

SURGICAL TECHNIQUE
SHORT HUMERAL NAIL AND LONG HUMERAL NAIL



Short humeral nail and long humeral nail

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Indications:

Short humeral nail and long humeral nail are intended to treat:

- stable or unstable broken parts of the humeral head
- pathological fractures
- pseudoarthrosis, humeral shaft

Nail allows for osteosynthesis of the humerus and it is introduced antegrade. Numerous locking options allow fair fixation even on short bone fragments. The aim of fixation is reposition of head dislocation, its stable connection to humeral shaft and reconstruction of the rotator cuff – either by suture or fixation of both humeral bumps.

Warning:

Within the proximal locking, when the location of locking holes is precisely determined, it is necessary to consider the position of neurovascular bundle and axillary nerve. It is necessary to avoid their damage mainly when making locking holes and within the introduction of locking screws.

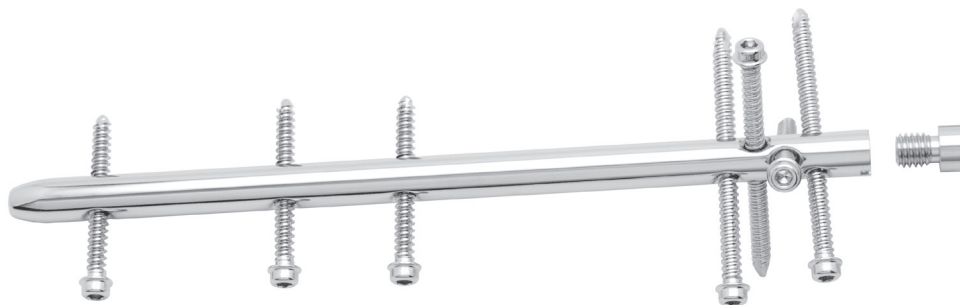
While performing distal locking, it is necessary to respect the course of the brachial artery and median nerve. Ventrodorsal locking is recommended. Lateromedial locking is only possible in exceptional indications, bearing the risk of radial nerve damage.

Implant:

Short and long humeral nails are made of implant steel (under ISO 5832-1) or Ti6Al4V alloy (under ISO 5832-3). It is not allowed to combine these materials for nails and screws. Nails are filled nails with a circular cross-section of 6, 7, 8 and 9 mm in diameter. **Short humeral nail** is available in diameters of 6, 7, 8, 9 mm in 150 mm length. **Long humeral nail** is available in diameters of 6, 7, 8, in 190 mm to 290 mm length. In 20 mm steps.

Humeral nail implant system consists of the right or left nail of the diameter 6, 7, 8 or 9 mm, and the respective length. One or more locking screws 3.5 mm with flanged head for nails of 7, 8, 9 mm diameter or 2.7 mm for 6 mm diameter nails and between one and four locking screws 4 mm with flanged head, which are to lock the nail. The nail can be closed with a end cap 0, 5 or 10.

Short humeral nail



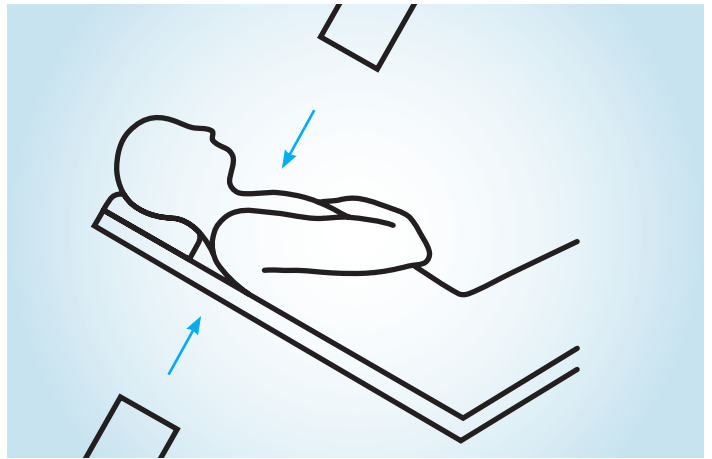
Long humeral nail



Surgical technique

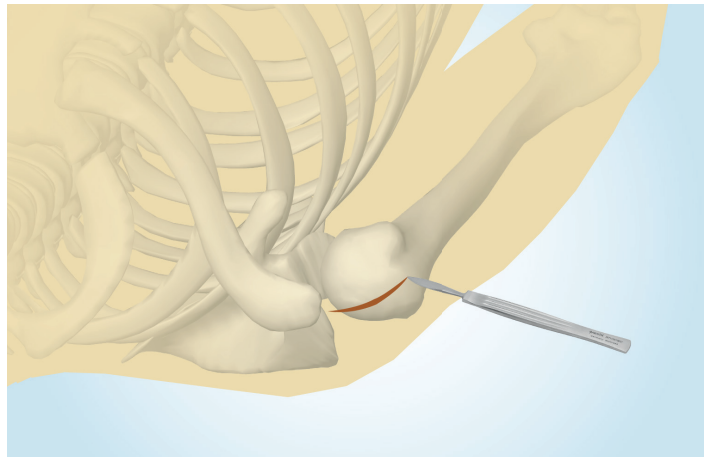
1. Position of the patient

The patient is placed on the operating table in a semi-sitting position. The arm on operated side is supported, the head is rotated to the healthy arm. Another option is to place the patient into supine position, allowing the limbs extend outside the table, ensuring their free travel outside the operating table.



2. Fracture reduction

Under the X-ray control, fracture reduction is implemented in both projections. In the case of purely ligamentous rupture of the rotator cuff, we are to start stitches for its later repair. Investigate the condition of glenoidal acetabulum, surface and location of the humeral head, dislocation of bumps and the position of humeral diaphysis. We perform the reduction by introducing elevatorium within the fracture line, limb manipulation, pulling stitches using the bumps, and the introduction of auxiliary Kirschner wires.

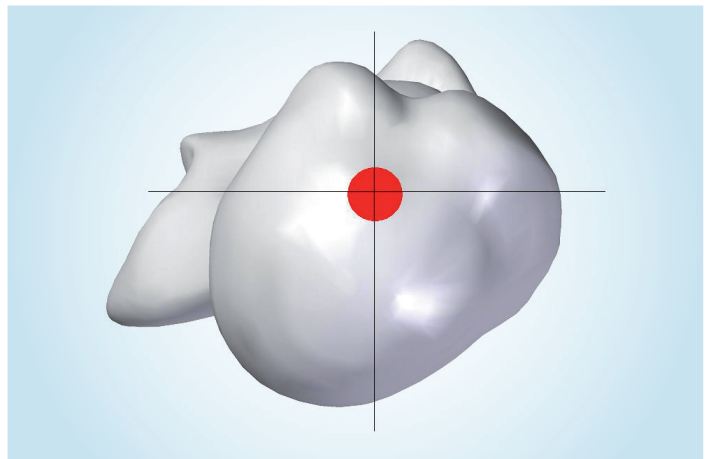
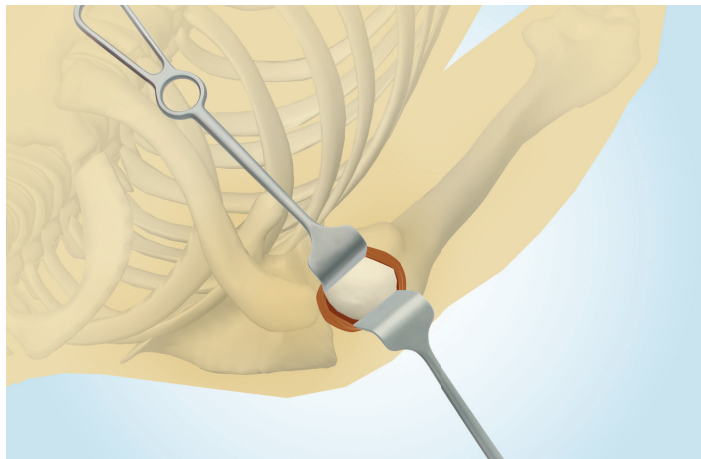


3. Surgical approach

Several surgical approaches are available: Limited transdeltoid approach (recommended), classic deltoideopectoral and minimally invasive.

Limited transdeltoid approach: entry point under visual control, protection of the long head of biceps, revision (and reconstruction) of the rotator cuff, palpation revision of the shoulder joint, the orientation of the humeral head position, the idea of reduction, fracture line revision, palpation inspection of nail insertion, repair of humeral bumps (screws, rope over bit), control of the nail introduction depth. This improves the quality of osteosynthesis and reduces the exposure to X-rays.

The incision is brought in front of the AC joint, parallel to the peripheral end of the clavicle, it should not reach 4 cm below the acromion (risk of injury to *a. axillaris*, the length of the arm, amount of soft tissue and anatomical varieties must be taken into account). After parting the fibers of the deltoid muscle longitudinally we reach the shoulder joint capsule. Cut the capsule lengthwise, you will usually need to remove the haemorrhage and detect the rotator cuff. Entry Point is located at the top of the humeral head.

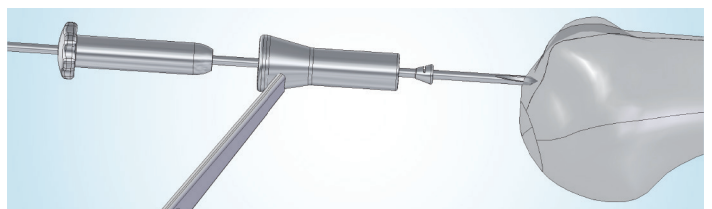



4. Entry point establishment

Create the entry point using a cutter and olive wire.

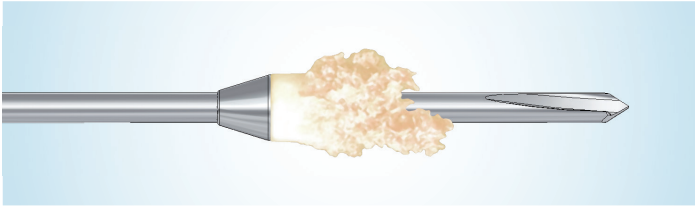
First find the point of entry using the wire with olive, then place the cutter sleeve on the wire and insert spacer sleeve into the cutter sleeve. Then introduce the wire into the bone up to the olive.

Remove the spacer sleeve and using the wire, place the cutter clamped in a drill to create the entry point. Mill through the cutter sleeve. The cutter is equipped with a scale that determines the depth of the milled bone. A minimum of 15 mm of bone should be milled-off. Deeper insertion is possible at the discretion and need of the surgeon. Milling is most often performed until the marrow cavity is reached. The cutter can make an opening of up to 50 mm deep. Cutters are available in two versions. Ø 9 mm cutter for nails with a diameter of 9 mm and Ø 8 mm cutter for nails with diameters 6, 7 and 8 mm.

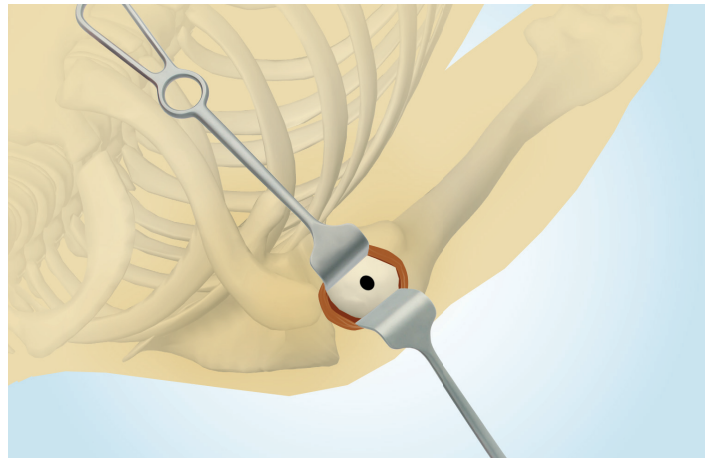


 Ø 9 mm cutter is fitted with a black marked tape.

After milling the opening, take off the cutter and the sleeve and pull out the wire with olive with the milled-off bone. The correct trephination is confirmed by a regular roller pushed out of the cutter.

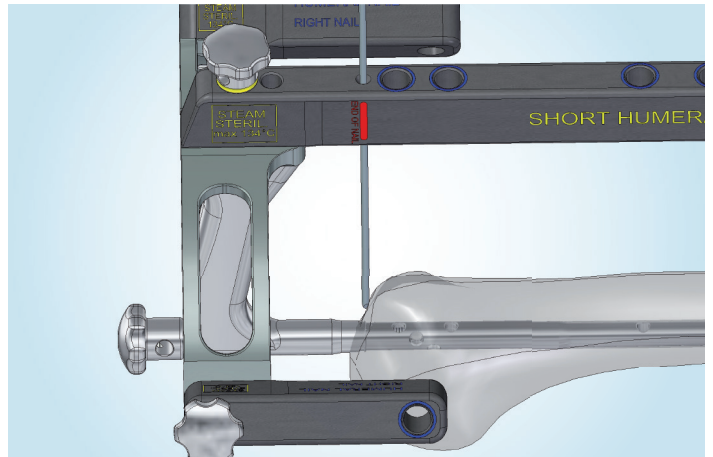


Note: An alternative is to create an entry point with a punch. It can be used in cases where the humeral head is not damaged in the vicinity of the entry point.

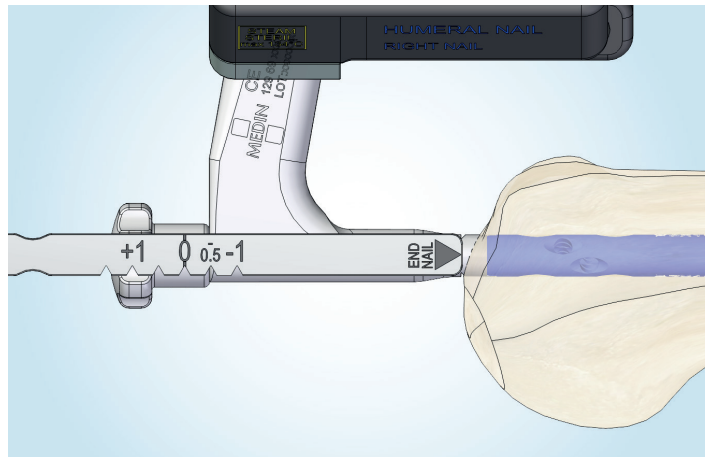


5. Nail introduction

The nail is introduced by hand as far into the bone cavity as possible. The nail must be fully nested in the cavity of bone. Introduction can be checked with X-ray; aiming device is provided with a groove, which indicates the end of the nail. Other option is by Ø 2 mm, when the wire introduced into the hole of the aiming device marked by a red groove and the text „nail end“ on the crossbar.

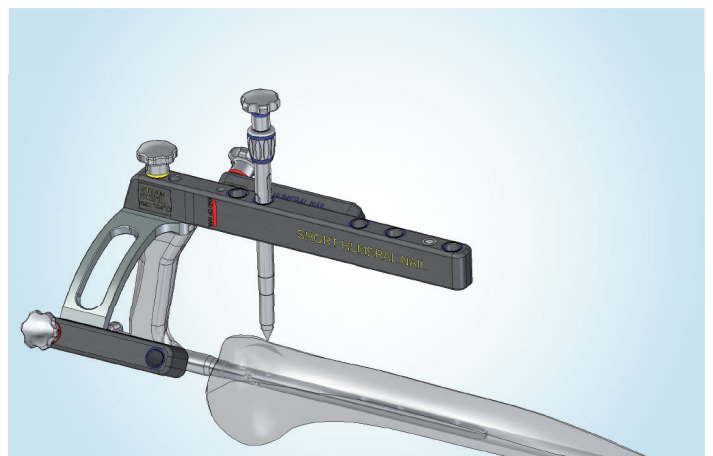


A gauge may also be used to check the depth of insertion. The introduction of the nail, especially when passing through the fracture line, must be checked with the X-ray amplifier.



6. Creating a hole for screws

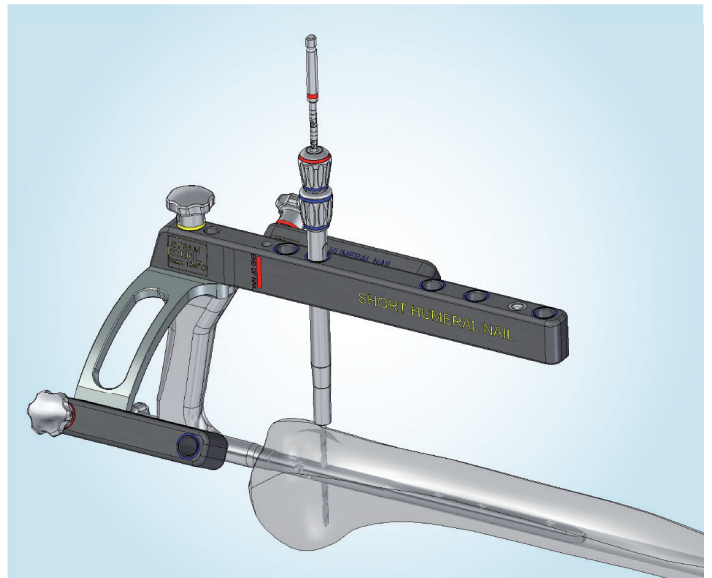
Insert the blue-labeled sleeve (Ø 8 / 6 sleeve) into the aiming device. Push the sleeve to the skin, in order to create the incision site. Insert a centre punch into the sleeve and slide it to the bone. Press the centre punch lightly to create a mark in the bone for better guidance of the drill.



SHORT HUMERAL NAIL AND LONG HUMERAL NAIL

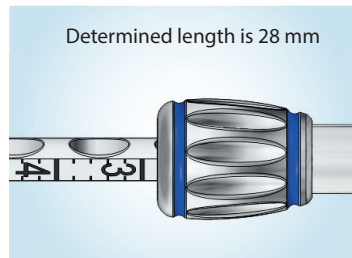
Then remove the centre punch and insert the blue- and red -labeled sleeve (Ø 6/ 2.7) or the blue and green sleeve (Ø 6/ 2.9). The drill bit is chosen by the surgeon. Drill a hole into the bone through this sleeve. The drill is equipped with a scale to determine the necessary length of the screw. This sleeve is used for introduced nail with a diameter of 7, 8 and 9 mm. Nails with a diameter of 6 mm must be drilled with a red drill bit only in the humeral head area. Drill holes in the shaft with a Ø 2 mm yellow-marked wire using a blue- and yellow-marked sleeve (6.1 / 2.1 sleeve).

Color coding of products

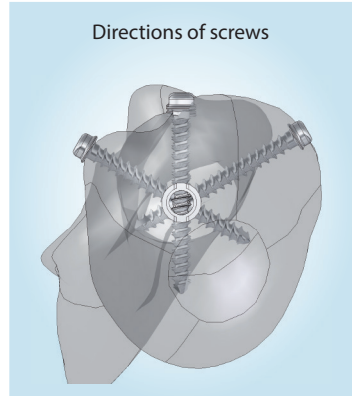


7. Screw insertion

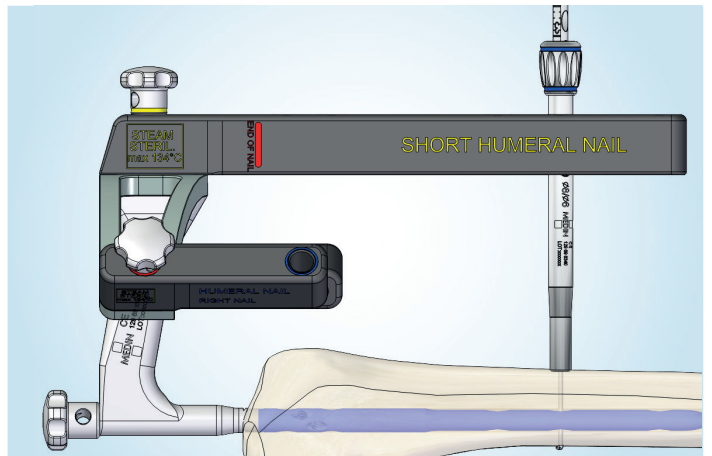
We can determine the length of the screw needed using a depth gauge. The proper method of calculating depth is illustrated in the diagram. A screw of determined length is put into a screwdriver and inserted into the bone through the sleeve. The screwdriver is provided with a scale that shows how far the screw still needs to be screwed.



The recommended procedure is to introduce two Ø 4 mm locking screws in the frontal plane into the head, then fix nail into the shaft. Finally introduce Ø 4 mm oblique locking screws into the head after the reduction of large bumps. Bumps can be fixed directly using Ø 4 mm locking screws (palpation control), fixation-based non-resorbable stitches, or a combination of both methods.

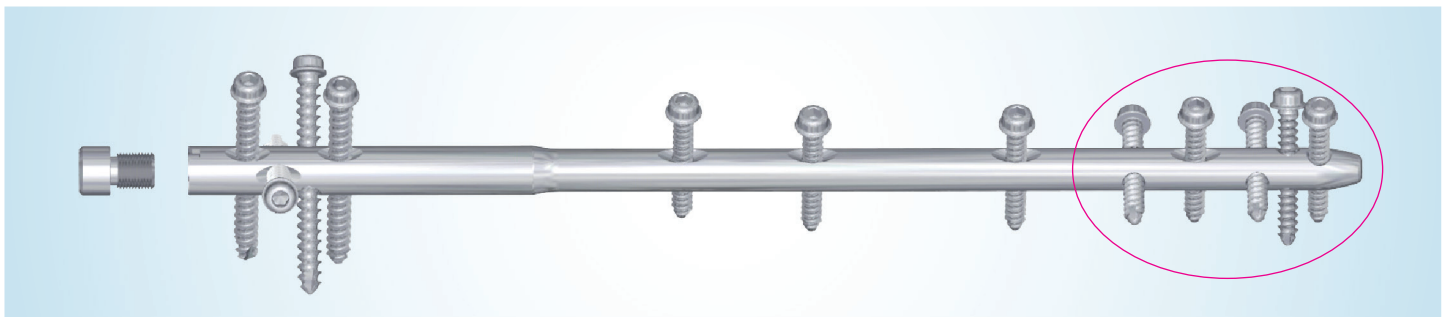


Note: Locking Ø 4 screws with flanged head are intended for openings in the humeral head, locking screws Ø 3.5 are intended for openings in the shaft. Use cortical screws HA 2.7 in the diaphysis for Ø 6 mm nails.



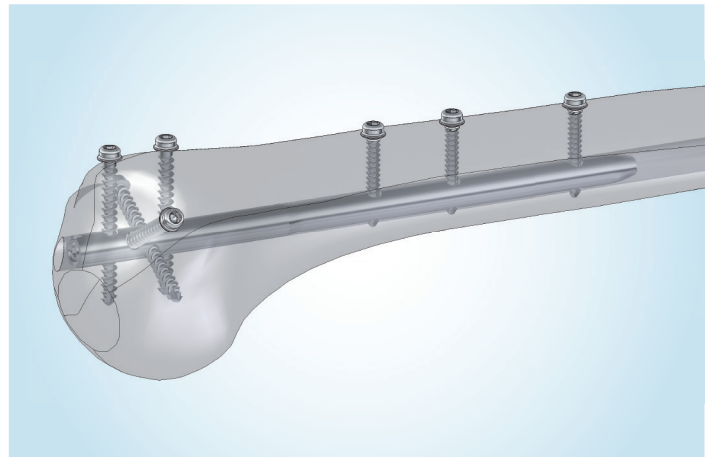
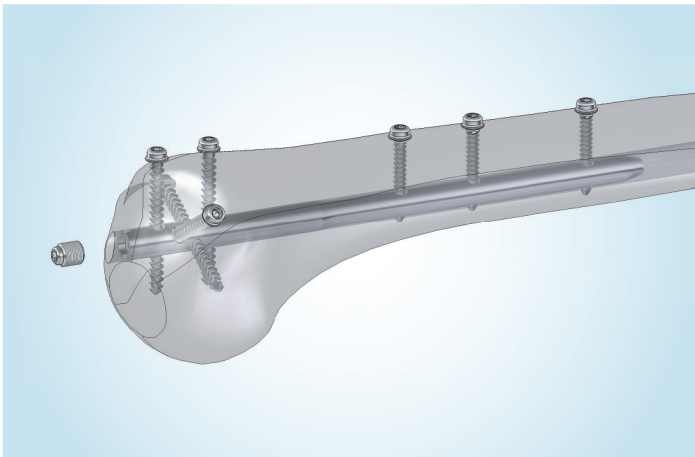
8. Distal locking of long nails

Long humeral nails can be locked in the distal part using strengthened flat-head locking screws 3.5 mm in diameter for Ø 7 and 8 mm nails. And Ø 2.7 mm cortical screws for Ø 6 mm nails. Locking in the distal part of the nail is performed by hand under X-ray and visual control or by using distal aiming. The method of locking using an aiming device is described in the Operation technique "Distal aiming of long humeral nail."



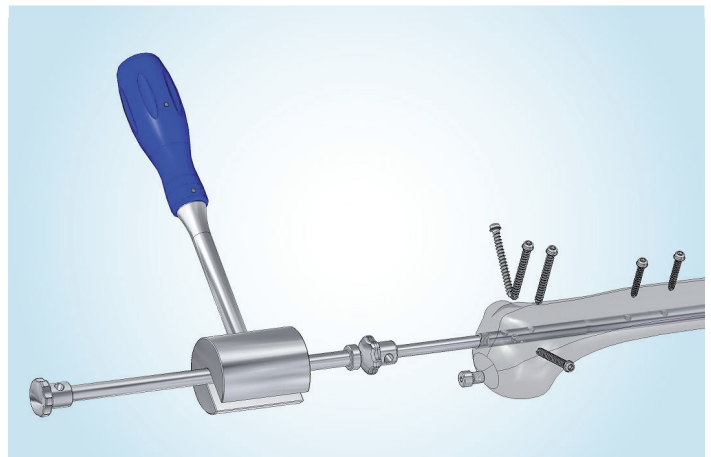
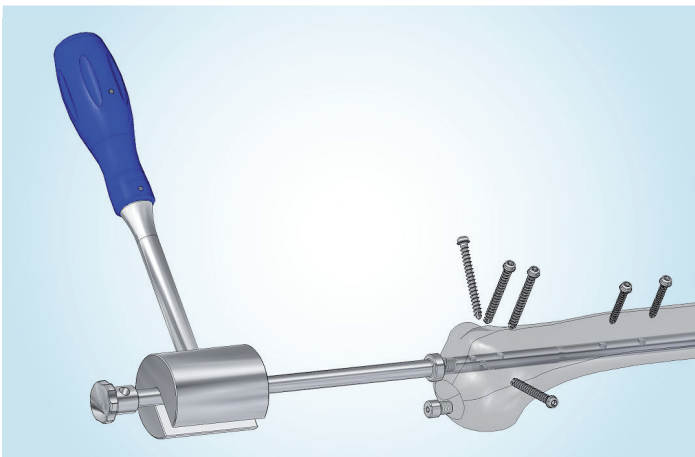
9. Closing the nail with an end cap

Once locking of the nail by screws is finished, dismantle the aiming device and close the nail with an end cap of required length.



10. Recommended procedure of implants extraction

If an end cap has been used, it must be removed first. After removing the end cap, the hammer axis is screwed into the nail to guide the hammer. If the nail is introduced deeper into the bone cavity, the screw of the aiming device can be screwed into the nail first and then the axis of the hammer is screwed into it. Once you remove the last screw from the nail, you can extract the nail from the bone cavity with light hammer blows.



11. Concluding remarks

- Before the introduction of the nail you must check following the assembly of nail and aiming device whether all the openings into which screws are introduced, match the openings in the nail and aiming device.
- To facilitate inserting sleeves, drilling and the introduction of screws, appropriate instrumentation tools are color-coded.
- Implants can be ordered in two versions, either steel or titanium alloy. When used in one patient, they should never be combined.
- To guarantee the safe use of the implant, the MEDIN Company requires using only implants supplied by them. There must be no combination of implants by other companies.



Crossbars of the aiming device are made of X-ray translucent material. Sterilization can be performed only by steam at a temperature of 134 °C! Using higher temperatures may result in permanent deformation and loss of functionality of crossbars!



Assembly of the aiming device

1. Assembly of the aiming device

Assembly of basic aiming device regardless of the side of operated hand. Screw can be tightened by hand or tightening rod can be used.



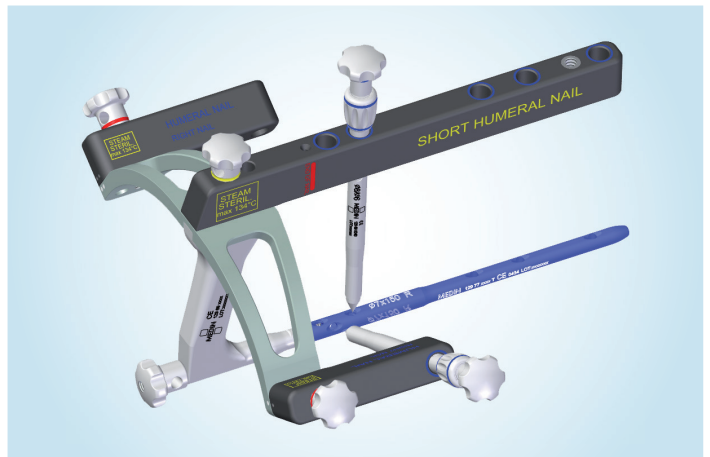
2. Assembly of the aiming device and the nail

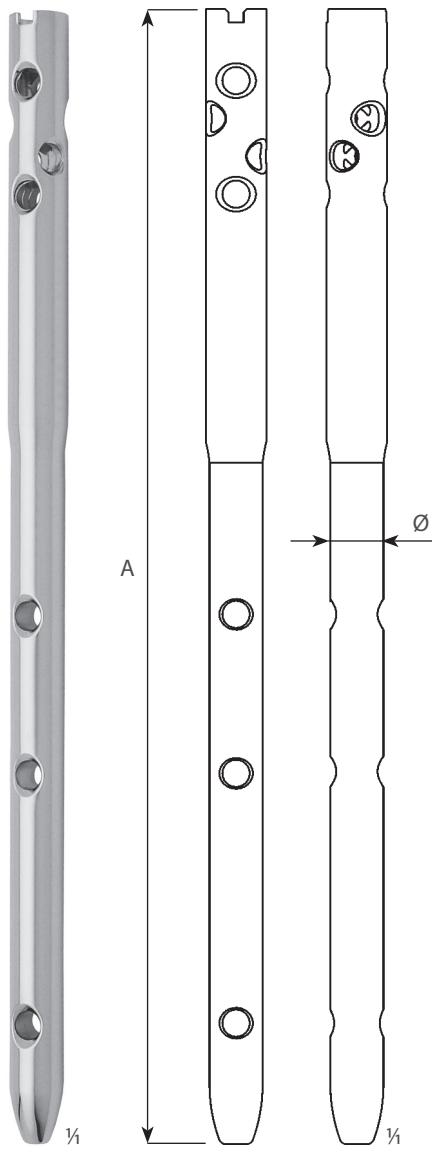
Assembly of the aiming device and the nail of required diameter and side. According to the orientation of the nail (left or right) attach the crossbars to the arm of the aiming device. They are marked for right and left nail. Screws are provided with a hole for tightening rod.



3. Checking the aiming device with nail

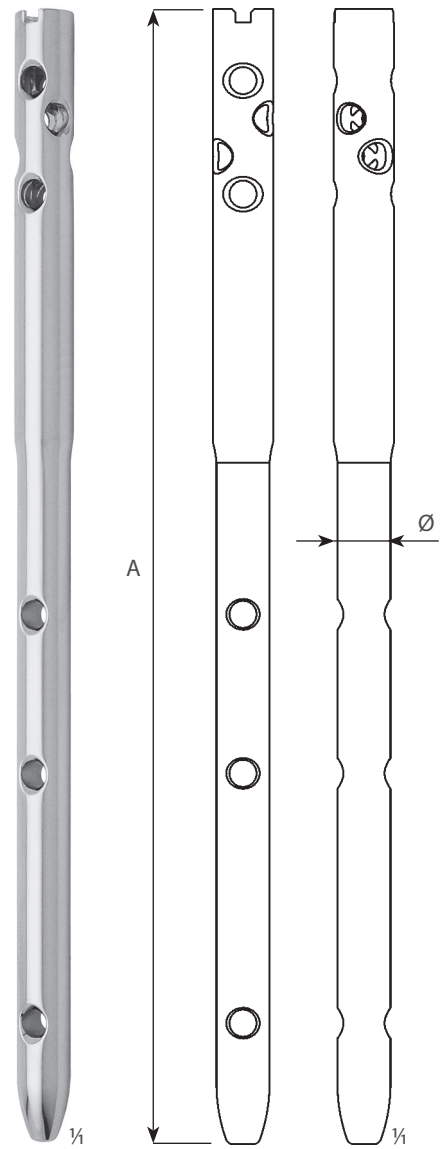
Place the sleeves into the aiming device and check all openings in the nail. Ø8 / 6.1 sleeve and Ø6 punch are suitable for checking.





RIGHT

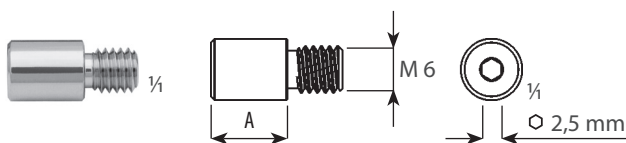
SSt	Ti	A	Ø
129 78 3850	129 78 3853	150 mm	6 mm
129 77 8680	129 77 8683	150 mm	7 mm
129 77 8690	129 77 8693	150 mm	8 mm
129 78 6050	129 78 6053	150 mm	9 mm



LEFT

SSt	Ti	A	Ø
129 78 3860	129 78 3863	150 mm	6 mm
129 77 9500	129 77 9503	150 mm	7 mm
129 77 9510	129 77 9513	150 mm	8 mm
129 78 6060	129 78 6063	150 mm	9 mm

STOPPERS



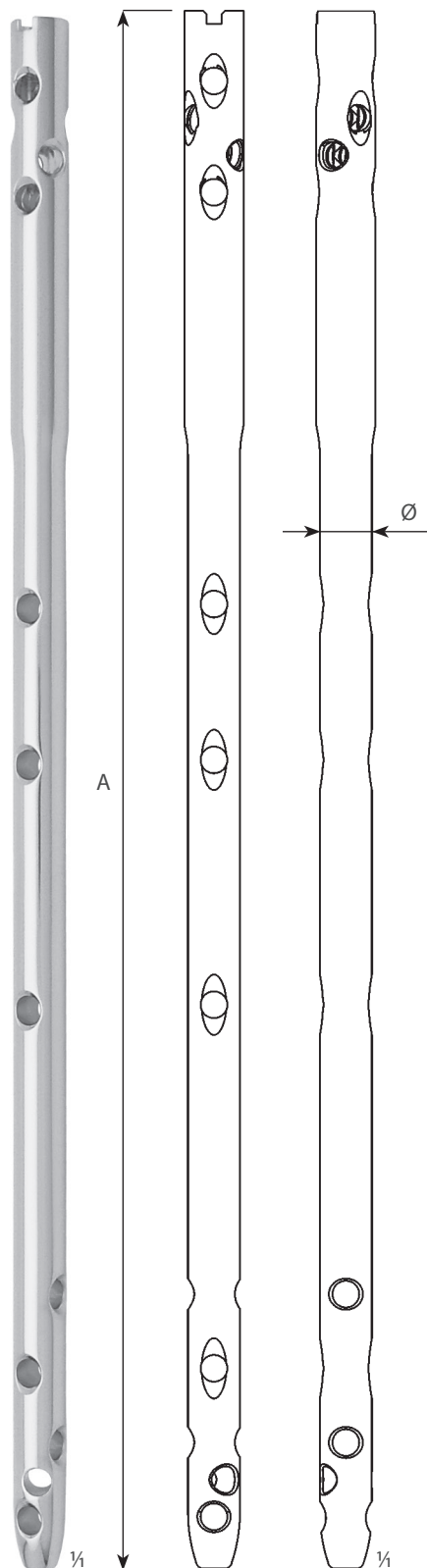
SSt	Ti	A	
129 77 2210	129 77 2213	0 mm	Fig. 0
129 77 2220	129 77 2223	5 mm	Fig. 5
129 77 2230	129 77 2233	10 mm	Fig. 10
129 78 8880	129 78 8883	15 mm	Fig. 15
129 78 8890	129 78 8893	20 mm	Fig. 20

NOTES: SSt – stainless steel in accordance with ISO 5832-1

Ti – titanium version, material: Ti6Al4V ELI in accordance with ISO 5832-3

SHORT HUMERAL NAIL AND LONG HUMERAL NAIL

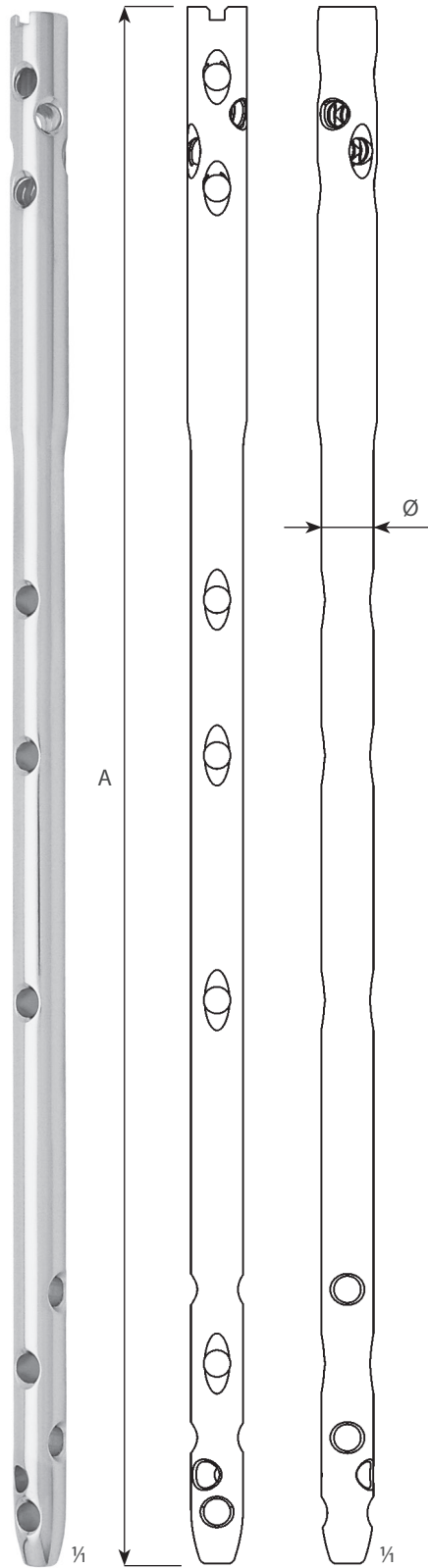
LONG HUMERAL NAILS



RIGHT

SSt	Ti	A	ø
129 78 3870	129 78 3873	190 mm	6 mm
129 78 3880	129 78 3883	210 mm	6 mm
129 78 3890	129 78 3893	230 mm	6 mm
129 78 3900	129 78 3903	250 mm	6 mm
129 78 3910	129 78 3913	270 mm	6 mm
129 78 3920	129 78 3923	290 mm	6 mm
129 77 9640	129 77 9643	190 mm	7 mm
129 77 9650	129 77 9653	210 mm	7 mm
129 77 9660	129 77 9663	230 mm	7 mm
129 77 9670	129 77 9673	250 mm	7 mm
129 77 9680	129 77 9683	270 mm	7 mm
129 77 9690	129 77 9693	290 mm	7 mm
129 77 9760	129 77 9763	190 mm	8 mm
129 77 9770	129 77 9773	210 mm	8 mm
129 77 9780	129 77 9783	230 mm	8 mm
129 77 9790	129 77 9793	250 mm	8 mm
129 77 9800	129 77 9803	270 mm	8 mm
129 77 9810	129 77 9813	290 mm	8 mm

NOTES: SSt – stainless steel in accordance with ISO 5832-1 Ti – titanium version, material: Ti6Al4V ELI in accordance with ISO 5832-3

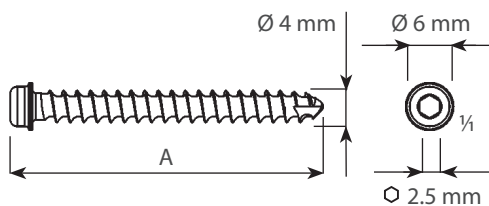


LEFT

SSt	Ti	A	ø
129 78 3930	129 78 3933	190 mm	6 mm
129 78 3940	129 78 3943	210 mm	6 mm
129 78 3950	129 78 3953	230 mm	6 mm
129 78 3960	129 78 3963	250 mm	6 mm
129 78 3970	129 78 3973	270 mm	6 mm
129 78 3980	129 78 3983	290 mm	6 mm
129 77 9700	129 77 9703	190 mm	7 mm
129 77 9710	129 77 9713	210 mm	7 mm
129 77 9720	129 77 9723	230 mm	7 mm
129 77 9730	129 77 9733	250 mm	7 mm
129 77 9740	129 77 9743	270 mm	7 mm
129 77 9750	129 77 9753	290 mm	7 mm
129 77 9820	129 77 9823	190 mm	8 mm
129 77 9830	129 77 9833	210 mm	8 mm
129 77 9840	129 77 9843	230 mm	8 mm
129 77 9850	129 77 9853	250 mm	8 mm
129 77 9860	129 77 9863	270 mm	8 mm
129 77 9870	129 77 9873	290 mm	8 mm

SHORT HUMERAL NAIL AND LONG HUMERAL NAIL

LOCKING SCREWS WITH FLANGED HEAD 4.0 mm

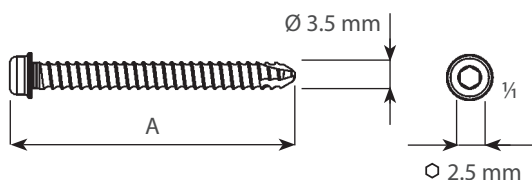


129 79 5501
self-tapping
40 mm

NOTES:
drilled with $\varnothing 2.7$ mm drill
introduction by a screwdriver with 2.5 mm socket

SSt	Ti	A
129 78 5371	129 78 5374	14 mm
129 78 5381	129 78 5384	16 mm
129 78 5391	129 78 5394	18 mm
129 78 5401	129 78 5404	20 mm
129 78 5411	129 78 5414	22 mm
129 78 5421	129 78 5424	24 mm
129 78 5431	129 78 5434	26 mm
129 78 5441	129 78 5444	28 mm
129 78 5451	129 78 5454	30 mm
129 78 5461	129 78 5464	32 mm
129 78 5471	129 78 5474	34 mm
129 78 5481	129 78 5484	36 mm
129 78 5491	129 78 5494	38 mm
129 78 5501	129 78 5504	40 mm
129 78 5511	129 78 5514	42 mm
129 78 5521	129 78 5524	44 mm
129 78 5531	129 78 5534	46 mm
129 78 5541	129 78 5544	48 mm
129 78 5551	129 78 5554	50 mm
129 78 5561	129 78 5564	55 mm
129 78 5571	129 78 5574	60 mm

LOCKING SCREWS STRENGTHENED WITH FLANGED HEAD 3.5 mm

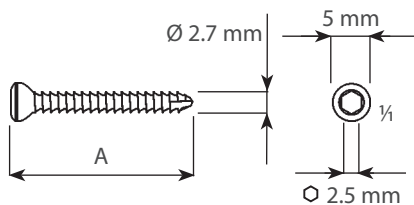


129 78 5931
self-tapping
38 mm

NOTES:
for $\varnothing 7, 8, 9$ mm humeral nails
drilled with $\varnothing 2.7$ mm drill
introduction by a screwdriver with 2.5 mm socket

SSt	Ti	A
129 78 5841	129 78 5844	20 mm
129 78 5851	129 78 5854	22 mm
129 78 5861	129 78 5864	24 mm
129 78 5871	129 78 5874	26 mm
129 78 5881	129 78 5884	28 mm
129 78 5891	129 78 5894	30 mm
129 78 5901	129 78 5904	32 mm
129 78 5911	129 78 5914	34 mm
129 78 5921	129 78 5924	36 mm
129 78 5931	129 78 5934	38 mm
129 78 5941	129 78 5944	40 mm
129 78 5951	129 78 5954	42 mm
129 78 5961	129 78 5964	44 mm
129 78 5971	129 78 5974	46 mm
129 78 5981	129 78 5984	48 mm
129 78 5991	129 78 5994	50 mm
129 78 6001	129 78 6004	55 mm
129 78 6011	129 78 6014	60 mm
129 78 6021	129 78 6024	65 mm
129 78 6031	129 78 6034	70 mm

CORTICAL BONE SCREWS HA 2.7



HA 2,7
129 79 5181
self-tapping
24 mm

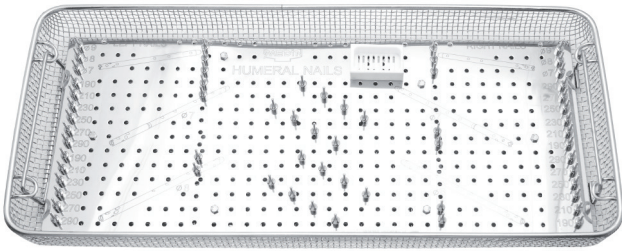
NOTES:
for $\varnothing 6$ mm humeral nails
drilled with $\varnothing 2.0$ mm K-wire
introduction by a screwdriver with 2.5 mm socket

SSt	Ti	A
129 79 5101	129 79 5104	8 mm
129 79 5111	129 79 5114	10 mm
129 79 5121	129 79 5124	12 mm
129 79 5131	129 79 5134	14 mm
129 79 5141	129 79 5144	16 mm
129 79 5151	129 79 5154	18 mm
129 79 5161	129 79 5164	20 mm
129 79 5171	129 79 5174	22 mm
129 79 5181	129 79 5184	24 mm
129 78 6101	129 78 6104	26 mm
129 78 6111	129 78 6114	28 mm
129 78 6121	129 78 6124	30 mm
129 78 6131	129 78 6134	32 mm
129 78 6141	129 78 6144	34 mm
129 78 6151	129 78 6154	36 mm
129 78 6161	129 78 6164	38 mm
129 78 6171	129 78 6174	40 mm

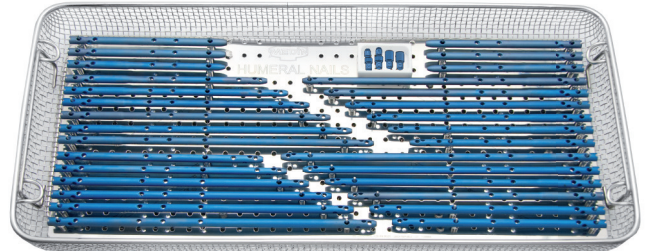
NOTES: SSt – stainless steel in accordance with ISO 5832-1 Ti – titanium version, material: Ti6Al4V ELI in accordance with ISO 5832-3

SHORT HUMERAL NAIL AND LONG HUMERAL NAIL

SET OF HUMERAL NAILS



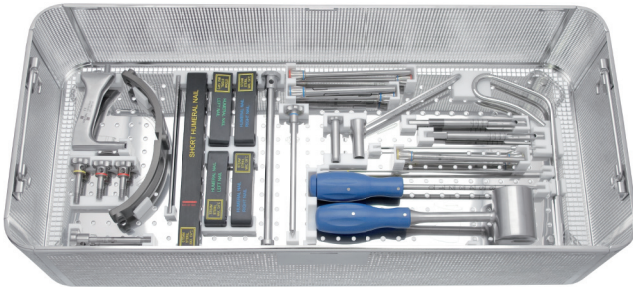
SIEVE FOR HUMERAL NAILS
129 69 6020
540 × 240 × 50 mm
without implants



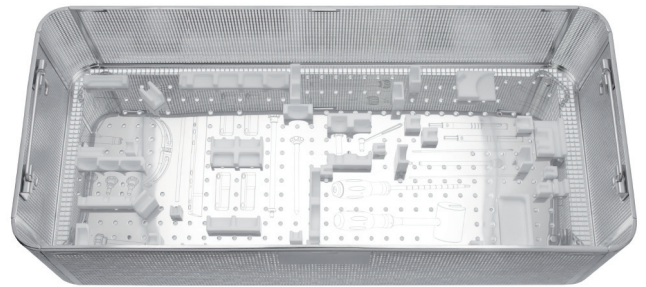
SET OF HUMERAL NAILS
STAINLESS STEEL
139 09 0310
540 × 240 × 50 mm
with implants

SET OF HUMERAL NAILS
TITANIUM
139 09 0313
540 × 240 × 50 mm
with implants

INSTRUMENTS FOR SHORT HUMERAL NAILS

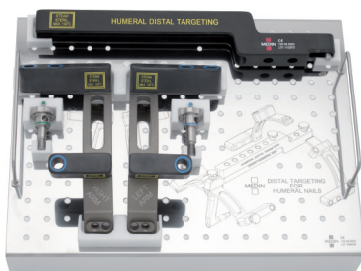


SET OF INSTRUMENTS FOR HUMERAL NAILS
139 09 0300
540 × 240 × 70 mm
with instruments

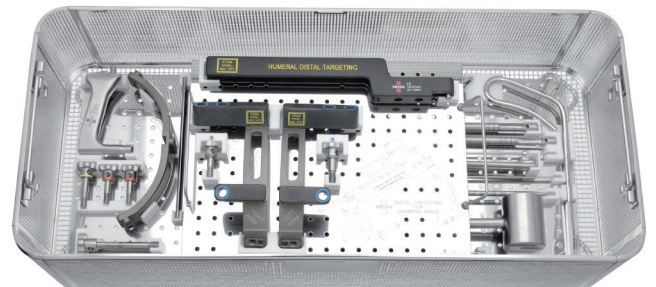


SIEVE FOR INSTRUMENTS FOR SHORT HUMERAL NAILS
129 69 6010
540 × 240 × 70 mm
without instruments

INSTRUMENTS FOR HUMERAL NAILS



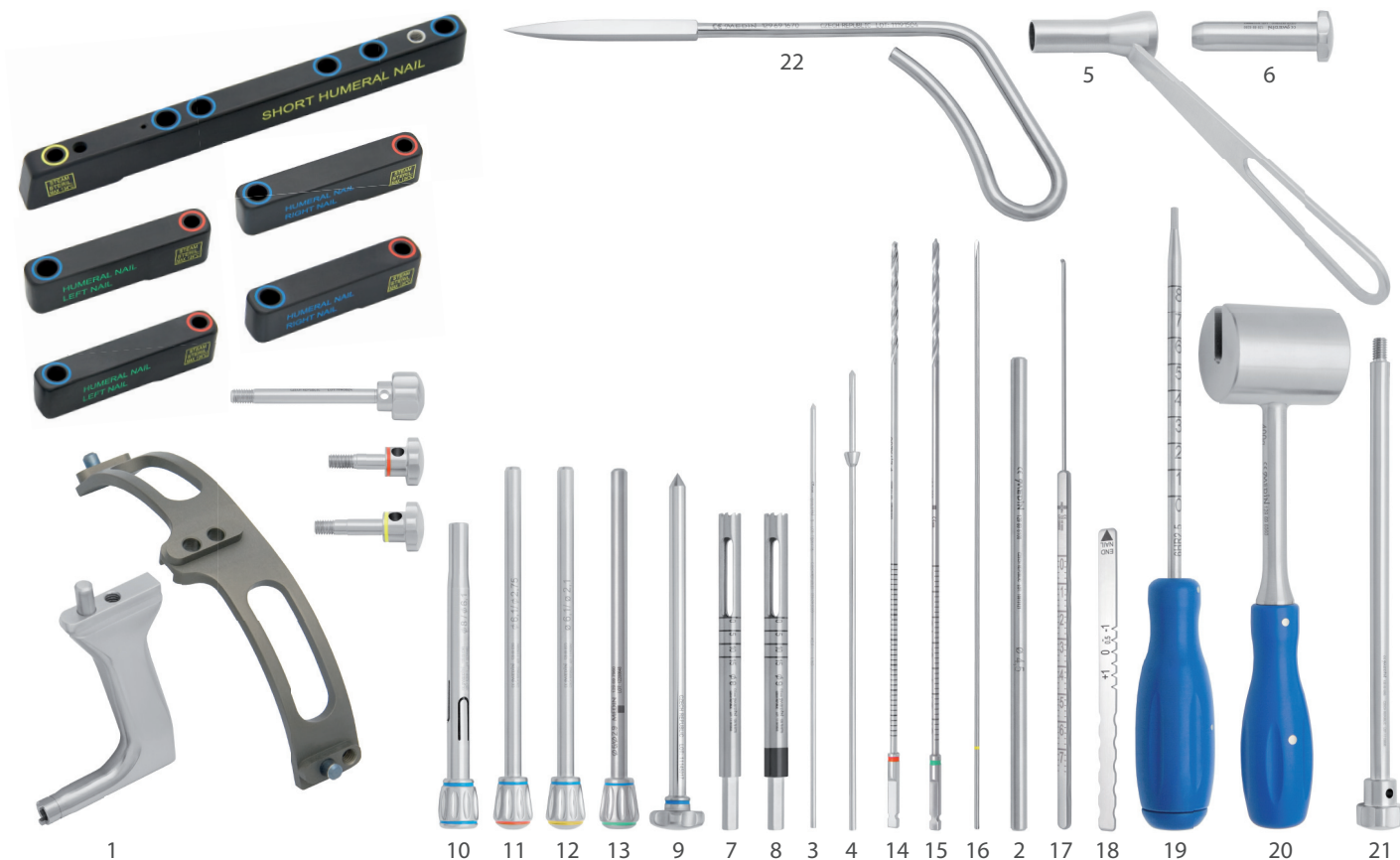
SET OF INSTRUMENTS FOR DISTAL HUMERAL AIMING
139 09 0620
with instruments



SET OF INSTRUMENTS FOR HUMERAL NAILS
139 09 0630
540 × 240 × 70 mm
with instruments

SHORT HUMERAL NAIL AND LONG HUMERAL NAIL

INSTRUMENTS FOR SHORT HUMERAL NAILS



129 69 6015
set

			psc
1	129 69 6320	Short humeral aiming device	1
2	129 69 6100	Wrench rod	1
3	129 09 3100	Extension wire 2x160 mm	2
4	129 09 9950	Wire with olive	1
5	129 69 6090	Cutting sleeve 9.2 mm	1
6	129 69 6280	Delimitation sleeve Ø 2.5/Ø 9	1
7	129 79 9770	Cutter Ø 8 mm	1
8	129 79 9775	Cutter Ø 9 mm	1
9	129 69 6300	Trocar humerus Ø 6 mm	1
10	129 69 6340	Sleeve Ø 8 / Ø 6	2
11	129 69 6350	Sleeve Ø 6 / Ø 2.7	2
12	129 69 6670	Sleeve Ø 6 / Ø 2	2
13	129 69 7960	Sleeve Ø 6 / Ø 2.9	2
14	129 69 6291	Drill Ø 2.7 mm; 230 mm	2
15	129 69 7971	Drill Ø 2.9 mm; 230 mm	2
16	129 78 9540	MEDIN K-wire 2x230 mm	2
17	129 69 8080	Depth gauge	1
18	129 69 8090	Gauge	1
19	129 69 5800	Screwdriver; hexagonal 2.5 mm	1
20	129 69 6050	Mallet axis	1
21	129 69 6060	Mallet 400 g	1
22	129 69 1670	Awl	1

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