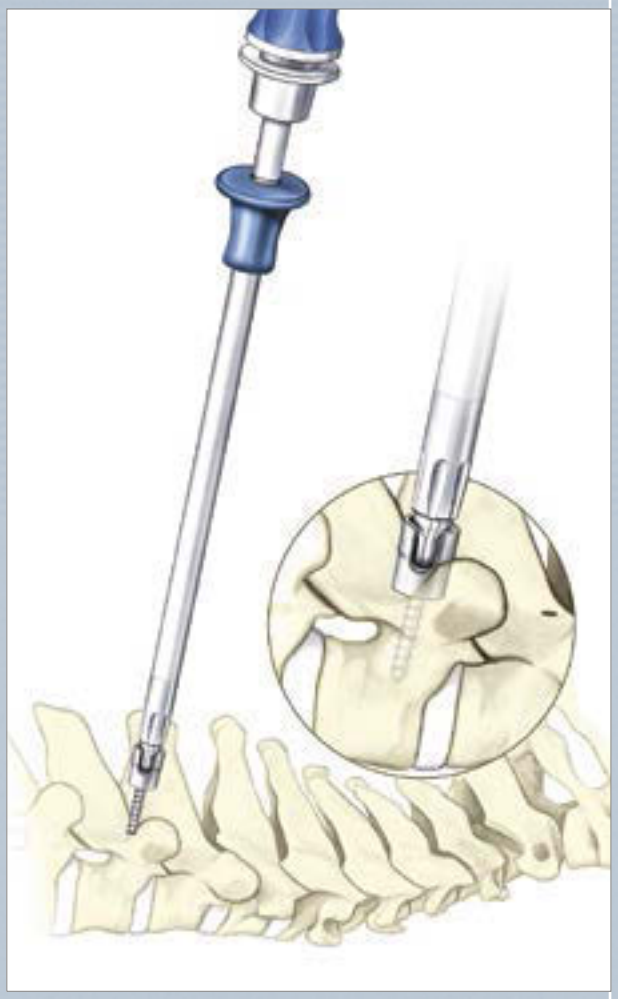
- *Threaded Screwdriver – FW128R*
- *Ratchet Handle – FW165R or Non-ratchet Handle – FW067R*

Self-Retaining Screwdriver
Alternatively the Self-Retaining Screwdriver can be used for screw placement.
To attach the screw onto the Self-Retaining Screwdriver, pull the blue trigger towards the handle and insert the screw on the end of the screwdriver while the trigger is retracted, then release the blue trigger.
The screw should now be securely locked on the screwdriver. While the tip of the screw stays firmly in position axially to the screwdriver, insert the screw into the bone.

Note:
The hex end of the Self-Retaining Screwdriver must be fully inserted into the spherical head of the screw. The pins of the head of the screwdriver create the Self-Retaining tip feature.

To disengage the screwdriver from the screw, pull back on the blue trigger, and maintain this while extracting the driver from the screw.

Note:
To ensure maximum polyaxiality with the screw, do not tighten the screw completely down to the bone. Leave a small gap below the head to allow rotation and angulation of the screw head.



- *Self-Retaining Screwdriver (optional) – FW070R*
- *Ratchet Handle – FW165R or*
  Non-ratchet Handle – FW067R

3. Polyaxial Screw Fixation

3.4 Screw Head Alignment

Once the screw is inserted, the position of the polyaxial head is optimized for rod insertion using the Screw Body Manipulator.

To facilitate rod placement, the polyaxial screw body can be rotated 360° and angled up to +/-35° in any direction. The ø 4.0 mm Favored Angle Screws provide additional angulation in the cephalad and caudal directions for a total of +/-55° for the "SX screw line" and +/- 45° for the "SW screw line".

In general, if the screw is inserted too far, polyaxial movement of the screw body will be impeded due to bone contact. In such a case, the screw should be turned counterclockwise using either the Ball End Screwdriver or the Self Holding Screwdriver until full polyaxial motion is achieved.

In the same manner, all the Polyaxial Screws are inserted.

- *Screw Body Manipulator – FW065R*
- *Ball End Screwdriver – FJ968R*

4. Rod Insertion

After the insertion of the Polyaxial Screws (and hooks), and prior to inserting the rods, the lordotic alignment of the cervical spine and the kyphotic alignment of the upper thoracic spine should be verified via intraoperative lateral x-ray.
The A-P height of the screws can be adjusted to simplify insertion of the ø 3.5 mm rod therefore reducing the need for rod contouring.

A trial rod template can be used to aid in rod contouring or trimming to the required length.
Rod templates exist in lengths of 60 mm, 120 mm and 290 mm.

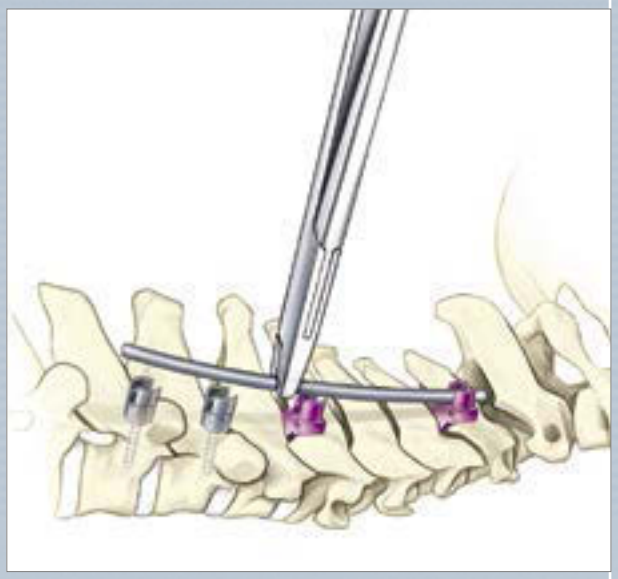
A Rod Cutter can be used to cut the rod. To avoid projection of the small piece to be cut, grasp it with the Rod Holding Forceps.

The rod is inserted with the Rod Holding Forceps.

Also a rod bender is available to contour the rod.

Note:
Always bend the S4® Cervical rods in one direction only. Do not bend back the rods.

Note:
For long S4® Cervical rods, bending should be carried out in several steps in order to avoid excessive or insufficient lordosis.

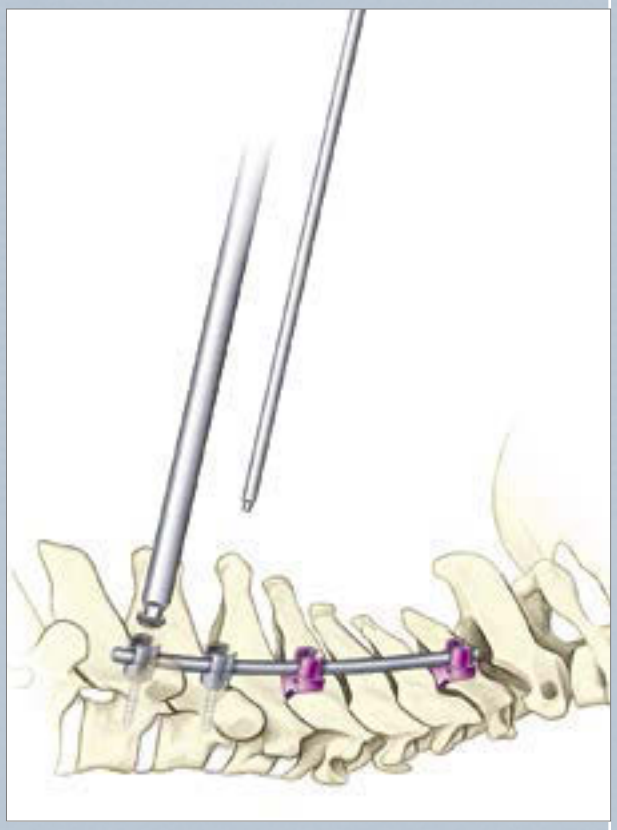


- *Rod Bending Template 60 mm – FW078R*
- *Rod Bending Template 120 mm – FW080R*
- *Rod Bending Template 290 mm – FW081R*
- *Rod Cutter – FW082R*
- *Rod Holding Forceps – FW076R*
- *Straight Cut Rod Cutter (optional) – FW672R*
- *Rod Bending Forceps – FW037R*

5. Set Screw

5.1 Set Screw Insertion

Start the Set Screw in the polyaxial body or hook by first turning the instrument counterclockwise until a click is heard or felt.
Then rotate the instrument clockwise until the Set Screw is hand-tightened. Starting the Set Screw in this manner ensures cross-threading is minimized.



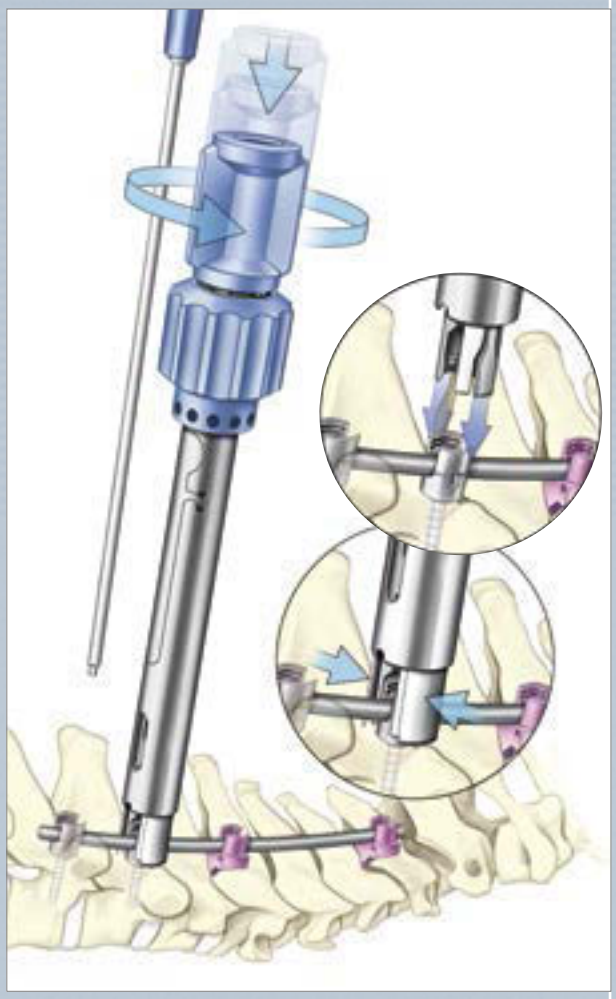
- *Set Screw Starter – FW133R*
- *Double Ended Set Screw Starter – FW134R*

5.2 Rod Persuasion

If required, the rod can be held down in the polyaxial body or hook using the Rod Holding Forceps or a Rod Persuader.

Linear Rod Persuader
Pull back the proximal knob in order to disengage the locking sleeves.
Attach the inner sleeve of the persuader to the screw head. Once the inner sleeve is fully engaged push down the proximal knob and then rotate it counterclockwise to secure the locking position. (Rod Persuasion continues on next page.)

Note:
Applying the Linear Rod Persuader the set screw can only be inserted using the Single Ended Set Screw Starter FW133R (or the previous version FW058R).



- *Rod Holding Forceps – FW076R*
- *Linear Rod Persuader – FW673R*
- *Set Screw Starter – FW133R*

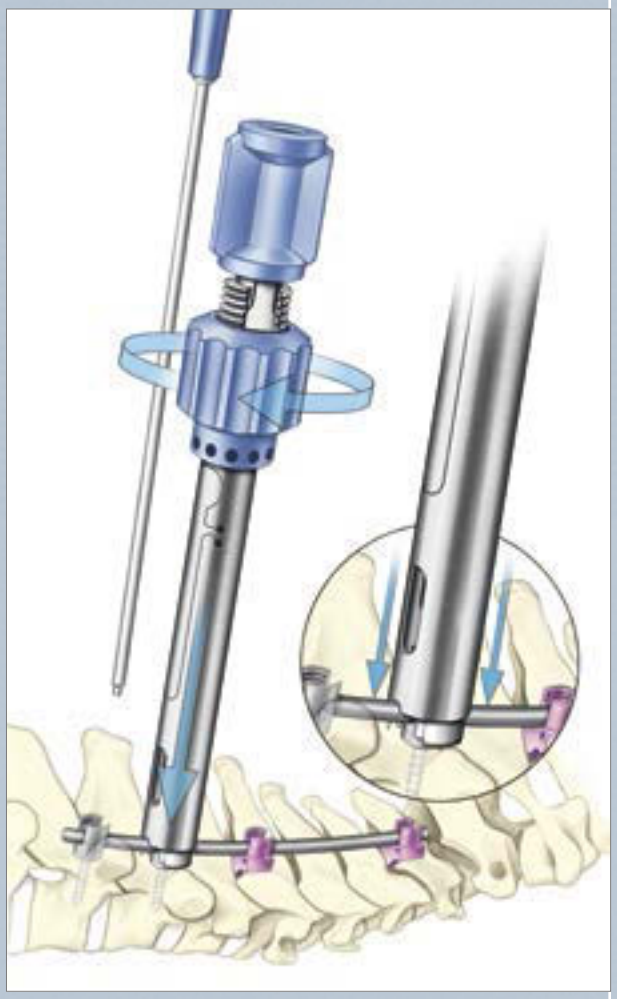
5. Set Screw

5.2

Linear Rod Persuader
Persuade the rod by turning the persuasion wheel until the rod is fully seated in the screw tulip.
While the Rod Persuader is applied, the Set Screw can be inserted through the Rod Persuader using only the Single Ended Set Screw Starter.

To disengage the Linear Rod Persuader turn the persuasion wheel counterclockwise.
To release the locking sleeve turn the proximal knob clockwise and pull the proximal knob.
Then pull to disengage the Linear Rod Persuader from the screw head.

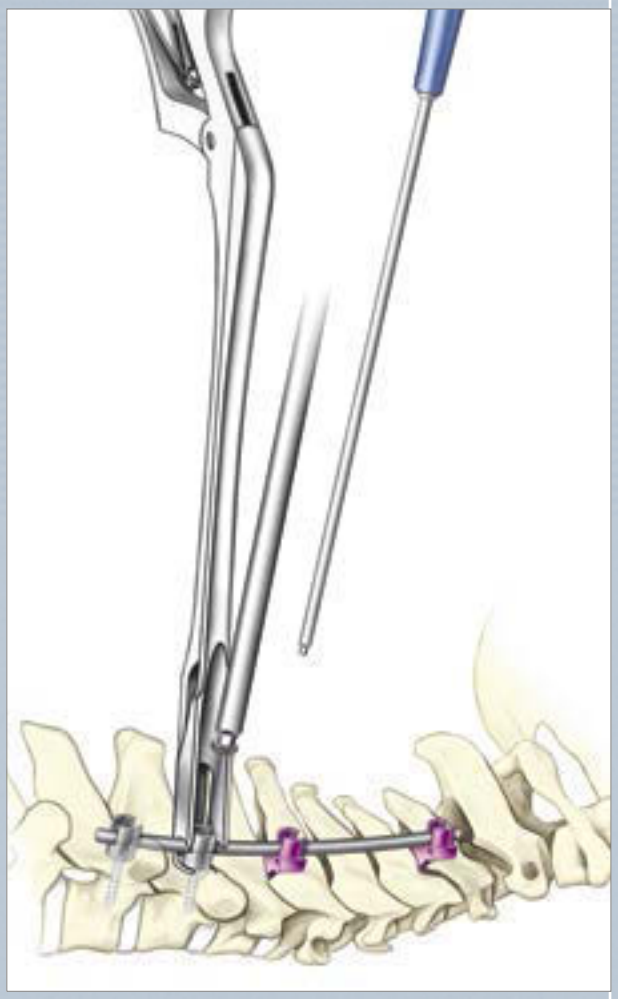
Note:
Applying the Linear Rod Persuader the set screw can only be inserted using the Single Ended Set Screw Starter FW133R (or the previous version FW058R).



- *Linear Rod Persuader – FW673R*
- *Set Screw Starter – FW133R*

Rod Persuader
Alternatively the classic style Rod Persuader FW077R can be used.

Place the Rod Persuader over the screw head and ensure the tip of the persuader is fully engaged under the head of the screw.
Squeeze the handle of the persuader to seat the rod into the head of the screw.
While the Rod Persuader is applied, the Set Screw can be inserted though the working end.



- *Rod Persuader – FW077R*
- *Set Screw Starter – FW133R*

5. Set Screw

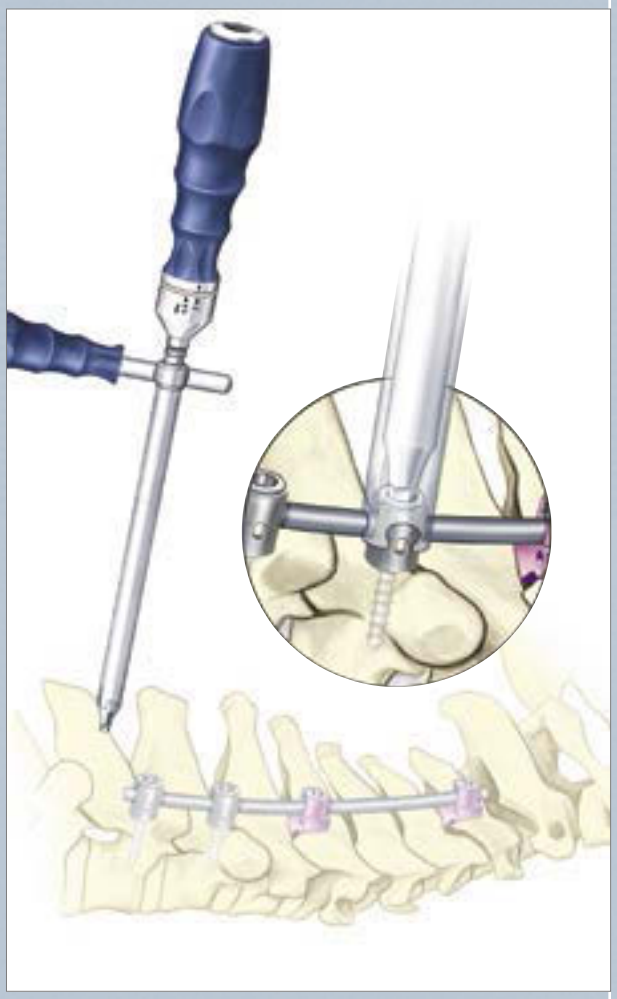
5.3 Final Tightening

The Torque Indicating Screwdriver is used with the Counter Torque Instrument to tighten the loaded Set Screw to the pre-defined optimum torque of 2.8 Nm.

It is imperative to use the Counter Torque Instrument to prevent applying the torque directly to the patient's spine, and also to ensure perpendicular placement of the screwdriver thus simplifying correct tightening of the Set Screw. The torque requirement corresponds to 2.8 Nm. A mark is present on the screwdriver that illustrates to the surgeon when the specified torque has been applied.
Since optimal strength is achieved at 2.8 Nm, over-tightening is unnecessary and should be avoided to prevent damage to the implants.

The final tightening to the specified torque of 2.8 Nm is the last stage of the instrumentation if no cross connectors are used.

Alternatively the Torque Limiting T-Handle in combination with the Set Screw Torque/Removal Driver Shaft can be used for final tightening. The use of the Counter Torque Instrument is also imperative for this procedure.

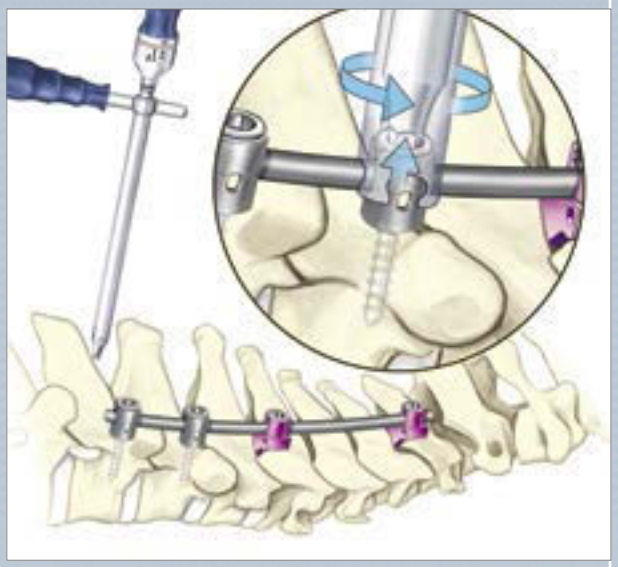


- *Torque Indicating Screwdriver – FW061R*
- *Counter Torque Handle – FW062R*

  or:
- *Torque Limiting T-Handle (optional) – FW129R with Set Screw Torque/Removal Driver Shaft – FW064R*
- *Counter Toruqe Handle – FW062R*

6. Screw – Removal

Set Screw Removal
In case of removal of the Set Screw using the Set Screw Torque/Removal Driver Shaft in combination with the Counter Torque Handle is recommended.

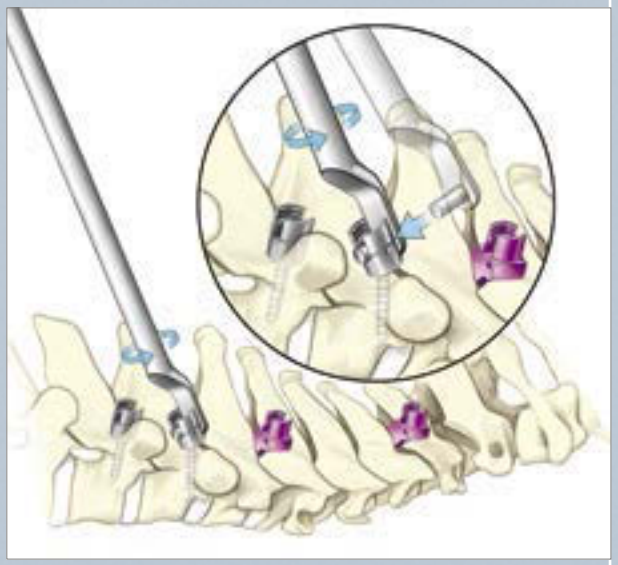


- *Ratchet Handle – FW165R or Non-ratchet Handle – FW067R*
- *Set Screw Torque/Removal Driver Shaft – FW064R*
- *Counter Torque Handle – FW062R*

Screw Removal
In the unlikely event that a screw needs to be removed, screw removal can be performed using the Ball End Screwdriver.

In case the screw tulip is locked at an extreme angle, the Polyaxial Screwrevision Instrument can be used.
The hook shaped working end is inserted into the tulip of the screw body and the screw is carefully removed by turning the tulip taking care not to apply lateral forces to the screw shaft.

Note:
By using the Screw Revision Instrument in the tulip screw, the principle of a u-joint helps to preserve the integrity of the screw hole.



- *Polyaxial Screw Revision Instrument – FW135R*

7. C1-C2 Screw Fixation

7.1 Introduction

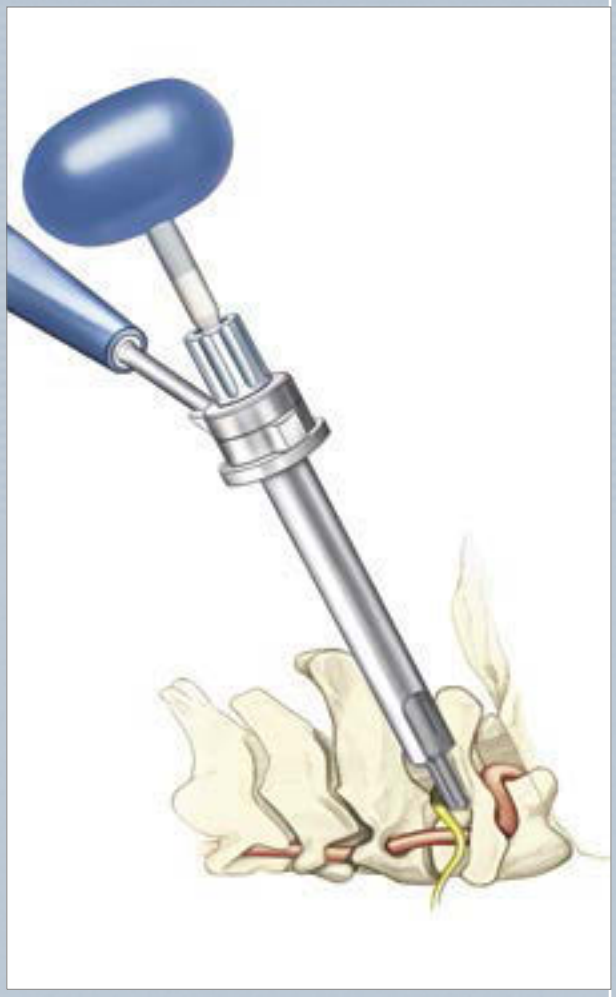
Since the anatomy at C1 is very challenging Aesculap has developed special instruments and implants to meet those special anatomical challenges.
The occipital nerve as well as the vertebral artery lie very close to the entry point of the polyaxial Smooth Shank Screw!
To protect those structures, a special guiding sleeve with a window was designed. Through this sleeve, the opening of the cortical bone, the drilling, tapping and screw insertion can be performed.

7.2 Screw Hole Preparation

Cortical Punch
To ensure a safe procedure at the challenging anatomy of C1, the use of the Screw Starter Guide Tube is recommended.

The cortical bone can be opened by using the Smooth Shank Cortical Punch through the Screw Starter Guide Tube.

Note:
The Cortical Punch has a safety stop when used through the guide to prevent too deep insertion.



- *Screw Starter Guide Tube – FW054R*
- *Smooth Shank Cortical Punch – FW085R*

7. C1-C2 Screw Fixation

7.2

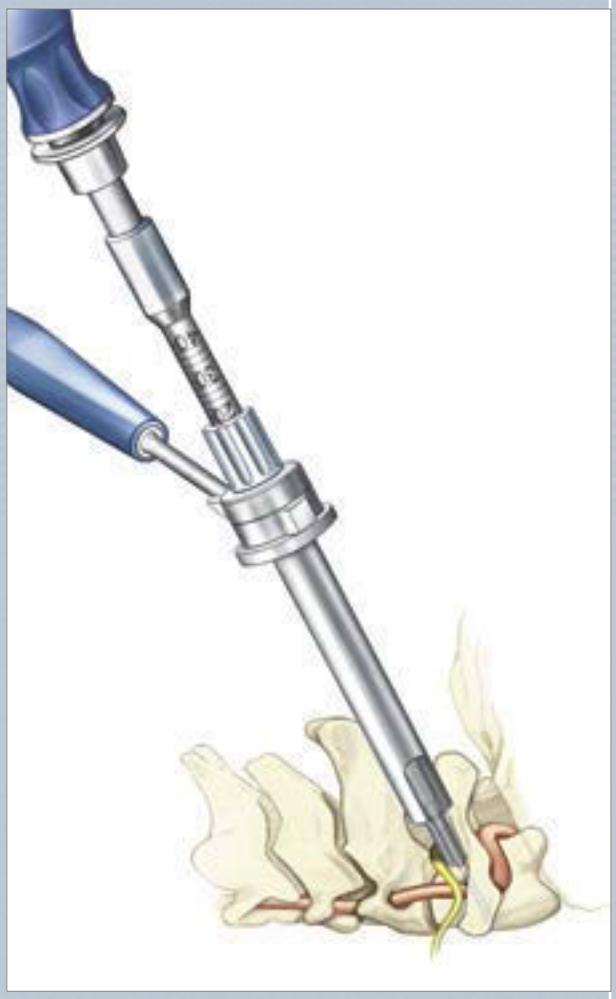
Drilling
To drill the hole, the Smooth Shank Screw Drill is recommended. The drill has a scale and two wheels to adjust the drill depth.

Attention:
Drilling must only be performed through the guiding sleeve!

- *Smooth Shank Screw Drill – FW086SU*
- *Twist Drill Handle (standard) – FJ839R*
- *Tear Drop Drill handle (optional) – SC436R*
- *Screw Starter Guide Tube – FW054R*

Tapping
To tap the pre-drilled hole use the Smooth Shank Screw Tap through the guiding sleeve. The tap has a scale to reconfirm the depth.

Like all S4® Cervical Screws, the Smooth Shank Screws are equipped with a self-tapping tip. To ensure optimal bone purchase tapping is recommended for the first 3 mm in unicortical screw placement or through the second cortex in bicortical screw placement.



- *Smooth Shank Screw Tap – FW087R*
- *Ratchet Handle – FW165R or Non-ratchet Handle – FW067R*
- *Screw Starter Guide Tube – FW054R*

7. C1-C2 Screw Fixation

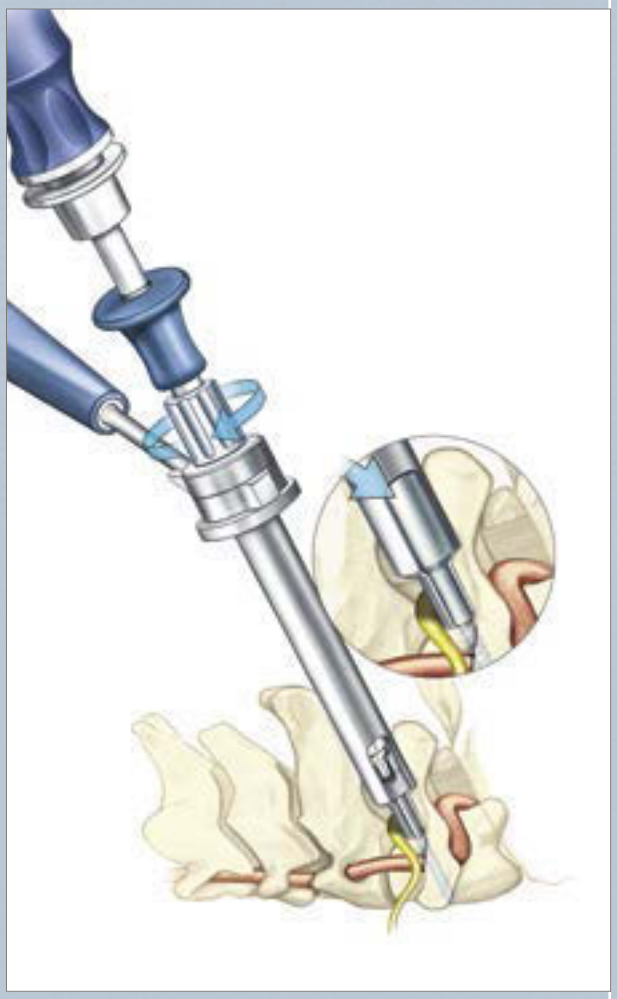
7.3 Screw Insertion

With the guiding sleeve still attached and the window closed, the Smooth Shank Screw can be inserted.
To screw down, the standard Self Holding Polyaxial Screwdriver is recommended.

The window can be opened after the screw is started to ensure a perfect sight onto the screw.

When the desired depth is reached and all thread is inside the bone and only the smooth shank is sticking out, the Screw Starter Guide Tube can be removed.

Note:
This Screw Starter Guide is dedicated for screw insertion into C1. The C2 screws are inserted using the regular instruments described earlier.



- *Self Retaining Polyaxial Screwdriver – FW070R*
- *Ratchet Handle – FW165R or*
  Non-ratchet Handle – FW067R
- *Screw Starter Guide Tube – FW054R*

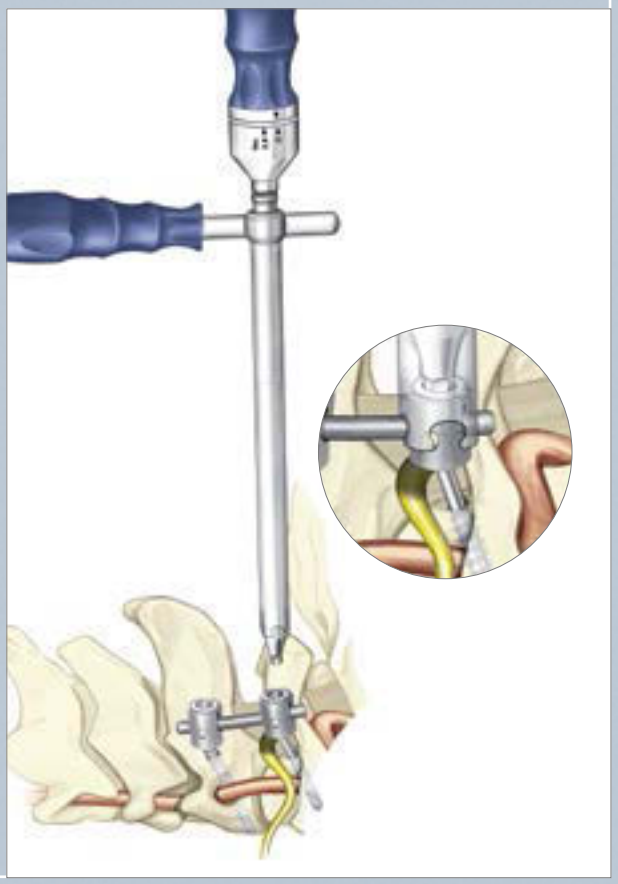
7.4 Rod Insertion

After placing the screws the rod can be inserted as described on page 17.

7.5 Set Screw Insertion and Final Tightening

With the rod in place the Set Screws can be inserted to fix the rod onto the polyaxial screws. If required, a Rod Persuader can be used to assist the insertion of the Set Screw.

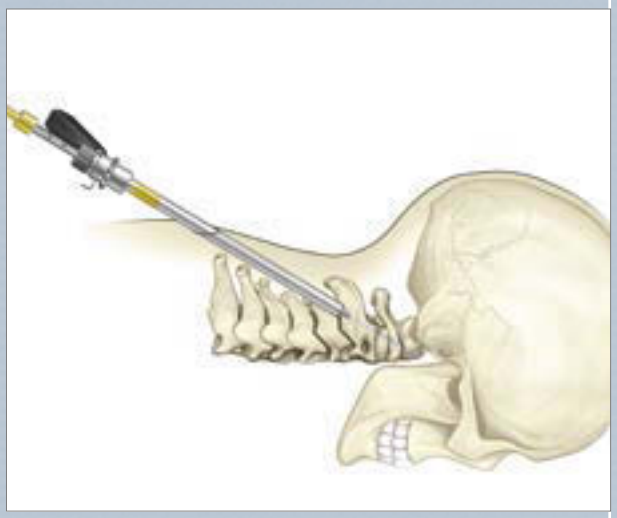
For set screw insertion and final tightening please follow the steps on page 18-22.



8. C1-C2 Transaricular Screw Fixation

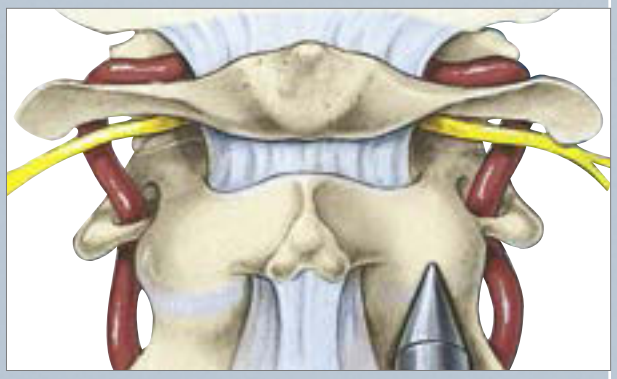
8.1 Introduction

The favored angle instrument components are based on the classical Magerl technique[4] for transarticular screw fixation. However, this instrumentation has been designed to reduce the approach to a minimum, keeping approach related surgical trauma as insignificant as possible. This technique involves standard exposure of the C1-2 area posteriorly and placement of screws bilaterally down the isthmus of C2 and across the C1-2 articulation to block movement and provide immediate internal fixation. The guide tube system, which is partly placed subcutaneously, not only makes the positioning of the implant more accurate and easier, but also protects the tissue while the instruments are guided safely into use.



8.2 Screw Entry Point Planning[5]

After exposure of the posterior elements of C1-2, the lamina of C2 is dissected to the C2-3 facet joints. The superior edge of the lamina of C2 can be followed laterally e.g. with a small angled curette, in order to identify the medial side of the C2 pedicle, which can serve as a visual landmark for the medial limit of screw positioning.



The dorsal surface of the isthmus can be followed anteriorly to the C1-2 articular joint by elevating the C2 nerve root and associated venous plexus. This allows determination of the proper screw alignment in a dorsal ventral plane.

An appropriate trajectory can be determined fluoroscopically by placing a drill or K-wire alongside the neck. In this manner, an entrance site for the drill guide is established in the axial plane. Its sagittal coordinate is chosen to allow the screw to be placed in a strict parasagittal plane through the isthmus of C2 and crossing the C1-2 articulation into the lateral mass of C1. The desired placement is 1 – 2 mm lateral to the lateral edge of the spinal canal.

For precise planning please also see section 2.1 "Pre-Operative Planning" of this surgical technique.

[4] *As originally described in: Magerl F, Seemann PS: Stable posterior fusion of the atlas and axis by transarticular screw fixation. In: Kehr P, Weidner A, eds. Cervical Spine. Wien, etc: Springer-Verlag, 1987:322-327.*
[5] *Ronald I. Apfelbaum, Aesculap Spine Apfelbaum C1-2 Fixation, April 1993.*

8.3 Insertion of Sleeve Guide

Once the skin entrance site is determined, a ca. 1.5 cm stab incision is made through the skin, subcutaneous tissue and dorsal fascia. It can be dilated with a haemostatic forceps and then the sleeve guide with the conical tipped obturator is worked through the tissue and into the surgical site.
Its position can be adjusted, due to the flexibility of the soft tissue, to place it at the precise entrance site for the screw, which is just above the inferior edge of the C2 inferior articular process.

- *Sleeve Guide with Inner Sleeve – FW066R*
- *C1/C2 Obturator – FJ983R*

8. C1-C2 Transaricular Screw Fixation

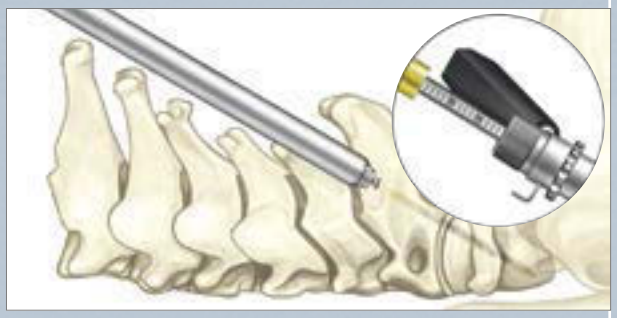
8.4 Screw Hole Preparation

Trocar
After removing the conical obturator, a sharp trocar is available to make a starter hole in the bone if desired.

- *Trocar – FJ984R*
- *Sleeve Guide with Inner Sleeve – FW066R*

Drilling
To drill the hole, insert the inner sleeve guide and the drill bit into the already placed guide. A click is heard when the inner sleeve guide is placed appropriately. The starter hole can then be drilled under fluoroscopic control through C2 into the lateral mass of C1. The depth of drilling is noted on the sliding sleeve of the inner drill guide.

A special long version sounder is available to be used through the long sleeve guide.



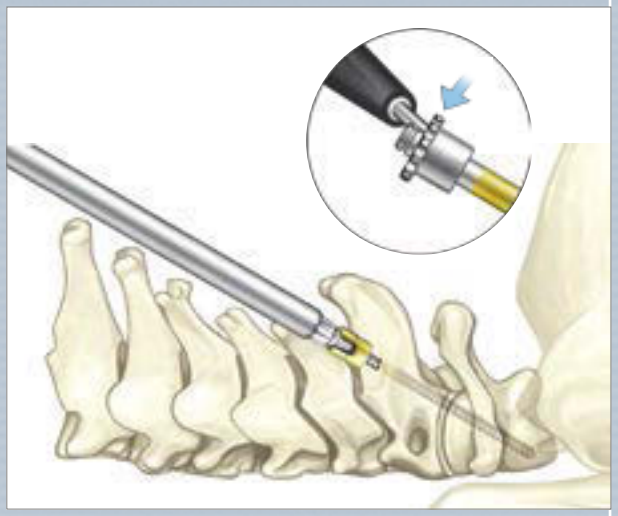
- *Inner Sleeve Guide – FJ985R*
- *Favored Angle Screw Drill (2.9 mm Long Drill) – FW088SU*
- *Twist Drill Handle – FJ839R (standard)*
- *Tear Drop Drill Handle – SC436R (optional)*
- *Sleeve Guide with Inner Sleeve – FW066R*
- *Sounder Long Version – FW671R*

Tapping
Like all S4® Cervical Screws, the Favored Angle Screws are equipped with a self-tapping tip. To ensure optimal bone purchase for easier starting of the screw tapping is recommended for the first 3 mm into the C2 as an optional step. Also optionally tapping can be performed through C2 into the C1. To tap the pre-drilled hole use the Favored Angle Screw Tap through the guided sleeve. The tap has a scale to reconfirm the depth.

- *Favored Angle Screw Tap, Ø 4.0 mm – FW089R*
- *Ratchet Handle – FW165R or*
  Non-ratchet Handle – FW067R
- *Sleeve Guide with Inner Sleeve – FW066R*

8.5 Screw Insertion

Before placing the screw the reduction inner sleeve of the sleeve guide needs to be removed by turning the wheel counterclockwise.
With the guide remaining in-situ the Favored Angle Screw can be inserted through the guide sleeve. The procedure is then repeated on the contralateral side.



8.6 Rod Insertion

After placing the remaining screws and/or occiput plate the rod can be inserted as described on page 17.

8.7 Set Screw Insertion and Final Tightening

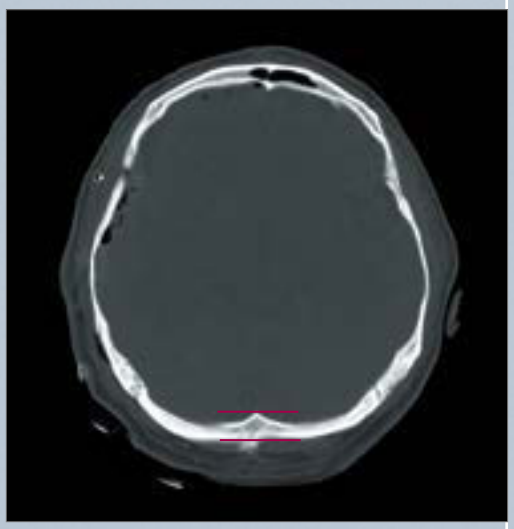
With the rod in place the Set Screws can be inserted to fix the rod onto the polyaxial screws. If required, a Rod Persuader can be used to assist the insertion of the Set Screw.
For set screw insertion and final tightening please follow the steps on page 18-22.

- *Favored Angle Screwdriver C1/C2 – FW069R*
- *Ratchet Handle – FW165R or Non-ratchet Handle – FW067R*
- *Sleeve Guide with Inner Sleeve – FW066R*

9. Occiput – Surgical Technique

9.1 Pre-Operative Planning

To ensure a safe procedure, it is recommended to measure the thickness of the occipital bone with the help of CT or other imaging possibilities.
The thickness indicates the length of the Occipital Screws that will be implanted later.



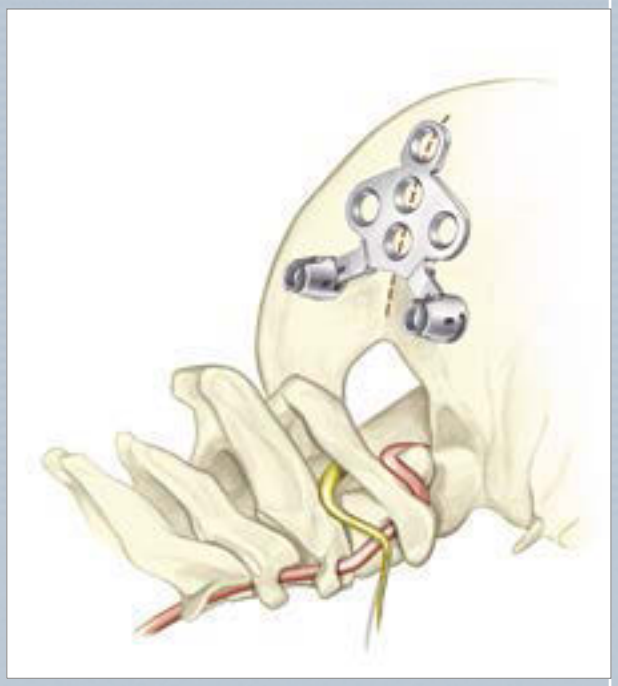
9.2 Size Verification/Plate Placement

The S4® Cervical System offers two different sizes of occipital plates (small & large) and two different types of designs (4-hole & 5-hole plates).

The plate size and design is chosen according to the anatomy of the respective patient.
After choosing the appropriate size the plate can be contoured to accommodate the occipital anatomy.
The plate can be bent between the holes using the Occipital Plate Bending Pliers.

Attention:
Do not deform the holes with the Bending Pliers. Bending on the holes would destroy the locking mechanism of the Occipital Screws.

The Occiput Plate should be placed midline to the EOP (External Occipital Protuberance) and the Foramen Magnum. The highest stability of the plate is achieved by midline fixation where the bone thickness is highest.



Occipital Plate Bending Pliers – FW090R

9. Occiput – Surgical Technique

9.3 Screw Hole Preparation

Drilling

After the plate design and size is determined, the holes can be drilled. There are two Drill Guides available and recommended for use. One for the ø 4.5 mm screws and one for the ø 5.5 mm screws.

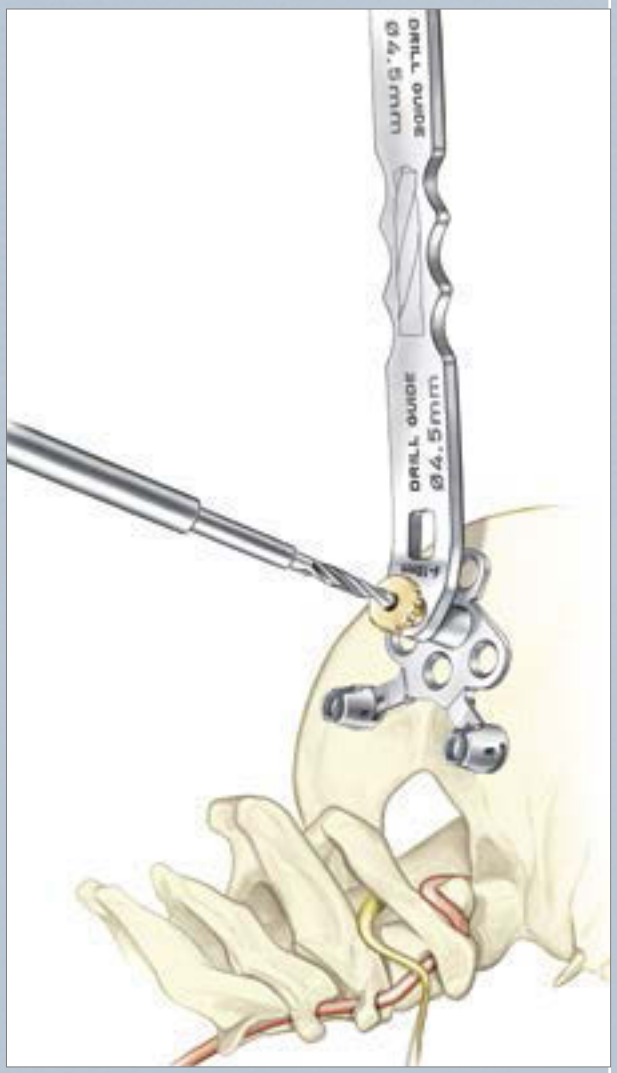
The Drill Guide can be used to hold the plate onto the Occiput. The desired drill depth can be determined by turning the inlay at the end of the guide.

The two ends of the Drill Guide cover different depths. One side can be set from 6 – 10 mm and the other side from 11 – 16 mm.

Attention:

It is recommended, that the first hole is prepared including tapping and the first screw is inserted before the other screws are implanted. The first screw holds the plate in place while drilling and tapping the other holes!

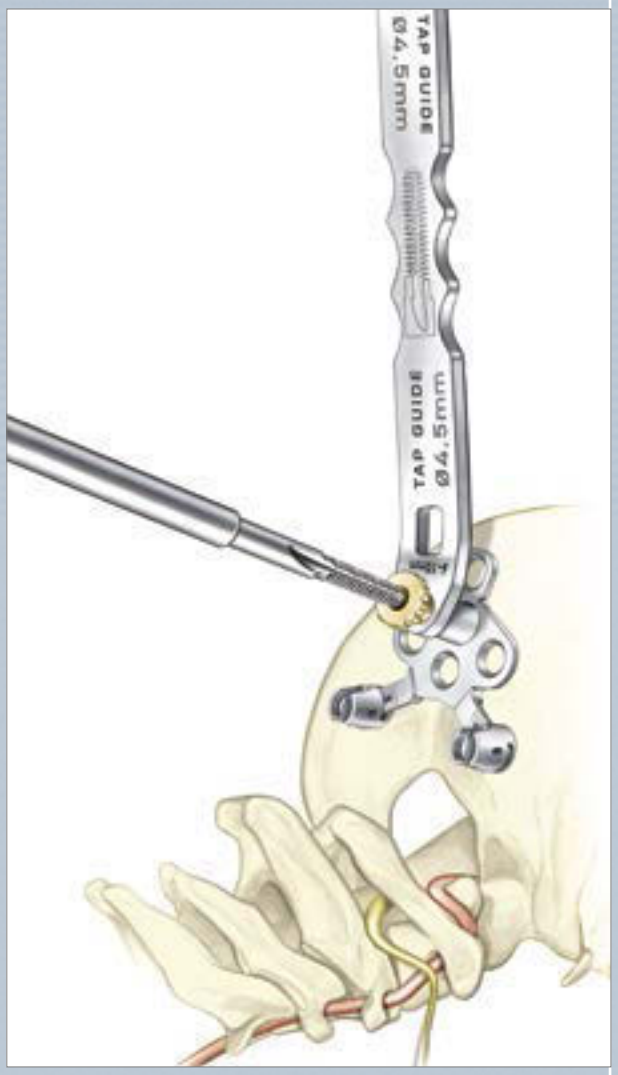
Even though the drill depth was measured before the surgery, proceed with care to prevent damage to the dura.



- *Occipital Drill Bit, ø 2.9 mm (ø 4.5 mm screws) – FW091SU*
- *Occipital Drill Bit, ø 3.9 mm (ø 5.5 mm screws) – FW092SU*
- *Occiptial Drill Guide Double-ended, ø 4.5 mm – FW095R*
- *Occiptial Drill Guide Double-ended, ø 5.5 mm – FW096R*

Tapping
After removing the Drill Guide the Tap Guide is used to tap the hole.
By using the Tap Guide the drilled hole will be further prepared for insertion of the Occiput Screws.

Like the Drill Guides, the two ends of the Tap Guide cover different depths. One side can be set from 6 – 10 mm and the other side from 11 – 16 mm.



- *Occipital Tap, ø 4.5 mm – FW093R*
- *Occipital Tap, ø 5.5 mm – FW094R*
- *Occiptial Tap Guide Double-ended, ø 4.5 mm – FW097R*
- *Occiptial Tap Guide Double-ended, ø 5.5 mm – FW098R*

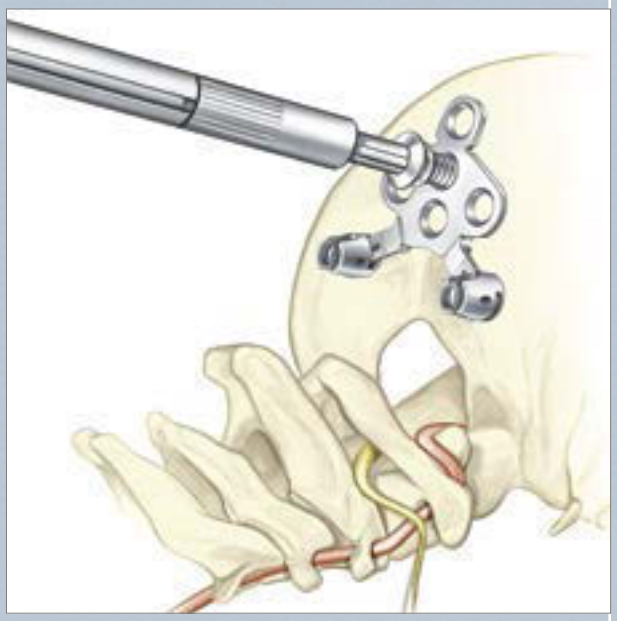
9.4 Screw Insertion and Screw Locking

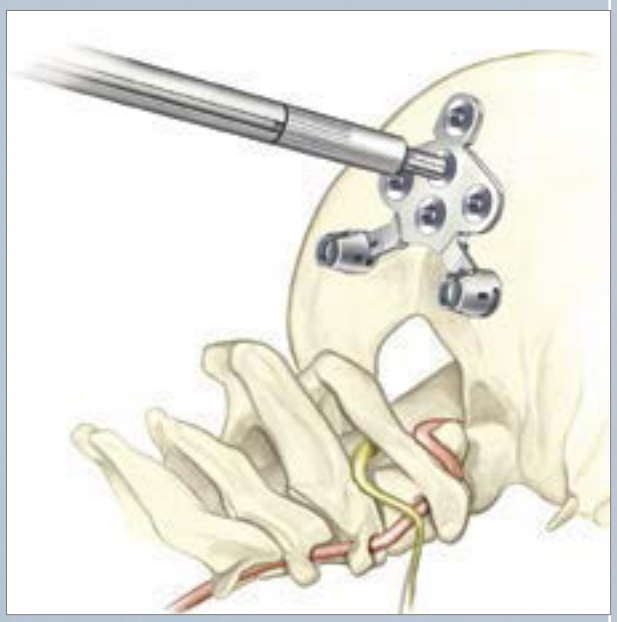
The Occiput Screws can now be inserted in the appropriate holes using the Occipital Screw Driver.

Since the bone thickness is highest at the EOP (External Occipital Protuberance) it is recommended to place the first screw in the EOP at the midline of the Occiput.

Two types of screws are available. Silver ø 4.5 mm screws and purple ø 5.5 mm screws which are backup or rescue screws for the silver ø 4.5 mm screws.

Locking the occipital screws firmly in the plate with the Occipital Screwdriver FW213R is sufficient. Do not overtighten the screws to prevent free spinning screw.



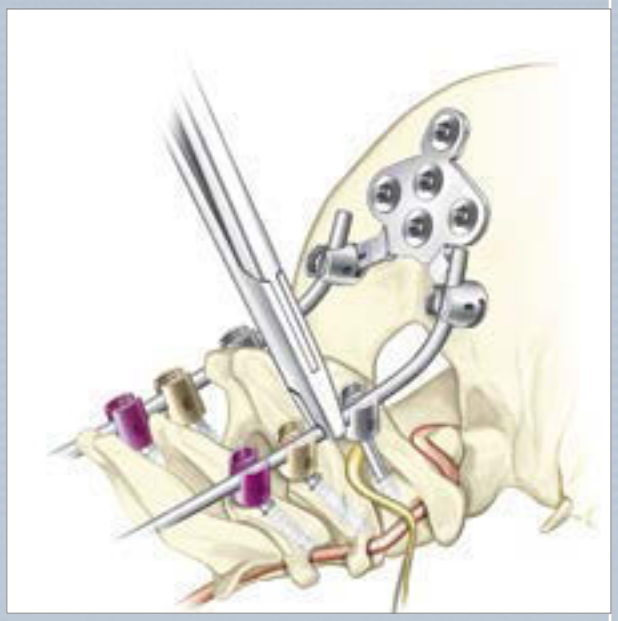


- *Occipital Screw Driver – FW213R*
- *Ratchet Handle – FW165R or Non-ratchet Handle – FW067R*

9.5 Rod Insertion

To connect the Occiput Plate to the cervical spine, the ø 3.5 mm Pre-Bent Rod is inserted into the rod receptacles.

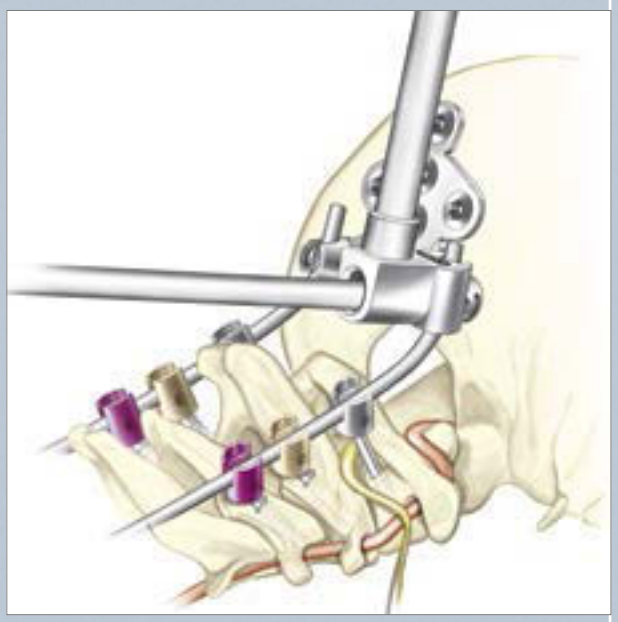
If needed, the Rod Holding Forceps or a Persuader can be used to assist the rod insertion. At the receptables of the plate please only use the Rod Holding Forceps to assist the insertion.



9.6 Set Screw Insertion and Final Tightening

Start the Set Screw in the threaded portion of the rod receptacles using the Set Screw Starter by first turning counterclockwise until a click is heard or felt.
Then rotate the instrument clockwise until the Set Screw is hand-tightened. Starting the Set Screw in this manner ensures cross-threading is minimized.

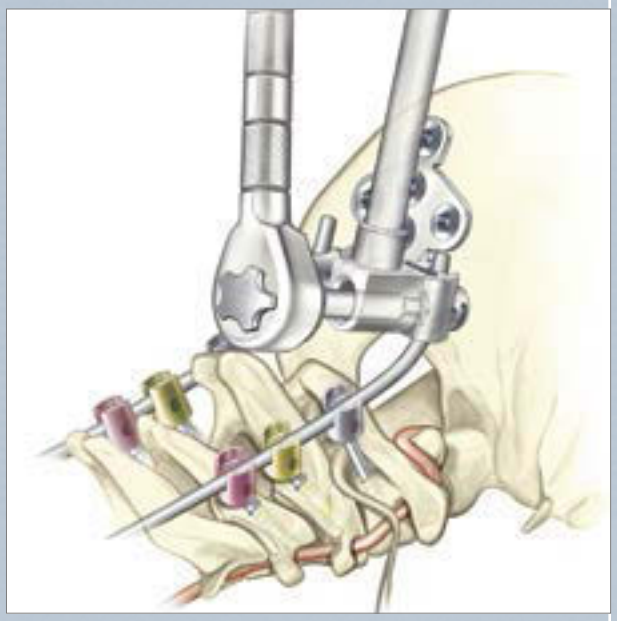
If needed, the Occipital Counter Torque Handle can be used to persuade the rod and guide the Set Screw into the rod receptacles.



- *Occipital Counter Torque Handle – FW104R*
- *Set Screw Starter – FW133R*
- *Mini Flex Set Screw Starter – FW109R*

9. Occiput – Surgical Technique

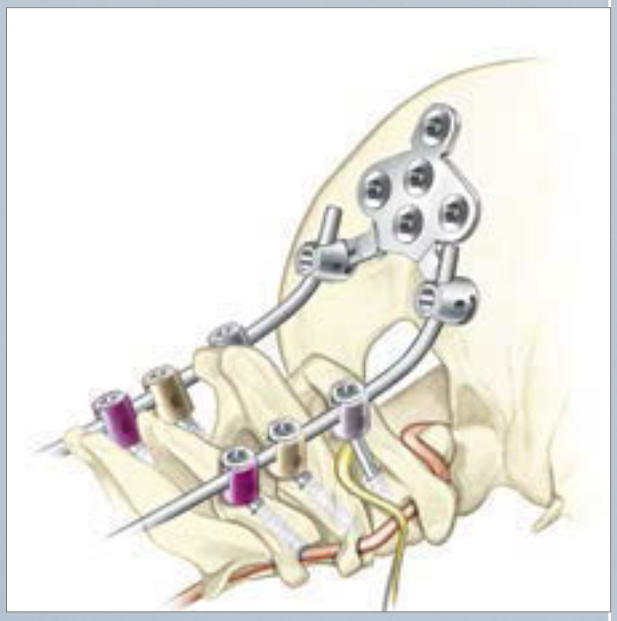
Finally the Set Screws have to be locked using the Occipital Torque Wrench.
The force (2.8 Nm) has to be countered with the Occipital Counter Torque Handle.



- *Occipital Counter Torque Handle – FW104R*
- *Occipital Torque Wrench – FW103R*

Final Construct

Note:
In the unlikely event that an occiput screw needs to be removed, the Occipital Screw Remover FW099R and the respective Shaft FW101R are used in conjuntion with the Occipital T-handle FW116R.



10. Options

10.1 Lamina Hooks

S4® Cervical offers four hook options: thick right, thick left, thin right, and thin left.
The choice of the hook used depends on the thickness of the lamina. The thin throat size is 4.5 mm and the thick throat is 6.0 mm.

The right or left thick or thin Lamina Hook is then selected and positioned on the lamina using the straight or curved Hook Holder. The process is repeated where other hooks are required as determined by the surgeon.

Note:
Hooks are color-coded: purple for the left; gold for the right.

10.2 Lateral Offsets, L-Shaped

Lateral Offset Connectors are available to offer variable placement of the hooks or Polyaxial Screws.

The lateral offset must first be placed onto the ø 3.5 mm Rod and then secured using the same Set Screw as for the hooks and Polyaxial Screws. Tighten to the same 2.8 Nm of torque as required for other components.

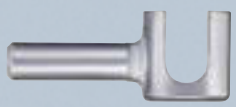
There are three left and right sizes available:

- *7 mm left, right*
- *9 mm left, right*
- *11 mm left, right*

Note:
Lateral Offset Connectors are color-coded: Purple for the left; gold for the right.

10.3 Lateral Offset Connectors

Offset Connectors can be used if a Polyaxial Screw must be placed lateral to the longitudinal axis of the Rod. The Offset Connector must first be placed onto the ø 3.5 mm Rod and then secured using the same Set Screw as used for the Polyaxial Screw. Final tightening to 2.8 Nm of torque is the same as all other components.



The Offset Connectors are not color-coded since right and left differentiation is not necessary.

10. Options

10.4 Cross Connectors

Cross Connector placement is based on specific case requirements and is recommended in cases where additional torsional stability may be required.
A measurement is made between the two ø 3.5 mm longitudinal Rods at the position where the Cross Connector is to be applied.

Choose the appropriate sized connector and lay it on the two Longitudinal Rods. Once correctly placed, tighten the Set Screws to the pre-defined torque of 2.8 Nm.

Note:
The Cross Connectors should not be bent.

Following sizes are available:

- *Fixed:*
  22 mm, 24 mm, 26 mm
- *Adjustable:*
  28 mm – 33 mm, 33 mm – 42 mm, 42 mm – 58 mm

10.5 Cable Connectors

The Cable Connector is placed onto the ø 3.5 mm Rod and then secured by using the same Set Screw as for the Polyaxial Screw assembly.
Tighten the Set Screw to the same 2.8 Nm of torque as the Polyaxial Screws.

The angled Cable Connectors are inserted in the same manner as the straight Cable Connector.

90° *45°*

There are three different Cable Connectors available:

- *Straight Cable Connector (silver)*
- *Left 45° Cable Connector (purple)*
- *Right 45° Cable Connector (gold)*

10.6 Parallel Rod Connectors

The parallel Rod Connectors are used when the surgeon needs to connect an existing (pre-instrumented) spinal rod construct to a new spinal rod construct. They have been designed to be clamped onto the spinal rods and then tightened down by one central Set Screw.
The connectors are secured by tightening the central Set Screw to the same 2.8 Nm of torque as the Polyaxial Screws.

ø 3.5 mm to ø 3.5 mm

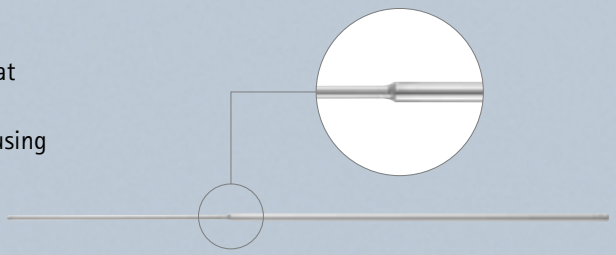
ø 3.5 mm to ø 5.5 mm

The parallel Rod Connectors are available in the following sizes:

- *ø 3.5 mm to ø 3.5 mm (connects S4® Cervical to previously implanted S4® Cervical levels)*
- *ø 3.5 mm to ø 5.5 mm (connects S4® Cervical to S4® Thoracolumbar)*

10.7 Dual Diameter Rod

The Dual Diameter Rod allows to form a construct that passes over the cervico-thoracic junction from a S4® Cervical construct to a S4® Thoracolumbar construct using only one rod.



10. Options

10.8 Rod Bending

The rod can be contoured to fit into the heads of the screws or hooks.

Note:
Titanium is highly notch sensitive and therefore care must be taken during rod contouring to ensure that surface damage to the rod is minimal. This is necessary to avoid potential fatigue failure of the implant.

Cut and bend the rod as necessary to fit smoothly inside the heads of the hooks and / or Polyaxial Screws. Only approximately 1 mm of rod settling will occur during assembly, so exact contour of the rods is essential to the successful assembly of the system.

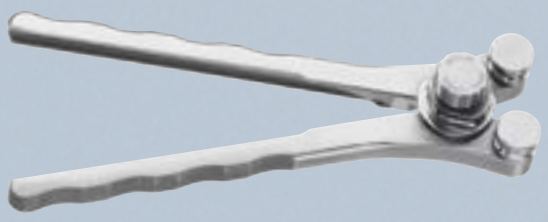
Beginning from either the cephalad or caudal directions, place the rod into the top loading screws and hooks.

The rod is best inserted using the Rod Holding Forceps (FW076R).

There are three bending options:

Pair of Rod Plate Benders - FW036R

In-Situ Rod Benders 90° – FW136R

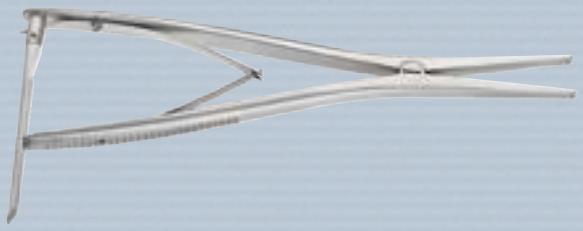


Rod Bending Forceps – FW037R

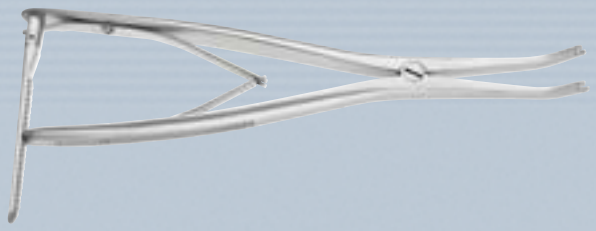
10.9 Compression or Distraction

If the surgeon sees a need for compression or distraction straight and curved Distraction Forceps as well as compression forceps are available. To achieve compression or distraction apply the forceps before tightening the Set Screws.
One Set Screw might be tightened before starting the process in order to create a fixed point for compression / distraction. Once the desired compression / distraction is achieved, fully tighten the (remaining) Set Screws.

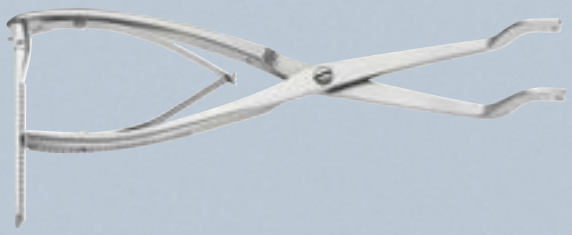
This technique ma be useful especially for placing hooks in the cervical spine.



Cervical Distraction Forceps Straight – FW523R



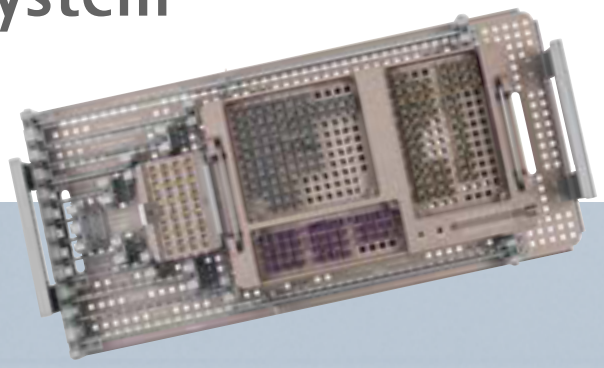
Cervical Distraction Forceps Curved – FW428R



Cervical Compression Forceps – FW427R

Aesculap® S4® Cervical System

11. Implants

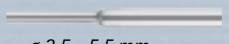


11.1

Please refer to the brochure O34202 for the corresponding "SW screw line".

Implants Sets

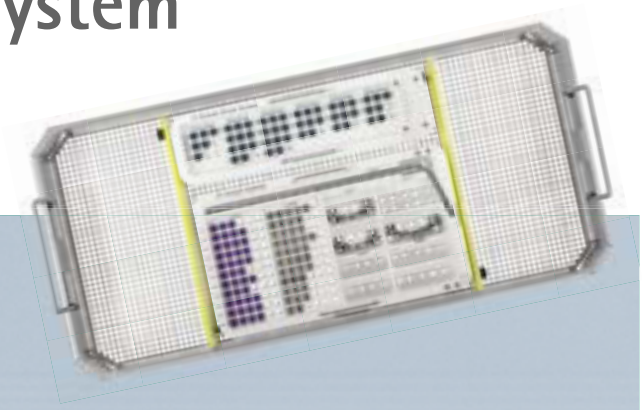
	Art. No.	Component	Set Proposal
 silver ø 3.5 mm	SX460T	S4® C Polyaxial Screw ø 3.5 x 10 mm	8
	SX462T	S4® C Polyaxial Screw ø 3.5 x 12 mm	12
	SX464T	S4® C Polyaxial Screw ø 3.5 x 14 mm	12
	SX466T	S4® C Polyaxial Screw ø 3.5 x 16 mm	10
	SX468T	S4® C Polyaxial Screw ø 3.5 x 18 mm	8
	SX470T	S4® C Polyaxial Screw ø 3.5 x 20 mm	8
	SX472T	S4® C Polyaxial Screw ø 3.5 x 22 mm	8
	SX474T	S4® C Polyaxial Screw ø 3.5 x 24 mm	8
	SX476T	S4® C Polyaxial Screw ø 3.5 x 26 mm	4
	SX478T	S4® C Polyaxial Screw ø 3.5 x 28 mm	4
	SX480T	S4® C Polyaxial Screw ø 3.5 x 30 mm	4
 purple ø 4.0 mm	SX461T	S4® C Polyaxial Screw ø 4.0 x 10 mm	4
	SX463T	S4® C Polyaxial Screw ø 4.0 x 12 mm	4
	SX465T	S4® C Polyaxial Screw ø 4.0 x 14 mm	4
	SX467T	S4® C Polyaxial Screw ø 4.0 x 16 mm	4
	SX469T	S4® C Polyaxial Screw ø 4.0 x 18 mm	4
	SX471T	S4® C Polyaxial Screw ø 4.0 x 20 mm	2
	SX473T	S4® C Polyaxial Screw ø 4.0 x 22 mm	2
	SX475T	S4® C Polyaxial Screw ø 4.0 x 24 mm	2
	SX477T	S4® C Polyaxial Screw ø 4.0 x 26 mm	2
	SX479T	S4® C Polyaxial Screw ø 4.0 x 28 mm	2
	SX481T	S4® C Polyaxial Screw ø 4.0 x 30 mm	3
 gold ø 4.0 mm	SX410T	S4® C Favored Angle Screw ø 4.0 x 10 mm	2
	SX412T	S4® C Favored Angle Screw ø 4.0 x 12 mm	4
	SX414T	S4® C Favored Angle Screw ø 4.0 x 14 mm	4
	SX416T	S4® C Favored Angle Screw ø 4.0 x 16 mm	4
	SX418T	S4® C Favored Angle Screw ø 4.0 x 18 mm	4
	SX420T	S4® C Favored Angle Screw ø 4.0 x 20 mm	4
	SX422T	S4® C Favored Angle Screw ø 4.0 x 22 mm	2
	SX424T	S4® C Favored Angle Screw ø 4.0 x 24 mm	2
	SX426T	S4® C Favored Angle Screw ø 4.0 x 26 mm	2
	SX428T	S4® C Favored Angle Screw ø 4.0 x 28 mm	4
	SX430T	S4® C Favored Angle Screw ø 4.0 x 30 mm	4
	SX432T	S4® C Favored Angle Screw ø 4.0 x 32 mm	4
	SX434T	S4® C Favored Angle Screw ø 4.0 x 34 mm	4
	SX436T	S4® C Favored Angle Screw ø 4.0 x 36 mm	4
	SX438T	S4® C Favored Angle Screw ø 4.0 x 38 mm	4
	SX440T	S4® C Favored Angle Screw ø 4.0 x 40 mm	4
	SX442T	S4® C Favored Angle Screw ø 4.0 x 42 mm	2
	SX444T	S4® C Favored Angle Screw ø 4.0 x 44 mm	2
	SX446T	S4® C Favored Angle Screw ø 4.0 x 46 mm	2
	SX448T	S4® C Favored Angle Screw ø 4.0 x 48 mm	2
	SX450T	S4® C Favored Angle Screw ø 4.0 x 50 mm	2
	SX452T	S4® C Favored Angle Screw ø 4.0 x 52 mm	2
	SX454T	S4® C Favored Angle Screw ø 4.0 x 54 mm	2
	SX456T	S4® C Favored Angle Screw ø 4.0 x 56 mm	2

	Art. No.	Component	Set Proposal
 ø 3.5 - 5.5 mm	SW192T	S4® C Dual Diameter Rod, ø 3.5 mm – 5.5 mm, 400 mm	2
	SW194T	S4® C Rod, Straight ø 3.5 x 30 mm	4
	SW195T	S4® C Rod, Straight ø 3.5 x 60 mm	4
	SW196T	S4® C Rod, Straight ø 3.5 x 90 mm	4
 ø 3.5 mm	SW197T	S4® C Rod, Straight ø 3.5 x 120 mm	4
	SW198T	S4® C Rod, Straight ø 3.5 x 150 mm	4
	SW003T	S4® C Set Screw for ø 3.5 and ø 4.0 mm Ployaxial Screws	24
	SW015T	S4® C Lamina Hook, left, thin	2
	SW017T	S4® C Lamina Hook, left, thick	2
	SW025T	S4® C Lamina Hook, right, thin	2
	SW027T	S4® C Lamina Hook, right, thick	2
 Fixed	SW112T	S4® C Cross Connector, Fixed, 22 mm	1
	SW113T	S4® C Cross Connector, Fixed, 24 mm	1
	SW114T	S4® C Cross Connector, Fixed, 26 mm	1
 Variable	SW115T	S4® C Cross Connector, Adjustable, 28 – 33 mm	1
	SW116T	S4® C Cross Connector, Adjustable, 33 – 42 mm	1
	SW117T	S4® C Cross Connector, Adjustable, 42 – 58 mm	1
 	SW005T	S4® C Lateral Offset Connector	4
	SW007T	S4® C Lateral Offset Connector, L-shaped, Left, 7 mm	2
	SW009T	S4® C Lateral Offset Connector, L-shaped, Left, 9 mm	2
	SW011T	S4® C Lateral Offset Connector, L-shaped, Left, 11 mm	2
	SW013T	S4® C Lateral Offset Connector, L-shaped, Right, 7 mm	2
	SW019T	S4® C Lateral Offset Connector, L-shaped, Right, 9 mm	2
	SW021T	S4® C Lateral Offset Connector, L-shaped, Right, 11 mm	2
 ø 3.5 mm	SW110T	S4® C Rod Connector, Parallel, 3.5 – 3.5 mm	2
	SW111T	S4® C Rod Connector, Parallel, 3.5 – 5.5 mm	2
 45°	SW049T	S4® C Cable Connector, 90°	2
	SW054T	S4® C Cable Connector, Left, 45°	2
	SW056T	S4® C Cable Connector, Right, 45°	2
	MF201	Implant Tray Base	1
	MF202	Implant Tray Lid	1
	MF203	Implant Tray Upper Rod Tray	1
	MF204	Implant Set: Screw Caddy	1
	MF205	Implant Set: Set Screw Caddy	1
	MF206	Implant Set: Rod Connector Caddy	1
	MF207	Implant Set: Lateral Connector Caddy	1

* Recommended container: JK442 with corresponding lid JK489

Aesculap® S4® Cervical System

11. Implants



11.2

Complementary Implant Set for Occiput and Smooth Shank Screws

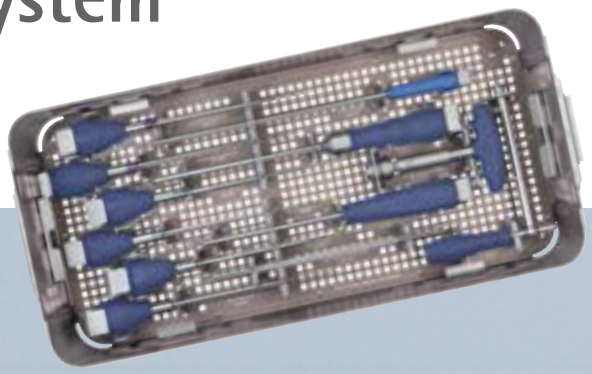
	Art. No.	Component	Set Proposal
	SW202T	S4® C Occiput Plate, Small 5-hole	1
	SW203T	S4® C Occiput Plate, Small 4-hole	1
	SW204T	S4® C Occiput Plate, Large 5-hole	1
	SW205T	S4® C Occiput Plate, Large 4-hole	1
 ø 4.5 mm	SW126T	S4® C Occiput Plate Screw ø 4.5 x 6 mm	6
	SW127T	S4® C Occiput Plate Screw ø 4.5 x 7 mm	4
	SW128T	S4® C Occiput Plate Screw ø 4.5 x 8 mm	6
	SW129T	S4® C Occiput Plate Screw ø 4.5 x 9 mm	4
	SW130T	S4® C Occiput Plate Screw ø 4.5 x 10 mm	6
	SW131T	S4® C Occiput Plate Screw ø 4.5 x 11 mm	6
	SW132T	S4® C Occiput Plate Screw ø 4.5 x 12 mm	6
	SW133T	S4® C Occiput Plate Screw ø 4.5 x 13 mm	3
	SW134T	S4® C Occiput Plate Screw ø 4.5 x 14 mm	3
	SW135T	S4® C Occiput Plate Screw ø 4.5 x 15 mm	3
	SW136T	S4® C Occiput Plate Screw ø 4.5 x 16 mm	3
 ø 5.5 mm	SW206T	S4® C Occiput Plate Screw ø 5.5 x 6 mm	3
	SW207T	S4® C Occiput Plate Screw ø 5.5 x 7 mm	2
	SW208T	S4® C Occiput Plate Screw ø 5.5 x 8 mm	3
	SW209T	S4® C Occiput Plate Screw ø 5.5 x 9 mm	2
	SW210T	S4® C Occiput Plate Screw ø 5.5 x 10 mm	3
	SW211T	S4® C Occiput Plate Screw ø 5.5 x 11 mm	3
	SW212T	S4® C Occiput Plate Screw ø 5.5 x 12 mm	3
	SW213T	S4® C Occiput Plate Screw ø 5.5 x 13 mm	2
	SW214T	S4® C Occiput Plate Screw ø 5.5 x 14 mm	2
	SW215T	S4® C Occiput Plate Screw ø 5.5 x 15 mm	2
	SW216T	S4® C Occiput Plate Screw ø 5.5 x 16 mm	2
	SW200T	S4® Rod ø 3.5 x 240 mm prebent for occipital plate	4

Art. No.	Component	Set Proposal
SX508T	S4® C Smooth Shank Screw 4.0 x 8 sm.sh. x 16 mm thread	2
SX509T	S4® C Smooth Shank Screw 4.0 x 11 sm.sh. x 16 mm thread	2
SX510T	S4® C Smooth Shank Screw 4.0 x 14 sm.sh. x 16 mm thread	2
SX511T	S4® C Smooth Shank Screw 4.0 x 8 sm.sh. x 18 mm thread	2
SX512T	S4® C Smooth Shank Screw 4.0 x 11 sm.sh. x 18 mm thread	2
SX513T	S4® C Smooth Shank Screw 4.0 x 14 sm.sh. x 18 mm thread	2
SX514T	S4® C Smooth Shank Screw 4.0 x 17 sm.sh. x 18 mm thread	2
SX515T	S4® C Smooth Shank Screw 4.0 x 9 sm.sh. x 20 mm thread	2
SX516T	S4® C Smooth Shank Screw 4.0 x 12 sm.sh. x 20 mm thread	2
SX517T	S4® C Smooth Shank Screw 4.0 x 15 sm.sh. x 20 mm thread	2
SX518T	S4® C Smooth Shank Screw 4.0 x 18 sm.sh. x 20 mm thread	2
SX530T	S4® C Smooth Shank Screw 4.0 x 9 sm.sh. x 22 mm thread	2
SX531T	S4® C Smooth Shank Screw 4.0 x 12 sm.sh. x 22 mm thread	2
SX532T	S4® C Smooth Shank Screw 4.0 x 15 sm.sh. x 22 mm thread	2
SX533T	S4® C Smooth Shank Screw 4.0 x 10 sm.sh. x 24 mm thread	2
SX534T	S4® C Smooth Shank Screw 4.0 x 13 sm.sh. x 24 mm thread	2
SX535T	S4® C Smooth Shank Screw 4.0 x 16 sm.sh. x 24 mm thread	2
SX536T	S4® C Smooth Shank Screw 4.0 x 10 sm.sh. x 26 mm thread	2
SX537T	S4® C Smooth Shank Screw 4.0 x 13 sm.sh. x 26 mm thread	2
SX538T	S4® C Smooth Shank Screw 4.0 x 16 sm.sh. x 26 mm thread	2
JG213R	Aesculap Standard metal tray	1
JF217R	Lid for tray	1
FW137P	Tray Insert for Occiput Implants	1
FW138P	Tray Insert for Smooth Shank Screws	1
JG300	Plastic Fixation Pins (10 per pack, black)	1
JG360	Silicone Divider	2

* Recommended container: 1 x JK444 Container and 1 x JK489 correspinding lid (can be stored together with Occiput Instruments Tray together in one container).

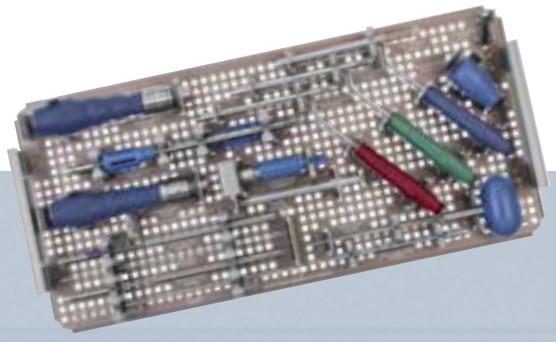
Aesculap® S4® Cervical System

12. Instruments

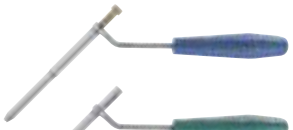


12.1 Bone Preparation and Screw Placement – Lower Tray

Art. No.	Component	Set Proposal
FW677R	Bone Probe Blunt Curved (Ø 2.4 mm)	1/optional
FW676R	Bone Probe Blunt Straight (Ø 2.4 mm)	
FW675R	Bone Probe Curved (Ø 2.4 mm)	
FW674R	Bone Probe Straight (Ø 2.4 mm)	
FW679R	Bone Probe Thoracic Curved (Ø 2.9 mm)	
FW678R	Bone Probe Thoracic Straight (Ø 2.9 mm)	
FW133R	Set Screw Starter	1
FW134R	Double Ended Set Screw Starter	1
FW061R	Torque Indicating Screwdriver	1
FW062R	Counter Torque Handle	1
FW129R	Torque Limiting T-Handle	optional
FW135R	Polyaxial Screw Revision Instrument	1



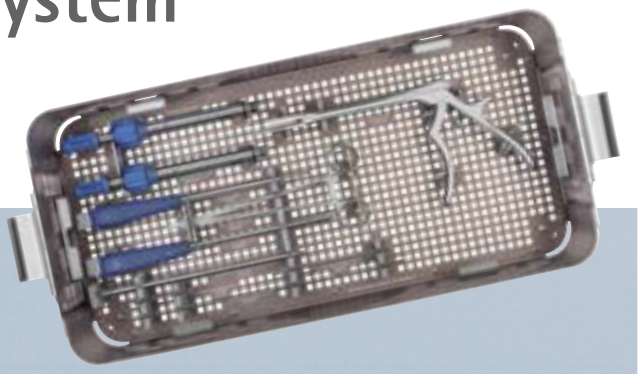
Bone Preparation and Screw Placement – Upper Tray

	Art. No.	Component	Set Proposal
	FW041R	Center Punch	1
	FW051SU	Drill 2.4 mm	1
	FW052SU	Drill 2.9 mm	1
	FJ839R	Twist Drill Handle	1
	FW053R	Variable Drill Guide Short	1
	FW049R	Fixed Drill Guide, 14 mm	1
	FW669R	Fixed Drill Guide, 12 mm	optional
	FW044R	Sounder	1
	FW042R	Pedicle Depth Gauge	1
	FW046R	Screw Tap 3.5 mm	1
	FW047R	Screw Tap 4.0 mm	1
	FW165R	Ratchet Handle	2
	FW128R	Threaded Screwdriver	2
	MF208	S4® C Basic Instrument Set I-Base	1
	MF209	S4® C Basic Instrument Set I-Lid	1
	MF210	S4® C Basic Instrument Set I-Upper Tray	1

* Recommended container: JK442 with corresponding lid JK489

Aesculap® S4® Cervical System

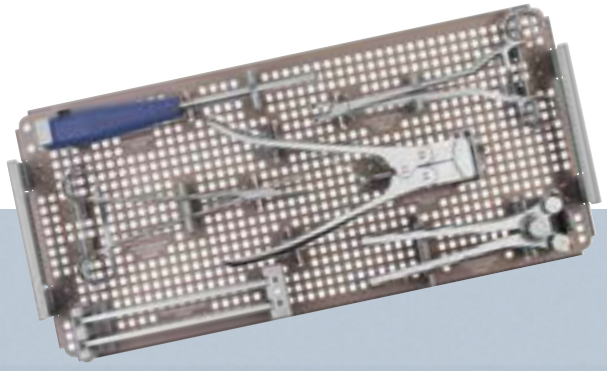
12. Instruments



12.2

Rod Cutting, Bending and Persuaders – Lower Tray

	Art. No.	Component	Set Proposal
	FW673R	Linear Rod Persuader	1
	FW077R	Rod Persuader	optional
	FW076R	Rod Holding Forceps	1
	FW064R	Set Screw Torque/Removal Driver Shaft	1
	FJ968R	Ball End Screwdriver	1
	FW065R	Screw Body Manipulator	1
	FW078R FW080R	Rod Bending Template 60 mm Rod Bending Template 120 mm	1 1
	FW081R	Rod Bending Template 290 mm	1



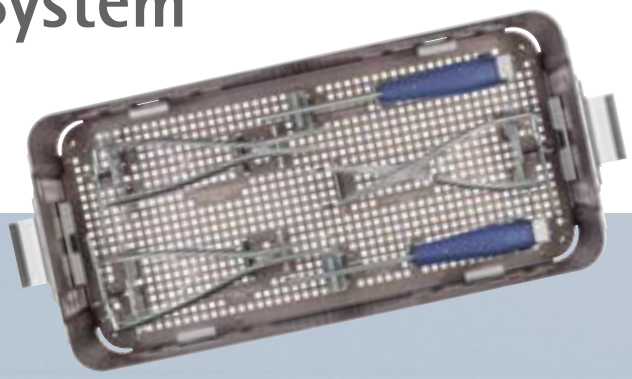
Rod Cutting, Bending and Persuaders - Upper Tray

	Art. No.	Component	Set Proposal
	FW071R	Lamina Preparator	1
	FW422R	Cervical Counter Hook Holding Forceps Straight	1
	FW528R	Cervical Hook Holding Forceps Curved	1
	FW082R	Rod Cutter for 3.5 mm Rods	1
	FW037R	Rod Bending Forceps for 3.5 mm Rods	1
	FW036R	Rod Bending Plates 3.5 mm	2
	MF211	S4® C Basic Instrument Set II-Base	1
	MF212	S4® C Basic Instrument Set II-Lid	1
	MF213	S4® C Basic Instrument Set II-Upper Tray	1

* Recommended container: JK442 with corresponding lid JK489

Aesculap® S4® Cervical System

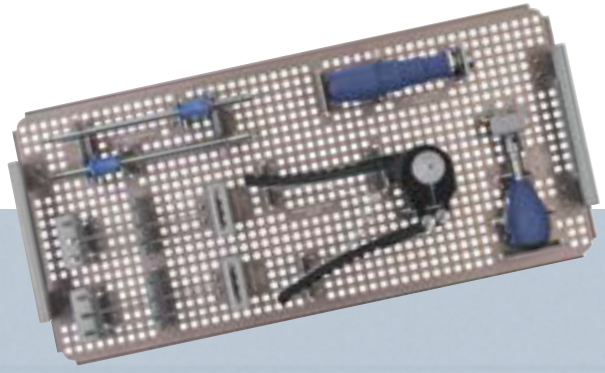
12. Instruments



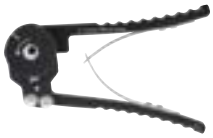
12.3

Optional Instrument Tray – Lower Tray

	Art. No.	Component	Set Proposal
	FW427R	Cervical Compression Forceps	optional
	FW523R	Cervical Distraction Forceps Straight	optional
	FW428R	Cervical Distraction Forceps Curved	optional
	FW136R	In-Situ Rod Benders 90°	optional

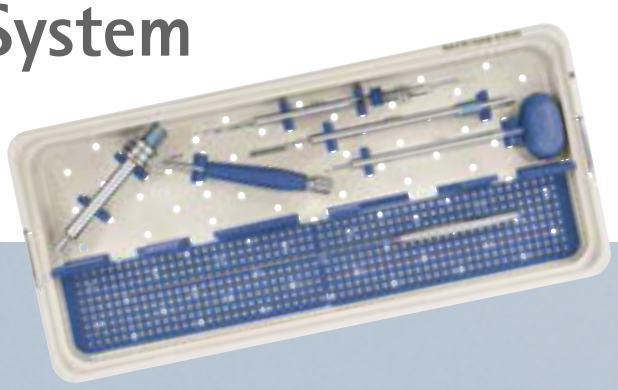


Optional Instrument Tray – Upper Tray

	Art. No.	Component	Set Proposal
	FW070R	Screwdriver Self Retaining	optional
	FW145R	Pedicle Marker Angled	optional
	FW144R	Pedicle Marker Round	optional
	FW672R	Straight Cut Rod Cutter	optional
	FW067R	Non-Ratchet Handle	optional
	SC436R	Tear Drop Drill Handle	optional
	MF214	S4® C Basic Instrument Set II-Base	1
	MF215	S4® C Basic Instrument Set II-Lid	1
	MF216	S4® C Basic Instrument Set II-Upper Tray	1

* Recommended container: 1 x JK446 Container and 1 x JK489 correspinding lid (can be stored together with C1-C2 Trays together in one container).

Aesculap® S4® Cervical System



12. Instruments

12.4

Smooth Shank Screws – C1-C2 Screw Fixation

	Art. No.	Component	Set Proposal
	FW054R	Screw Starter Guide Tube	1
	FW085R	Smooth Shank Bone Awl	1
	FW086SU	Smooth Shank Screw Drill	1
	FW087R	Smooth Shank Screw Tap	1

Favored Angle Screws – C1-C2 Transarticular Screw Fixation

	Art. No.	Component	Set Proposal
	FW066R	Sleeve Guide with Inner Sleeve	1
	FJ983R	C1/C2 Obturator	1
	FJ984R	Trocar	1
	FJ985R	Inner Sleeve Guide	1
	FW088SU	Favored Angle Screw Drill (2.9 mm Long Drill)	1
	FW089R	Favored Angle Screw Tap, ø 4.0 mm	1
	FW069R	Favored Angle Screwdriver C1/C2	1
	FJ988R	Ball End Screwdriver	1
	FW671R	Sounder Long Version	optional
	MF214	S4® C Basic Instrument Set II-Base	1
	MF215	S4® C Basic Instrument Set II-Lid	1

* Recommended container: Please refer to page 53.

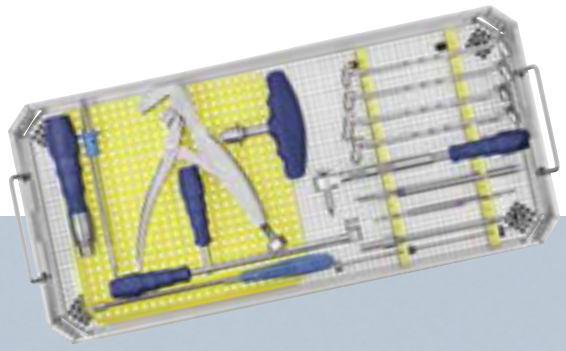
Aesculap® S4® Cervical System

12. Instruments

12.5

Occiput Instruments

	Art. No.	Component	Set Proposal
	FW090R	Occipital Plate Bending Pliers	1
	FW091SU	Occipital Drill Bit, ø 2.9 mm	1
	FW092SU	Occipital Drill Bit, ø 3.9 mm	1
	FW093R	Occipital Tap, ø 4.5 mm	1
	FW094R	Occipital Tap, ø 5.5 mm	1
	FW095R FW096R	Occipital Drill Guide Double Ended, ø 4.5 mm Occipital Drill Guide Double Ended, ø 5.5 mm	1 1
	FW097R FW098R	Occipital Tap Guide Double Ended, ø 4.5 mm Occipital Tap Guide Double Ended, ø 5.5 mm	1 1
	FW213R	Screwdriver	1
	FW099R	Occipital Screw Remover	1
	FW101R	Shaft for Occipital Screw Remover	1
	FW116R	Occiput T-handle for screw removal	1
	FW103R	Occipital Torque Wrench	1
	FW104R	Occipital Counter Torque Handle	1
	FW109R	Occiput Mini Flex Set Screw Starter	1



12.5

Art. No.	Component	Set Proposal
JF223R	Aesculap Standard metal tray	1
JF227R	Lid for tray	1
JG310	Inlays (Yellow 240 x 40 mm)	2
JF945	Mattress (Yellow 248 x 237 mm)	1
JG300	Plastic Fixation Pins (10 per pack, black)	1

* Recommended container: Please refer to page 47.

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