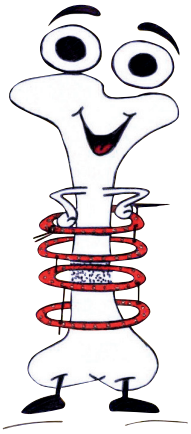
Dial Medicali

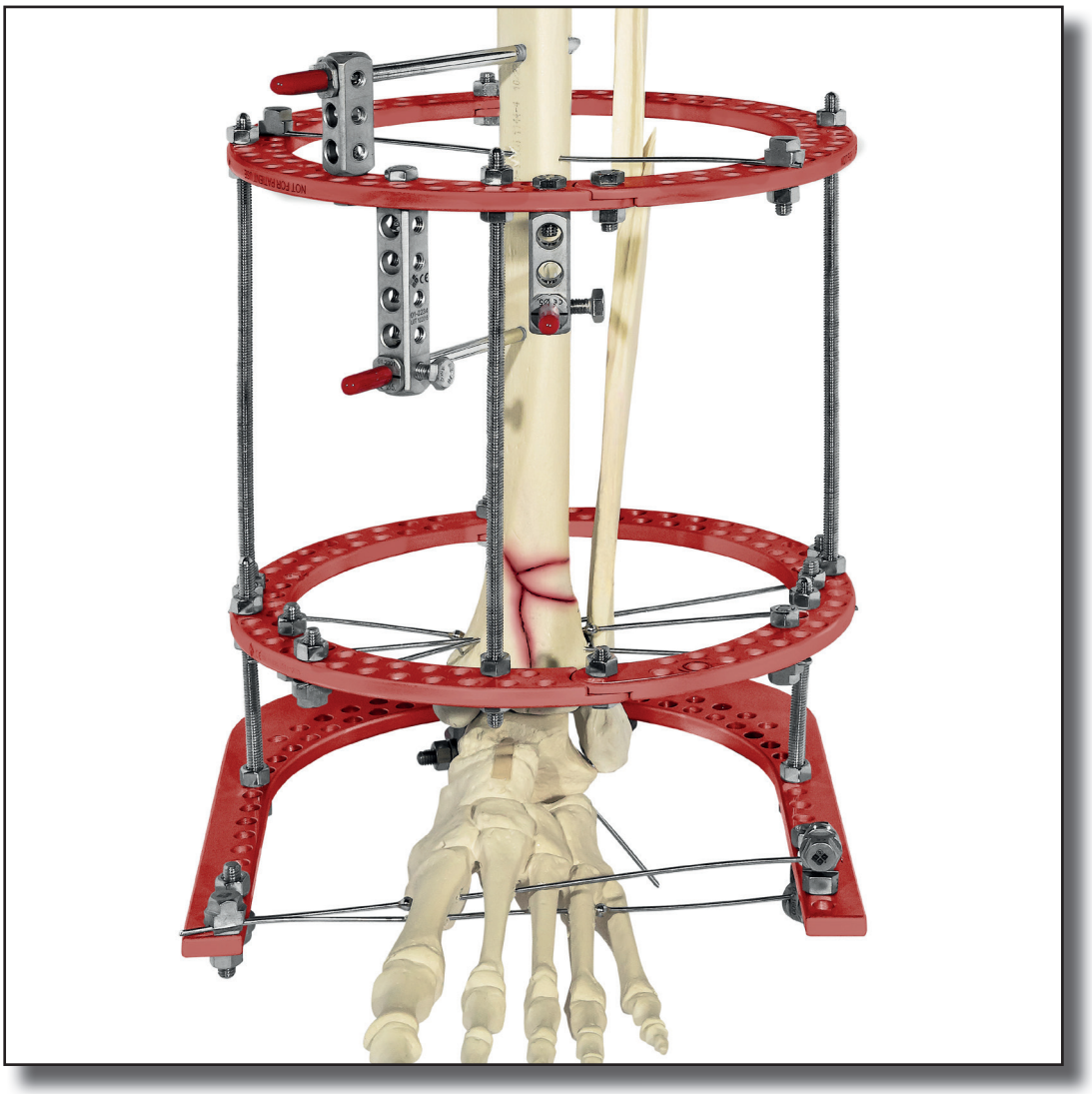
MILANO - ITALY



RRS®2

Ring Rod System “Circular Frame“ 2

INSTRUCTIONS FOR USE



RING ROD SYSTEM - CIRCULAR FRAME 2

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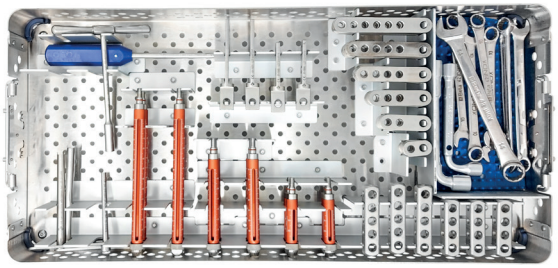
RRS®²

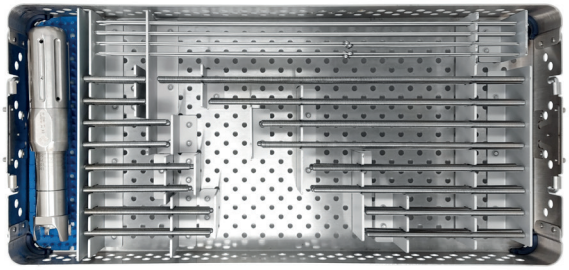
Ring Rod System "Circular Frame" 2

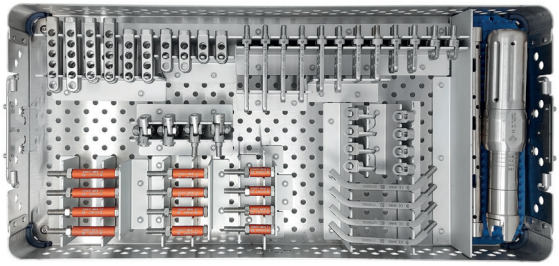
INTRODUCTION

RRS is a circular external fixator composed of different elements, which can be connected in order to guarantee a mechanical support for the bone, which they are anchored to, through transbony wires and/or half-pins. RRS is particularly indicated for treatment of bone fracture as well as for deformity corrections, lengthening and pseudarthrosis. Moreover, the system is suitable for performing arthrodesis and bone transport.

RRS is designed to be a very simple and versatile external fixator. The system offers functional and pre-assembled components, which allow a faster frame assembly. Moreover, it allows customizable frame constructs to treat a variety of orthopaedic conditions.







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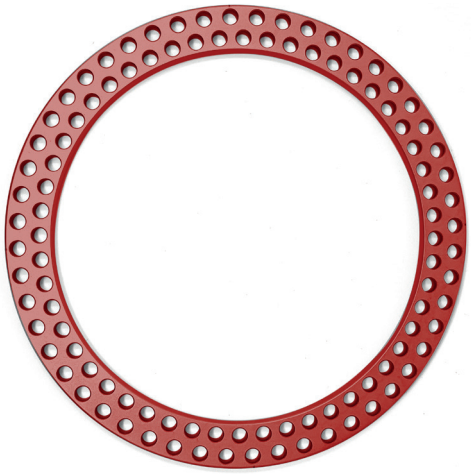
RRS®²

Ring Rod System "Circular Frame" 2

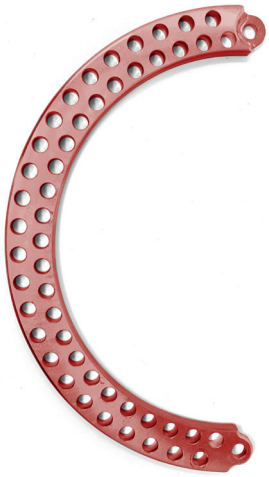
RRS RINGS

RRS rings are realized in anodized aluminium alloy, with high mechanical properties. Rings are available in a variety of different sizes (for both pediatric and adult patients) and shapes (full rings, half rings, 5/8 rings, foot rings), in order to be suitable for treating a wide range of clinical conditions. All rings present a double raw of holes accepting 6mm components. Pediatric rings (from 110 to 150 mm) are 7 mm thick, while wider rings (from 160 to 240mm) present an increased thickness (9 mm) to enhance mechanical resistance.



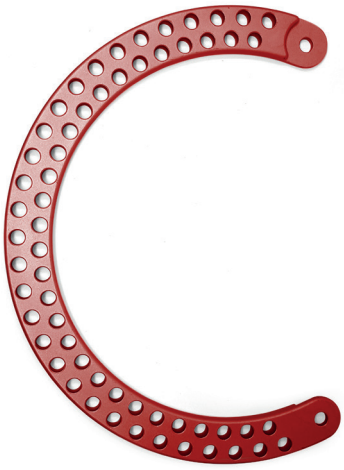
FULL RINGS

Full rings are offered in 10 different sizes with an internal diameter ranging from 110mm to 240mm.



HALF RINGS

Half rings also are available in 10 different sizes with an internal diameter between 110mm and 240mm. They can be used alone or they can be connected in order to form a full ring. Each half ring presents two specific junction holes, whose configuration guarantees a great stability.



5/8 RINGS

5/8 rings are offered in 7 different sizes ranging from 140 to 220mm. These rings have a partial circumference. In this way, they result particularly indicated to accommodate joint motion or wound access, despite the presence of the external fixator.

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Ring Rod System "Circular Frame" 2

RRS RINGS

FOOT RINGS

Foot rings are particular external supports with the shape of a horseshoe. They are available in 11 sizes, with different internal diameters (120, 140, 160, 180 mm) and lengths (80, 120, 160mm).

ARCHES

Arches are commonly indicated for proximal femur. They are offered in two different sizes, Mini and Mini Plus.

RING SIZING

The surgeon has to choose the proper ring size required based on the size of the limb.
From the mechanical point of view, the smallest diameter ring that fits the extremity should be used. However, a ring that fits too closely may cause compression and skin ulceration of the extremity that becomes oedematous. A guideline is that at least 2 cm of space should be maintained between the skin and the ring circumferentially.

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Ring Rod System "Circular Frame" 2

RRS CONNECTION ELEMENTS

A connection element is a component connecting two rings, such as a threaded rod or a linear spacer.
The concept of a "ring block" is important with respect to frame stability. Simply defined, a ring block is the portion of the frame that is attached to a bone segment. It is recommended that each bone segment is stabilized by a ring block consisting of two rings with at least two points of fixation per ring and four connection elements.
Rings are provided with markers on the lateral surface, which indicate ideal positions for connection elements. These markers help the surgeon during the frame assembly.

THREADED RODS

Threaded rods are the main junction elements for connecting two rings. In this way, one ring can be fixed parallel and aligned to another one at a certain distance. Rods have a 6mm outer diameter and are offered in 10 different lengths, ranging from 60 to 400mm. A threaded rod can be secured to a ring using two M6 nuts.

OBLIQUE SUPPORTS

Oblique supports are particularly indicated for the proximal femur. They can be used to connect an arch or a partial ring to another ring, forming a parallel but not aligned block. Each oblique support presents a male end and a female end. They can be used coupled, mounted one above the other, in order to reach a more proximal site.

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Ring Rod System "Circular Frame" 2

CONNECTION ELEMENTS

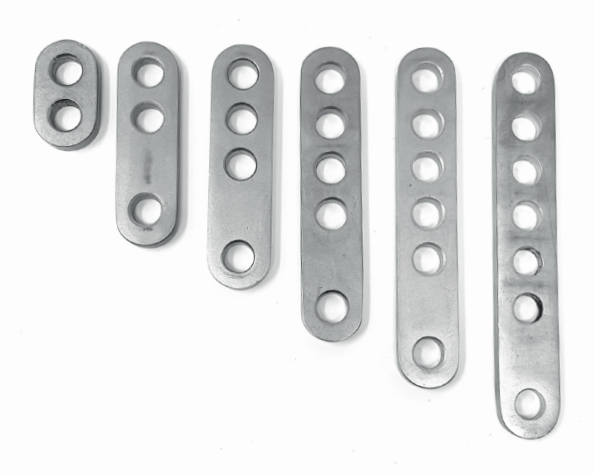
LINEAR SPACERS

Spacers are used to connect two rings, in order to form a stable, parallel and aligned block with a short distance between rings. They are available in 3 different lengths (20, 30, 40mm). Spacers have a male end, which has to be secured to the ring using a M6 nut.

PLATES

Plates can be used to connect two rings forming a parallel but not aligned block. They are offered in 6 different sizes, with the number of holes ranging from 2 to 7 holes.

Each plate has to be fixed to one ring through a bolt and a M6 nut, and to the other ring using a threaded rod, secured to another hole of the plate through two nuts.



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Ring Rod System "Circular Frame" 2

RRS ELEMENTS

BOLTS: are available in 5 different lengths:
10, 14, 16, 20 and 30 mm.

NUTS: RRS set offers 4 different kinds of nuts:

Standard M6 nuts

Tall nuts, which result useful in case of reduced space

M6 safe nuts, which are provided with an internal o-ring

Square nuts, which present four numbered faces

WASHERS: RRS set offers different kinds of washers:

Standard washers, which are available in 2 different thicknesses (2 and 4mm)

Conical washers (couple), which are placed on the threaded rods for achieving an aligned, non-parallel ring block. Each couple is composed of a concave and a convex washer. Each threaded rod requires two couples of conical washers, one for each side of the ring.

Slotted washers, which present a slot, allowing converting a standard bolt to a slotted wire fixation bolt. This washer can be used to fix a K-wire on a ring, when the universal K-wire bolt is not appropriate.

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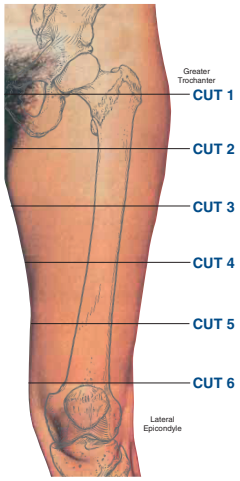
Ring Rod System "Circular Frame" 2

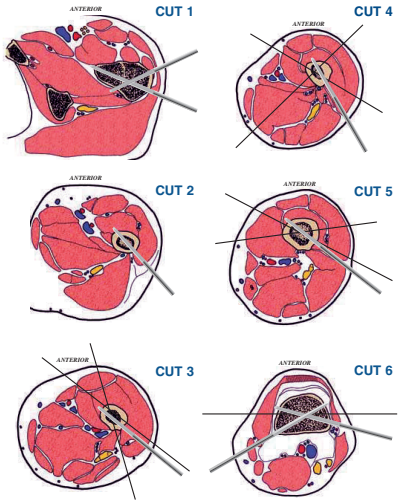
K-WIRES AND HALF-PINS

K-wires, olive K-wires and half-pins are the primary methods of connection between the external fixation frame and the bone. The goal is to achieve a stable fixation of the bone.
The ring should be perpendicular to the long axis of the bone segment and the bone should be centred within the ring.
We define “safe corridors” the areas through which pins and wires can be safely inserted without injuring major neurovascular structures. It is a prerequisite for surgeons using external fixation systems to be familiar with safe corridors. The following atlases of cross sectional anatomy provide guidance in locating safe corridors.

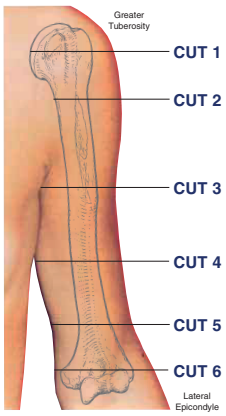
FEMUR left



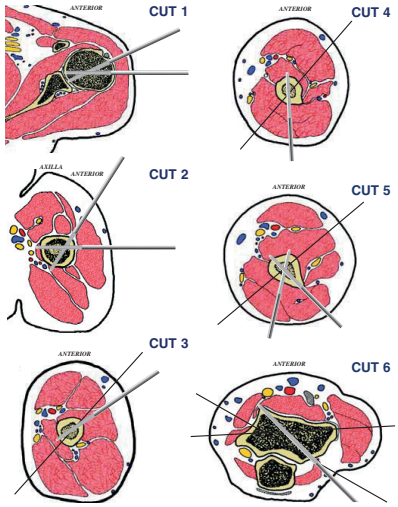
INSERTION WIRES AND HALF-PINS - LEFT



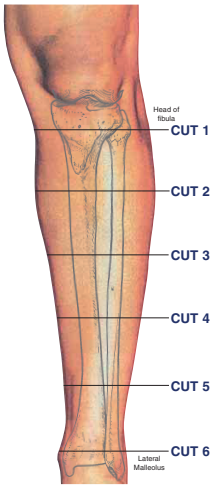
HUMERUS left



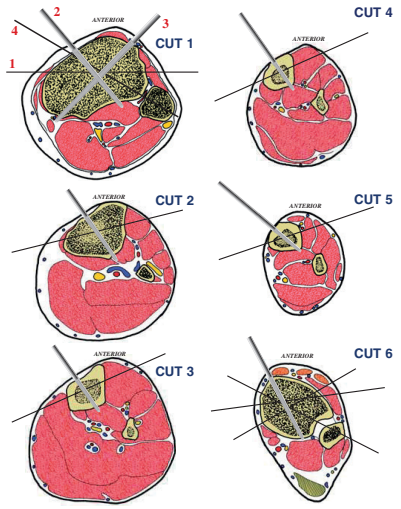
INSERTION WIRES AND HALF-PINS - LEFT



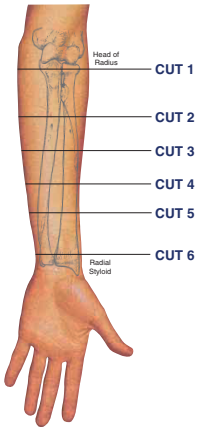
TIBIA and FIBULA left



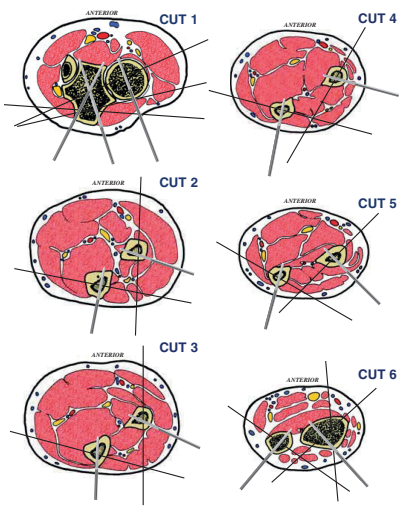
INSERTION WIRES AND HALF-PINS - LEFT



RADIUS AND ULNA left



INSERTION WIRES AND HALF-PINS - LEFT



Images taken from Catagni M. Atlas for the Insertion of Transosseous Wires and Half-Pins. Ilizarov Method. In: Bianchi-Maiocchi A, ed. Milan, Italy: Medi Surgical Video; 2003.
Thanks to prof. Catagni for his kind concession

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Ring Rod System "Circular Frame" 2

K-WIRES

K-wires are offered in 1.8mm diameter and have a bayonet-shaped tip, which efficiently drills through bone minimizing heat generation. They are available in either smooth or olive configurations. Olive wires can be used to buttress the bone provided that they are inserted from opposite directions. The opposing olive beads will prevent bone sliding despite narrow crossing angles. Olive wire can also serve to move a bone segment in a desired direction (compression or fracture reduction).

Regarding K-wires crossing, two perpendicular wires represent the best configuration. The greater the angle of intersection, the higher is the stability of the system. Generally, it is recommended to have a minimum angle of 45°.

K-wire insertion involves the following steps:

1. Place the wire on the surface of the ring and push it through the skin with the desired orientation. Use fluoroscopy to check the proper orientation of the wire with respect to the bone.
2. Drill the wire through the bone using a slow speed. Saline-soaked gauzes can be used to cool and direct the wire during drilling. If the bone is particularly hard, then frequent pauses will prevent necrosis due to heat buildup.
3. When the tip of the wire is through the soft tissue on the opposite side of the extremity, push the wire using a hammer until it reaches the skin edge. Advance the wire beyond the ring to allow fixation and tensioning.

In case of insertion of an olive wire, a small tab incision has to be made to allow the bead to pass through the skin. Olive wires have to be advanced until the bead reaches the bone cortex.
Once the wire is inserted, it has to be secured to the ring using K-wire bolts.

These specific bolts are provided with both a slot and a hole for wire fixation. The bolts have to be secured with nuts.
The bolt at the distal end (sharp) of the K-wire has to be tightened using a couple of 10mm wrenches. The head of the bolt must not be rotated with respect to the axis of the wire, so it is recommended to hold the head of the bolt with the wrench while tightening the nut. Once secured on the ring, the distal tip of the K-wire is cut to avoid injury.

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Ring Rod System "Circular Frame" 2

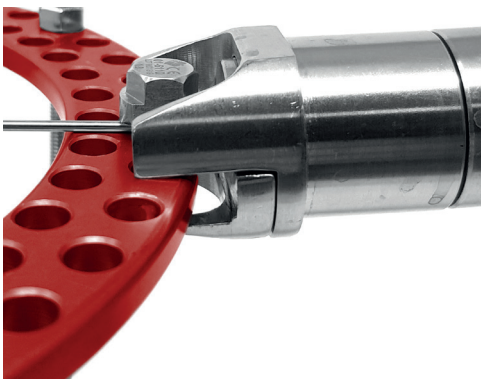
K-WIRES

The wire could not be exactly on the surface of the ring. In this case, the space between the wire and the ring should be filled with washers. If the distance is such that the washers are not enough, a female or male hinge should be used. Hinges are offered with holes number ranging from 1 to 6.

The proximal side of the K-wire has to be provisionally secured with a K-wire bolt and tipically tensioned up to 130 kg or 90 kg, depending on the anatomical site. Wire tensioning greatly enhances the rigidity of the wire and the stability of the frame.

Tensioning is performed through the wire tensioner and involves the following steps:

1. Fully open the tensioner and slide it over the wire. Ensure the tensioner is firmly against the ring.
2. Bend the opposite end of the wire 90° to the plane of the ring, in order to check if tension is correctly applied on that side.
3. Apply tension, tightening the tensioner until the desired value.
4. Tighten the nut on the K-wire bolt.
5. Release the wire tensioner.



K-wire ends are usually curled on to the side of the ring with the end buried into one of the adjacent ring holes.

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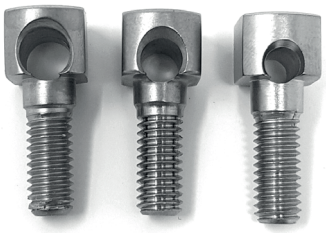
Ring Rod System "Circular Frame" 2

HALF-PINS

Half-pins insertion follows the same principles of aligning the ring on the limb perpendicular to its longitudinal axis, as for K-wires.
Half-pins have a greater stiffness with respect to K-wires and have the advantage of avoiding soft tissues on the contralateral ring side, where compartments with more soft tissue may be subjected to irritation if traversed by K-wires.
By the way, the use of half-pins instead of wires may depend on surgeon preference, anatomical constraints and mechanical principles.
Half-pins fixation may involve different components, depending on the distance the pin is inserted away from the plane of the ring. These hardware components include:

- Half-pin bolts, whose size is specific for the half-pin diameter. These bolts are available in 3 different sizes: 4, 5 and 6mm.



- Cubes, which are "universal", i.e. suitable for half-pins with 4, 5, 6mm diameter. Cubes have to be provided with a specific sleeve depending on half-pin diameter.

  Cubes are available with holes number ranging from 1 to 5. One and two holes cubes are offered with both male and female configuration.

Non self-drilling half-pins require pre-perforation. Self-drilling ones can require pre-perforation too, if the cortical bone is particularly resistant and/or thicker than 3-4mm. It is suggested to use a drill bit whose diameter is at least 1.5mm lower than the one of the half-pin. We always recommend pre-perforation.

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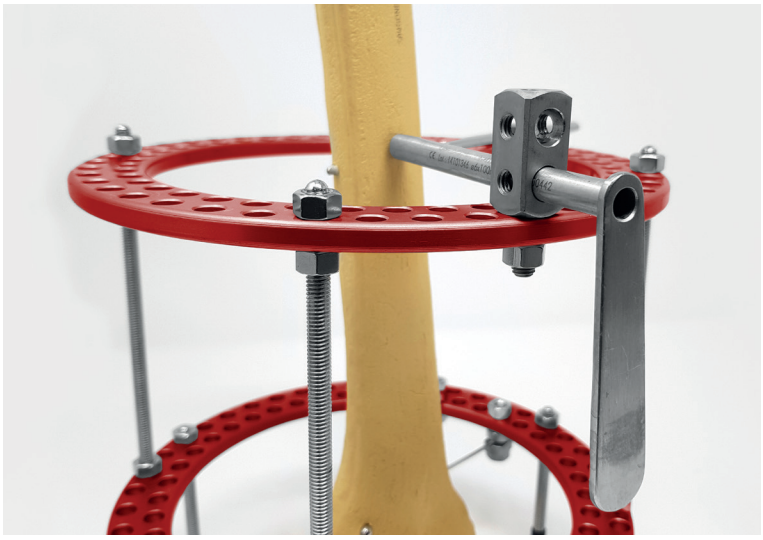
HALF-PINS INSERTION STEPS:

1. Choose the desired component for pin fixation (i.e. bolt or cube) and insert it into an appropriate hole.

2. If a cube is used, pass the half-pin guide through the hole of the cube along the direction of insertion. If a pin bolt is used, avoid this step



3. Make a small longitudinal stab incision in the skin at the desired level. Use a scissor or haemostat to spread the incision and prepare a track through the soft tissues to the bone.

4. Insert the trocar in the half-pin guide and set it directly on the bone surface

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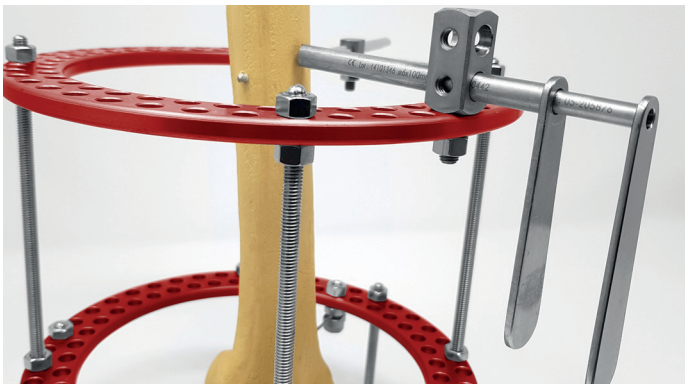
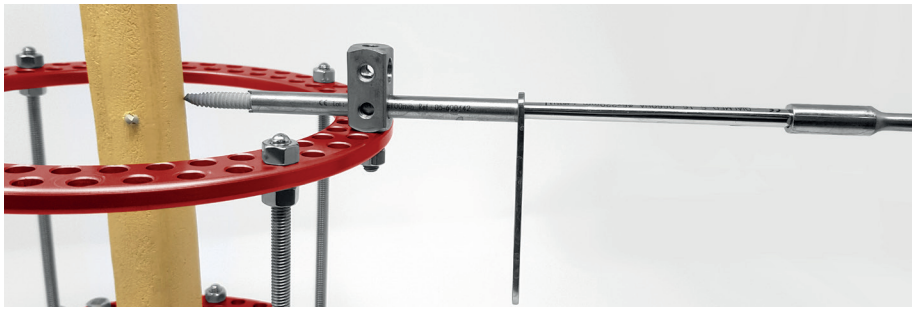
HALF-PINS INSERTION STEPS:

5. Remove trocar and pass the drill-guide and the drill bit through the screw-guide.

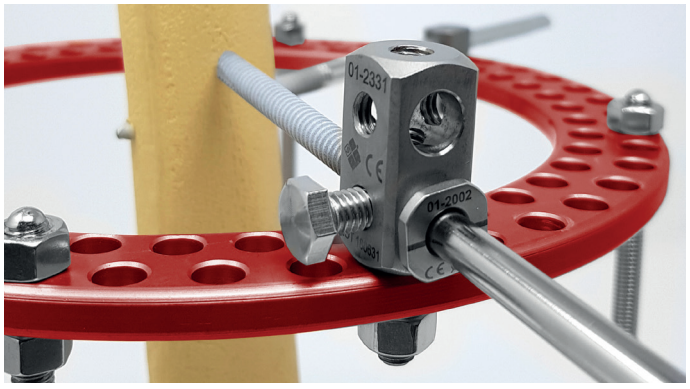


6. Once the hole is drilled, remove the drill bit and the guide. Insert the desired half-pin manually using the T-handle until in engages the second cortex. The half-pin has to be bicortical with at least 1-2 threads crossing the second cortex.



7. Remove the half-pin guide.

8. Firmly secure the bolt or cube to the ring. In case of use of a cube, insert the appropriate sleeve and stabilize the pin with a 10mm bolt.



9. Cut the half-pin using the pin cutter.

In case of insertion of a self-drilling half-pin without pre-perforation, the method comprises the direct insertion of the half-pin through a cube or a bolt under power. It is recommended to use the motor with reamer configuration.

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LIMB LENGTHENING WITH RRS

As already mentioned above, one of the indication of RRS system is limb lengthening. This may be due to one of many disorders such as congenital limb length discrepancy, bone loss due to fracture, infection, and tumour.
The usual frame for limb lengthening consists of two rings connected by four linear distractors. An additional ring can be required to enhance stability.
Once the frame has been assembled and fixed to the bone, the bone is cut at the level desired by the surgeon.

LINEAR DISTRACTOR

RRS linear distractors are 4 steps telescopic rods, which consist of an aluminium tube which serves as a platform for a threaded rod. The threaded rod is able to turn freely in the tube.
The aluminium tube is marked with a graduated scale, which represents the maximal extension of the distractor.

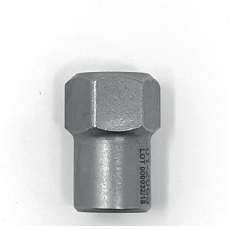
The distractor is provided with a ferrule marked with numbers ranging from 1 to 4. To perform distraction, the ferrule has to be turned in the direction of increasing numbers. To provide compression, it has to be turned in the direction of decreasing numbers. Each complete turn (360° turn, from 1 to 1) corresponds to 1mm. Linear distractors are offered in 4 different sizes: 60, 100, 150 and 200mm.

In case of limb lengthening, the threaded rods should be inserted in the distractors until they reach the bottom. During treatment, once the threaded rod reaches the top of the graduated scale and it's not visible in the aluminium tube anymore, it should be replaced with a longer one, if the lengthening is not finished yet.

On the contrary, in case of compression, the threaded rods should be partially inserted in the distractors. Once the threaded rod reaches the bottom of the distractor, it should be replaced with a shorter one

SQUARE NUTS

If the distance between the two rings is not enough for linear distractors, square nuts should be used on the threaded rods to achieve either distraction or compression.



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ANGULAR CORRECTION WITH RRS

Correction of angular deformities through a circular external fixator requires advanced skill and experience in the application of the frame. Pre-operative planning is essential: the surgeon has to analyse x-rays of the patient in order to calculate the angular deformity and determine how to assemble the frame. RRS hinges and motor have to be used in these cases.
It is important to determine the apex of the angular deformity, in order to choose the proper hinge location.

COMPLETE HINGE

The complete hinge allows to connect two rings at any angle. It has a threaded hole to accept a threaded rod, which needs to be secured with a M6 nut. The complete hinge can be female or male.

ASSEMBLED HINGE

The assembled hinge is a double hinge, which has a threaded hole as the complete one to accept a threaded rod. This hinge works as a cardanic hinge providing 360° of motion, which allows connecting two supports at virtually any angle. This hinge can be female or male too.

MOTOR

The motor is an angular distractor, which consists of a compression/distraction wheel with a threaded hole at the top and a bracket for connecting it to the ring.
The hole accepts a threaded rod, which rotates when the wheel is turned. The bracket of the motor interfaces with the end of the rod.
The angular distractor has to be coupled with a specific hinge, which has to be connected to the top of the threaded rod.
The angular correction is carried out as a result of the gradual distraction by the motor.

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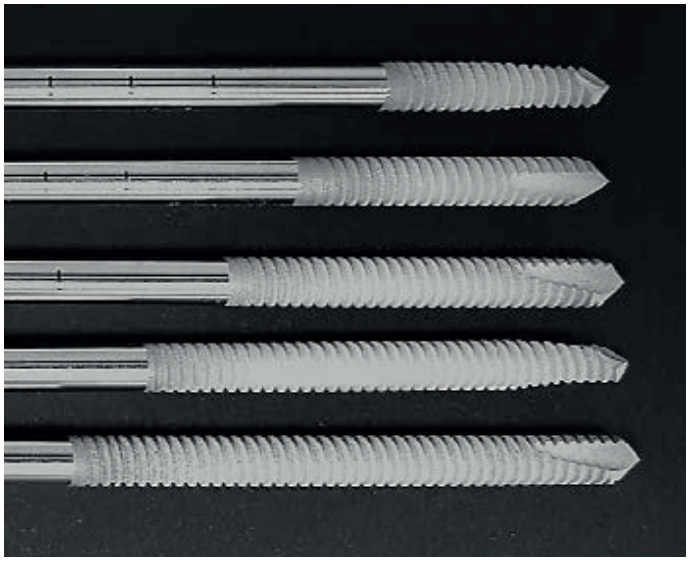
PinFix®

Quality half-pin for external fixation

HALF-PINS

THREAD-BONE CONTACT SURFACE

crew diameter area	thread lenght	Total
5mm	30mm	821.10 mm²
5mm	40mm	1094.80 mm²
5mm	50mm	1368.50 mm²
5mm	60mm	1642.20 mm²
5mm	70mm	1915.90 mm²
6mm	30mm	1005.60 mm²
6mm	40mm	1340.80 mm²
6mm	50mm	1676.00 mm²
6mm	60mm	2011.20 mm²
6mm	70mm	2346.40 mm²



SELF-DRILLING AND SELF-TAPPING HALF-PINS

Cylindrical - Diameter 6 mm
Coated - Stainless steel
Drill diameter 4.5 mm

16-0630HA	PinFix HA 220/30
16-0640HA	PinFix HA 220/40
16-0650HA	PinFix HA 220/50
16-0660HA	PinFix HA 220/60
16-0670HA	PinFix HA 220/70

SELF-DRILLING AND SELF-TAPPING HALF-PINS

Cylindrical - Diameter 6 mm
Not coated - Stainless steel
Drill diameter 4.5 mm

16-0630	PinFix 220/30
16-0640	PinFix 220/40
16-0650	PinFix 220/50
16-0660	PinFix 220/60
16-0670	PinFix 220/70

SELF-DRILLING AND SELF-TAPPING HALF-PINS

Cylindrical - Diameter 5 mm
Coated - Stainless steel
Drill diameter 3.2 mm

16-0530HA	PinFix HA 220/30
16-0540HA	PinFix HA 220/40
16-0550HA	PinFix HA 220/50
16-0560HA	PinFix HA 220/60

SELF-DRILLING AND SELF-TAPPING HALF-PINS

Cylindrical - Diameter 5 mm
Not coated - Stainless steel
Drill diameter 3.2 mm

16-0530	PinFix 220/30
16-0540	PinFix 220/40
16-0550	PinFix 220/50
16-0560	PinFix 220/60

SELF-TAPPING HALF-PINS

Cylindrical - Diameter 4 mm
Coated - Stainless steel
Drill diameter 2.7 mm

16-0425HA	PinFix HA 160/25
16-0435HA	PinFix HA 160/35

SELF-TAPPING HALF-PINS

Cylindrical - Diameter 4 mm
Not coated - Stainless steel
Drill diameter 2.7 mm

16-0425	PinFix 160/25
16-0435	PinFix 160/35
16-1925	PinFix 200/25
16-1935	PinFix 200/35

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PinFix®

Quality half-pin for external fixation

HALF-PINS

SELF-TAPPING HALF PIN

Cylindrical - Diameter 3.5 mm
Coated - Stainless steel
Drill diameter 2.7 mm

16-3925HA	PinFix 160/25
16-3935HA	PinFix 160/35

SELF-TAPPING HALF PIN

Cylindrical - Diameter 3.5 mm
Not coated - Stainless steel
Drill diameter 2.7 mm

16-3925	PinFix 160/25
16-3935	PinFix 160/35

TOOLS

05-200800	5/6 mm cutter
05-600237	T-Handle for 5 mm PinFix
05-600220	T-Handle for 6 mm PinFix
05-600235	T-Handle for wrist fixator
05-600435	5 mm Pin guide
05-205888	8x100 mm Pin guide - for 6mm pins
05-600442	8x120 mm Pin guide - for 6mm pins
05-216483	8x150 mm Pin guide - for 6mm pins
05-204497	2.7 mm drill guide
05-205852	3.2x80 mm drill guide
05-216506	3.2x130 mm drill guide
05-205876	4.5x80 mm drill guide
05-216490	4.5x130 mm drill guide
05-204435	guide for wrist pins

05-085188	2.7 mm drill
05-085331	3.2x200 mm drill
05-085355	4.5x200 mm drill
05-216469	3.2x300 mm drill AO Attachment
05-216476	4.5x300 mm drill AO Attachment

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DIA00101 RRS² TRAY 1

CODE	DESCRIPTION	QUANTITY
06-2000	Spacer 20mm	4
06-3000	Spacer 30mm	4
06-4000	Spacer 40mm	4
06-0002	Male hinge 2 holes	4
06-0003	Male hinge 3 holes	4
06-0004	Male hinge 4 holes	4
06-0005	Male hinge 5 holes	4
06-0006	Male hinge 6 holes	4
06-1002	Female hinge 2 holes	4
06-1003	Female hinge 3 holes	4
06-1004	Female hinge 4 holes	4
06-1005	Female hinge 5 holes	4
06-1006	Female hinge 6 holes	4
06-0001	Male hinge 1 hole	4
06-0010	Male hinge 1 tall hole	4
06-1010	Female hinge 1 tall hole	4
06-0007	Complete hinge male	5
06-1107	Complete hinge female	5
06-6060	Oblique support	4
06-0090	Hinge 90°	4
06-1001	Female hinge 1 hole	4
05-200871	Wire tensioner	1
05-085355	Drill bit 4.5 x 200 mm	1
05-085331	Drill bit 3.2 x 200 mm	1
05-205876	Drill guide 4.5 x 80 mm	1
05-205852	Drill guide 3.2 x 80 mm	1
05-600435	Sleeve guide for 5mm pins	1
05-205888	Sleeve guide for 6mm pins	1

DIA00102 RRS² TRAY 2

CODE	DESCRIPTION	QUANTITY
06-0300	Rod 60mm	8
06-0301	Rod 80mm	8
06-0302	Rod 100mm	8
06-0303	Rod 120mm	8
06-0304	Rod 150mm	8
06-0305	Rod 200mm	8
06-0306	Rod 250mm	8
06-0307	Rod 300mm	4
06-0308	Rod 350mm	4
16-9218/NS	K-wire	20
16-92P18/NS	K-Wire with olive	10
05-200871	Wire tensioner standard	1

DIA00103 RRS² TRAY 3

CODE	DESCRIPTION	QUANTITY
06-2002	Plate 2 holes	4
06-2102	Plate 2+1 holes	4
06-2103	Plate 3+1 holes	4
06-2104	Plate 4+1 holes	4
06-2105	Plate 5+1 holes	4
06-2106	Plate 6+1 holes	4
06-4002	Twisted plate 2 holes	2
06-4003	Twisted plate 3 holes	2
06-5604	Cube 4 holes	3
06-5605	Cube 5 holes	3
06-8008	Motor	1
06-04060	4 steps telescopic bar 60mm	4
06-04100	4 steps telescopic bar 100mm	4
06-04150	4 steps telescopic bar 150mm	4
05-200918	10 mm wrench	6
05-200901	Socket wrench 10 mm	2
05-600220	T-wrench for 6 mm pins	2
05-600237	T-wrench for 5 mm pins	2

DIA00104 RRS² TRAY 4

CODE	DESCRIPTION	QUANTITY
06-5000	Adapter for 5mm pins	10
06-6000	Adapter for 6mm pins	10
06-9000	Tall nut	10
06-7004	4 steps lenghtening nut	8
06-7006	M6 safe nut	5
06-0011	Conical washer (couple)	20
06-5601	Cube 1 hole	4
06-5602	Cube 2 holes	4
06-5603	Cube 3 holes	4
06-5701	Cube male 1 hole	4
06-5702	Cube male 2 holes	4
06-0033	Slotted washer	5
06-0022	2mm washer	20
06-0044	4mm washer	20
06-0310	M6 nut	200
06-0311	Bolt for 4mm pin	6
06-0312	Bolt for 5mm pin	6
06-0313	Bolt for 6mm pin	8
06-0314	Bolt 10mm	15
06-0315	Bolt 20mm	10
06-0316	Bolt 30mm	4
06-0317	Bolt 16mm	25
06-0019T	Universal Bolt for K wire	30
06-0319	Bolt 14mm	10
06-1008	Hinge for motor	1
02-81020	Bolt for hybrid frame	2

RINGS

06-0100	100 mm
06-0110	110 mm
06-0120	120 mm
06-0130	130 mm
06-0140	140 mm
06-0150	150 mm
06-0160	160 mm
06-0180	180 mm
06-0200	200 mm
06-0220	220 mm
06-0240	240 mm

RINGS 3/8

06-3130	130 mm
06-3140	140 mm
06-3150	150 mm
06-3160	160 mm
06-3180	180 mm

HALF-RINGS

06-2100	100 mm
06-2110	110 mm
06-2120	120 mm
06-2130	130 mm
06-2140	140 mm
06-2150	150 mm
06-2160	160 mm
06-2180	180 mm
06-2200	200 mm
06-2220	220 mm
06-2240	240 mm

5/8 RINGS

06-5130	130 mm
06-5140	140 mm
06-5150	150 mm
06-5160	160 mm
06-5180	180 mm
06-5200	200 mm
06-5220	220 mm

PROXIMAL ARCH

06-0101	Mini
06-0102	Mini plus

FOOT RING

06-16140	140x160 mm
06-16160	160x160 mm
06-16180	180x160 mm
06-80120	120x80 mm
06-80140	140x80 mm
06-80160	160x80 mm
06-80180	180x80 mm
06-12120	120x120 mm
06-12140	140x120 mm
06-12160	160x120 mm
06-12180	180x120 mm

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