SURGICAL TECHNIQUE GUIDE:

PROXIMAL ROTATIONAL METATARSAL OSTEOTOMY "PROMO"

Exclusively foot & ankle

Paragon 28®

PROMO®

PROXIMAL **RO**TATIONAL **M**ETATARSAL **O**STEOTOMY

Acknowledgment:

Paragon 28® would like to thank Pablo Wagner, MD and Emilio Wagner, MD for their contribution to the development of the surgical technique guide.

DESIGN RATIONALE

The PROMO concept originated with work performed by Pablo Wagner, MD and Emilio Wagner, MD. Further reading on their work in this field has been published in the following journal articles:

- Wagner et al. Proximal Oblique Sliding Closing Wedge Osteotomy for Hallux Valgus. *Foot Ankle Int (2013); 34(11): 1493-1500.*
- Wagner et al. Rotational Osteotomy for Hallux Valgus. A New Technique for Primary and Revision Cases. *Tech Foot & Ankle (2017); 16: 3-10.*
- Wagner et al. Is the Rotational Deformity Important in Our Decision Making Process for Correction of Hallux Valgus Deformity? *Foot Ankle Clin. (2018); 23: 205-217.*
- Wagner et al. Using the Center of Rotation of Angulation Concept in Hallux Valgus Correction. *Foot Ankle Clin. (2018); 23: 247-256.*

The premise of the procedure is based on the understanding that many hallux valgus deformities consist of a combined transverse plane and frontal plane deformity. The goal of hallux valgus correction is to relocate the metatarsal to its original location. To perform this correction, an accurate deformity measurement has to be performed pre-operatively.

Clinically and radiographically, the transverse plane deformity manifests as medial migration of the 1st metatarsal away from the 2nd metatarsal and lateral migration of the hallux. Transverse plane deformity is measured by the intermetatarsal angle ("IM ∡") of metatarsals 1 and 2 on an AP radiograph (Fig. 1). The frontal plane rotation angle ("Rotation ∡") can also be measured on an AP radiograph. Wagner et al. defined frontal plane rotation ranges based on the shape of the lateral edge of the 1st metatarsal head.[1] These categories are defined in the table below (Table 1).

If the frontal plane rotation angle cannot be determined prior to the surgery, an average rotation angle of 20-29° should be selected.

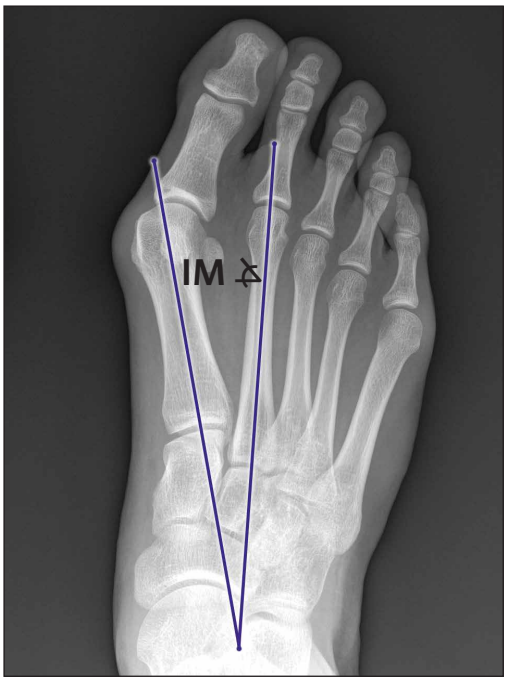
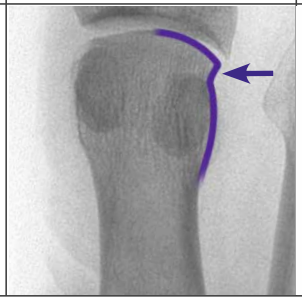
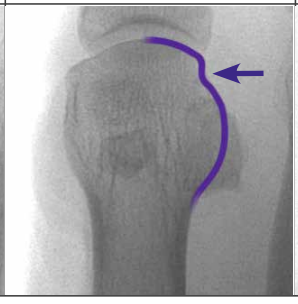
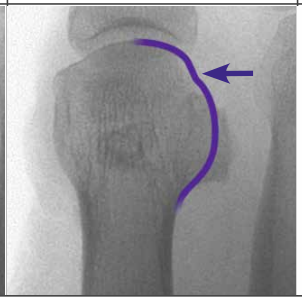
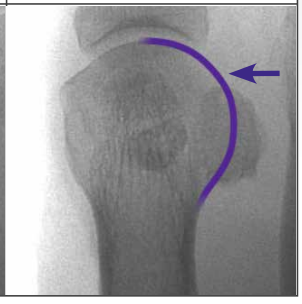


Figure 1

Table 1: Determining Rotation Based on 1st Metatarsal Head Shape

Rotation Range	0°	10°-19°	20°-29°	30°-39°
Lateral Head Shape	Sharp	Irregular	Rounded	Circular
Lateral Condyle Visibility	Not Visible	Notable	Observable	Apparent
Lateral Articular Surface Continuity	None	Step-Off	Notched	Smooth
Image Examples (Right 1st Metatarsal)				

The mathematics for calculating the osteotomy cut angle have their roots in trigonometry with adjustments made to increase the correction power. They have been simplified into the following table:

IM Angle (°)	Rotation Angle (°) 10-19	20-29	30-39
8-10	38	28	23
11-12	47	33	28
13-14	55	38	33
15-17	55	42	38
18-20	55	47	42

Osteotomy Cut Angle

The osteotomy cut angle can be delineated from this table by inputting the IM ∡ and rotation ∡. For example, a patient with a 12° IM∡ and a 30°-39° rotation∡ would have a 28° osteotomy cut angle.

Paragon 28 has developed instrumentation that facilitates precise and repeatable proximal rotational metatarsal osteotomies of the first metatarsal. A detailed surgical technique using this system is provided in the following pages. Likewise, solutions for fixation of this osteotomy were developed to provide a streamlined method of implant insertion that helps guard against plantar gapping, osteotomy shifting and de-rotation. By using the Paragon 28 patent-pending Precision® Guide PROMO system, a crossing screw can be placed centrally across the osteotomy while a Baby Gorilla® plate buttresses the metatarsal medially. This plate is intended for use with 2.5 mm locking screws.

INSTRUMENTATION

Positioning Jig – Left and Right

Cutting Jig

Rotation Jig

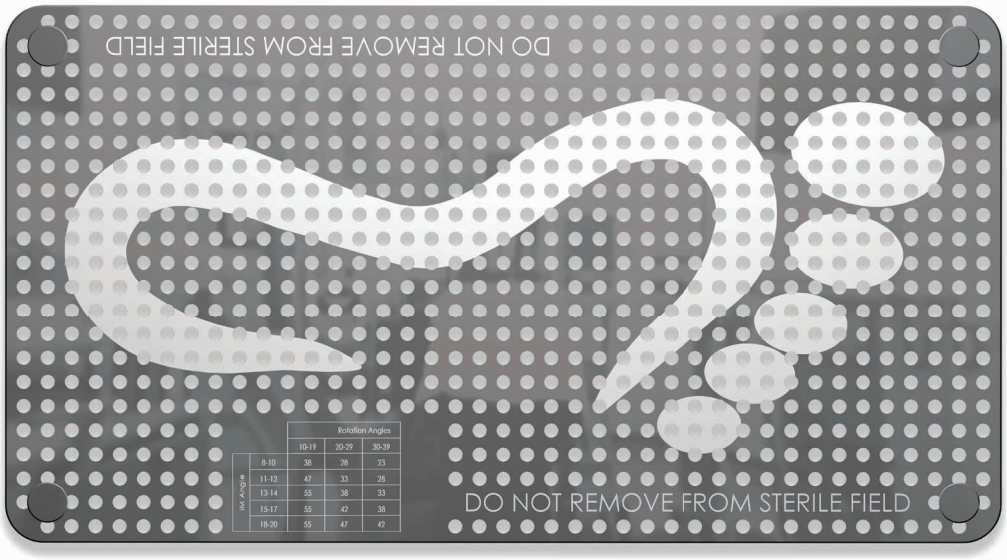
1.0 mm Wire Sleeve

1.2 mm Wire Sleeve

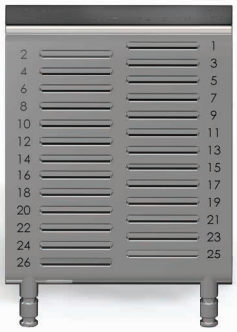
Precision® Guide PROMO

Set Screw

INSTRUMENTATION



Foot Plate



Foot Plate K-wire Guide

K-wire Guide Retainer

IMPLANTS

PROMO Implants- Left and Right Side Specific

Straight 23-28-33-38* PROMO Plate

Straight 42-47-55* PROMO Plate

Angled 23-28-33-38* PROMO Plate

Angled 42-47-55* PROMO Plate

* Plate numbers correspond to osteotomy cut angles

Baby Gorilla Plate Screws

2.5 mm Locking Baby Gorilla Plate Screws

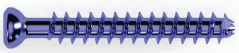
2.5 mm Non-locking Baby Gorilla Plate Screws

2.0 mm Locking Baby Gorilla Plate Screws

2.0 mm Non-locking Baby Gorilla Plate Screws

A Mini-Monster® cannulated screw caddy is available in 3.0 mm or 3.5 mm for cross-screw fixation of the osteotomy.

3.0 mm Mini-Monster® Cannulated Screw



3.5 mm Mini-Monster® Cannulated Screw

Akin Ancillary Fixation:

2.0 mm Mini-Monster® Cannulated Screw

2.5 mm Mini-Monster® Cannulated Screw

8 mm JAWS™ Staple

10 mm JAWS™ Staple

Baby Gorilla® 2 Hole Akin Plate

Baby Gorilla® 2 Hole Akin Plate with Compression

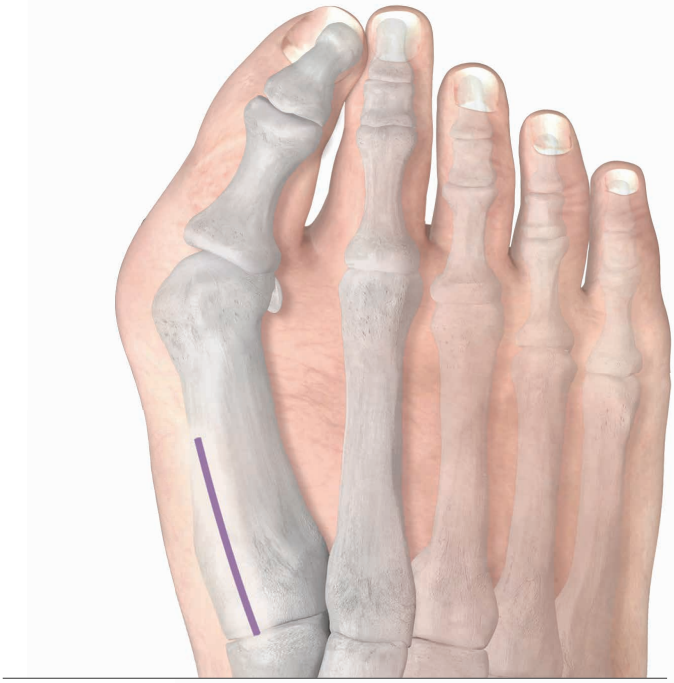
Baby Gorilla® Anatomic Medial Akin Plate

PRE-OPERATIVE PLANNING

Measurement of IM ∡ and rotation ∡ are performed pre-operatively and should be recorded or known prior to beginning the procedure. The surgical technique presented here is for a hallux valgus deformity that pre-operatively measured 30°-39° of metatarsal rotation and an IM angle of 12°, resulting in an osteotomy cut angle of 28°.

IM Angle	Rotation Angle 10-19	20-29	30-39
8-10	38	28	23
11-12	47	33	28
13-14	55	38	33
15-17	55	42	38
18-20	55	47	42

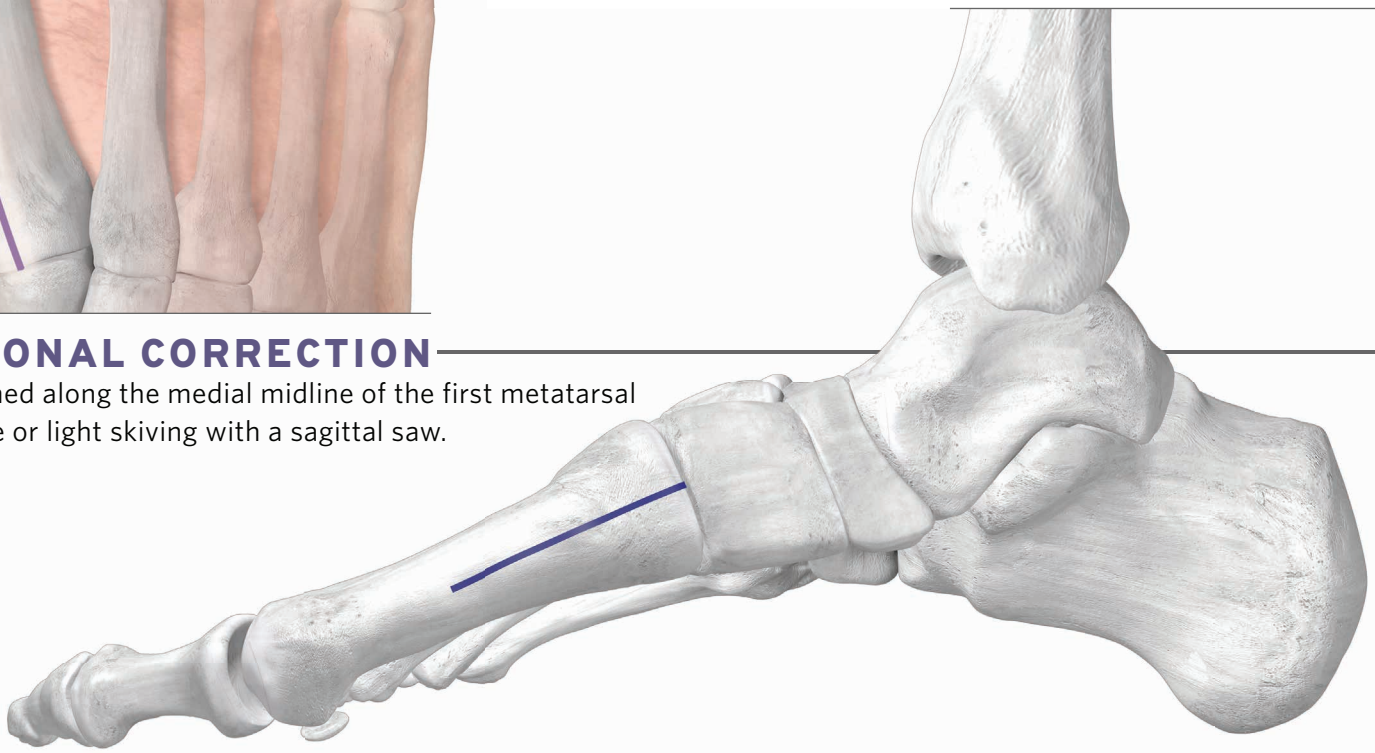
INCISION/EXPOSURE

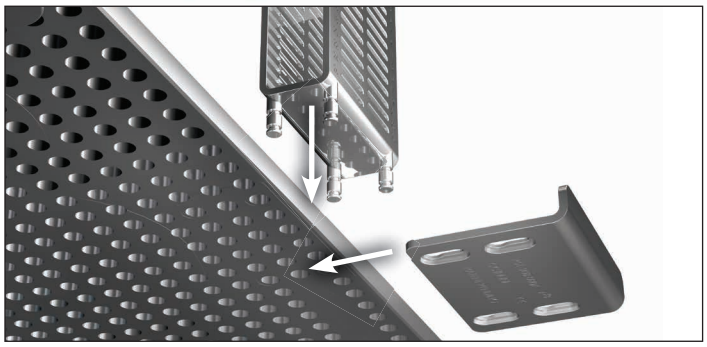


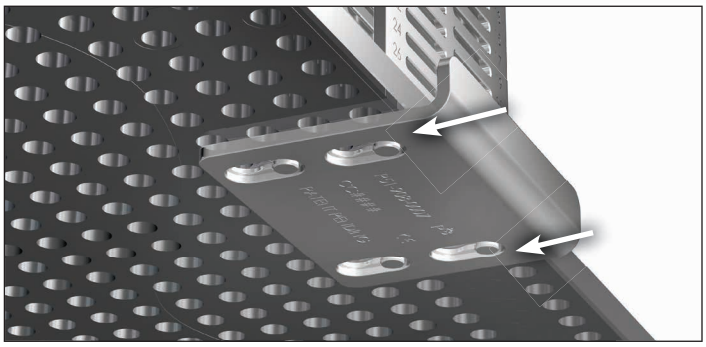
The procedure may be combined with a lateral release for hallux valgus correction, if desired. A medial or dorsomedial incision is made over the proximal 1st metatarsal, per surgeon preference. Dissection is carried down to the base of the first metatarsal.

ROTATIONAL CORRECTION

A line is etched along the medial midline of the first metatarsal using a bovie or light skiving with a sagittal saw.

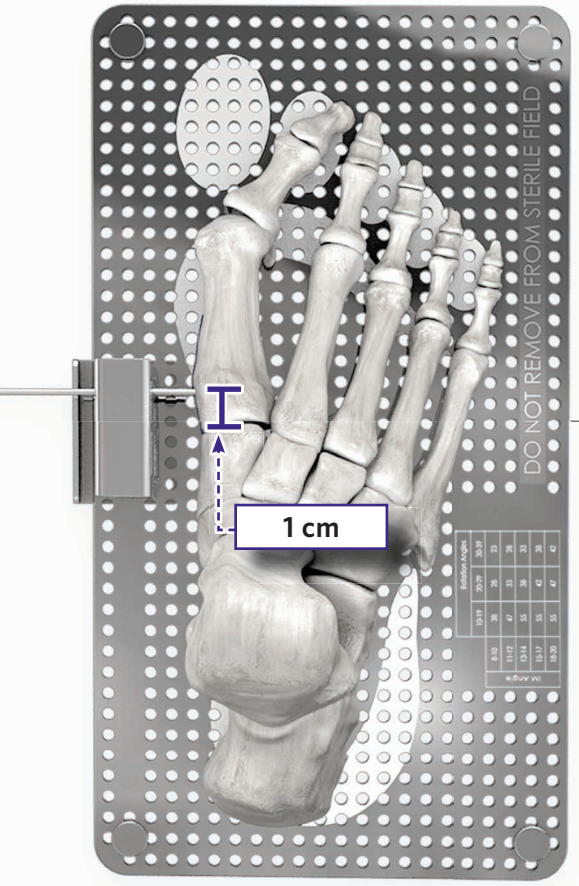






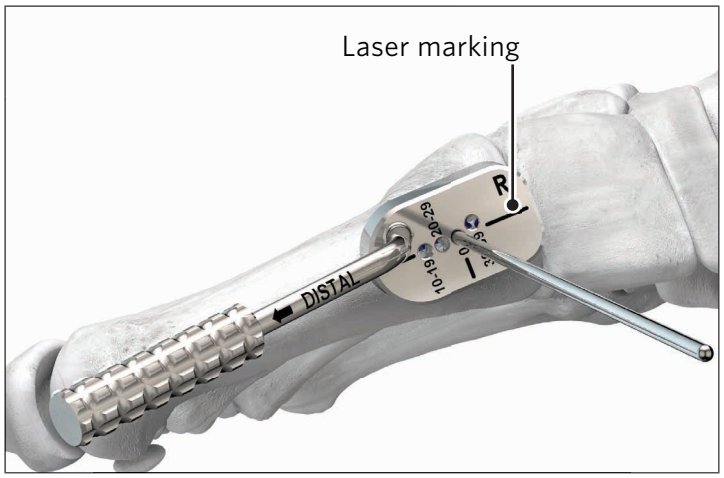
Insert the legs of the foot plate K-wire guide into the edge of the foot plate. Slide the K-wire guide retainer over the legs of the K-wire guide and slide to lock.

ROTATIONAL CORRECTION

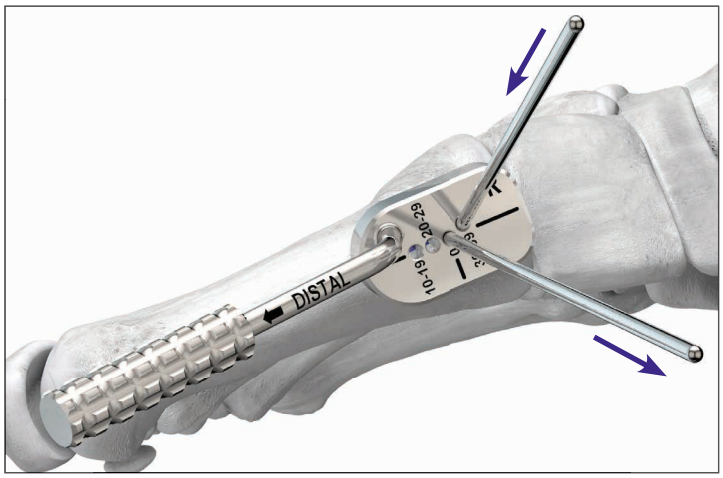


Locate 1 cm from the 1st metatarsal and mark the location with a pen or bovie. Place the foot on the foot plate under fluoroscopy.

Place a 1.6 mm K-wire through the foot plate K-wire guide such that the start point of the K-wire is at the mark corresponding to 1 cm from the 1st tarsometatarsal joint and along the medial midline of the 1st metatarsal. The K-wire guide will set the K-wire parallel to the weight-bearing surface. Under fluoroscopy, ensure that the K-wire is perpendicular to the long axis of the 1st metatarsal. Insert the K-wire and confirm position using fluoroscopy. Remove the foot plate and foot plate K-wire guide.



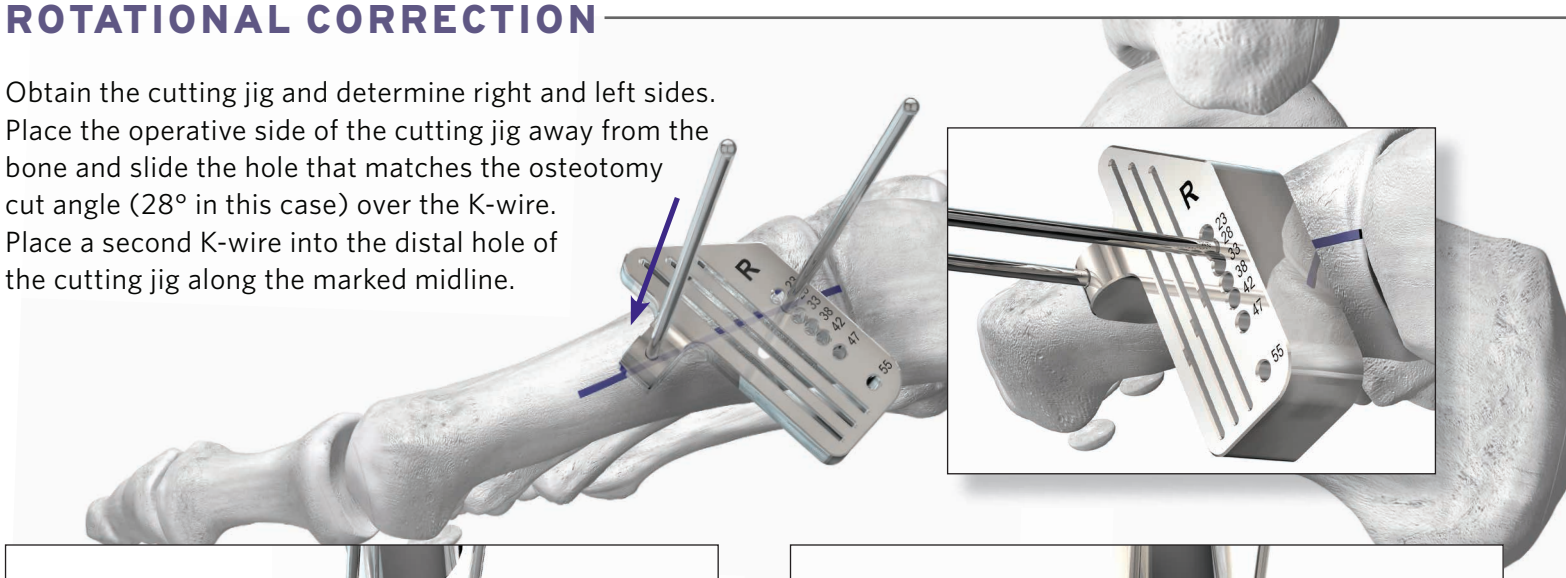
Slide the positioning jig over the K-wire at the "0" hole. This will now be referred to as the "0" K-wire. The laser marking should align with the line etched along the medial midline drawn on the 1st metatarsal.

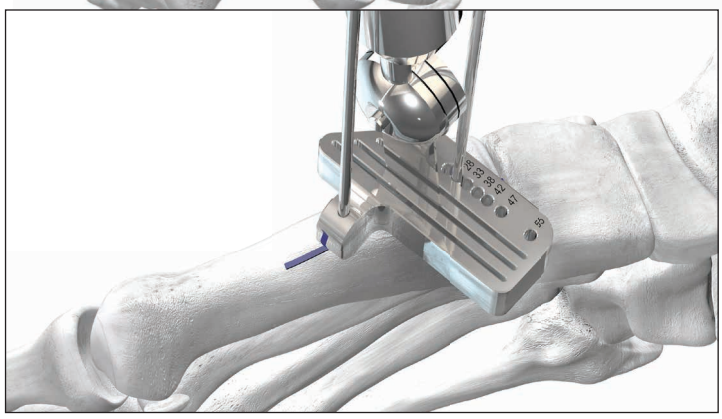


Obtain a second 1.6 mm K-wire. Place the 1.6 mm K-wire into the hole that corresponds to the rotation ∡ hole (in this instance, the 30-39 degree hole). Remove the "0" K-wire.

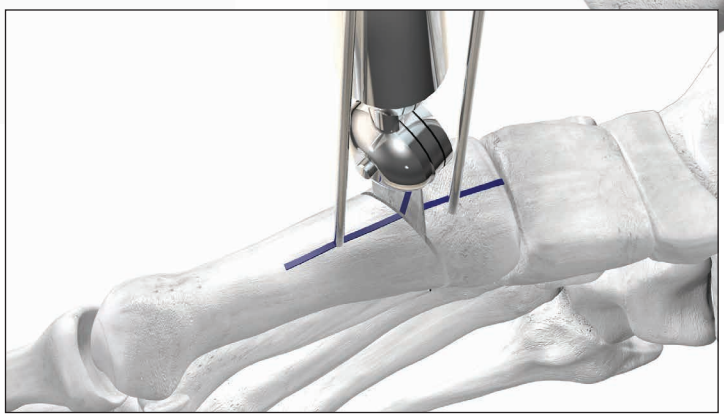
ROTATIONAL CORRECTION

Obtain the cutting jig and determine right and left sides. Place the operative side of the cutting jig away from the bone and slide the hole that matches the osteotomy cut angle (28° in this case) over the K-wire. Place a second K-wire into the distal hole of the cutting jig along the marked midline.





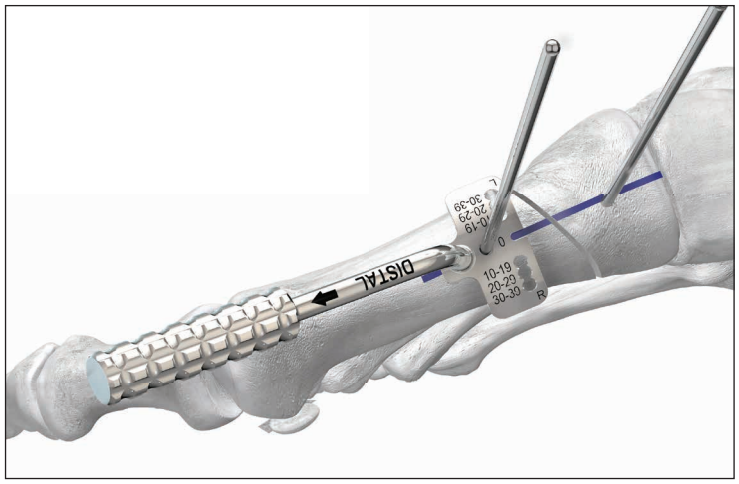
Perform an osteotomy through the cutting jig using a saw. In most instances, the proximal slot will be the most appropriate location for the osteotomy. Either of the three slots can be used depending on surgeon preference and ideal placement of the osteotomy.



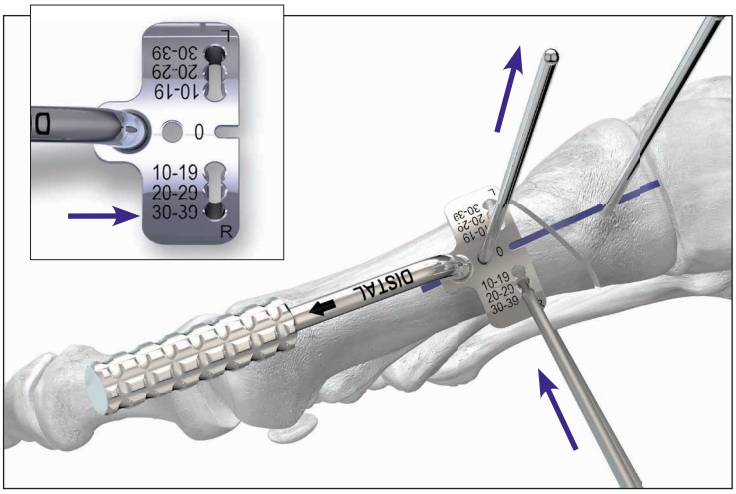
Remove the cutting jig. Complete the osteotomy making a free hand cut with the saw following the large, flat plane of the osteotomy as a guide for the cut plane, if necessary.

NOTE: A saw blade may not extend across the entire osteotomy.

DE-ROTATION OF OSTEOTOMY AND TEMPORARY FIXATION

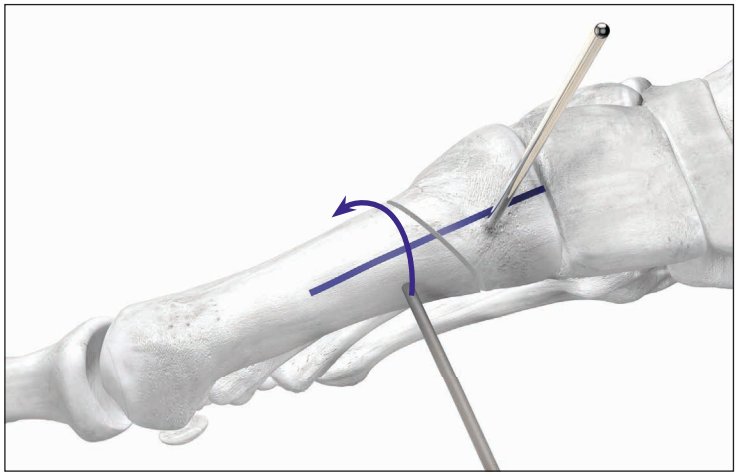


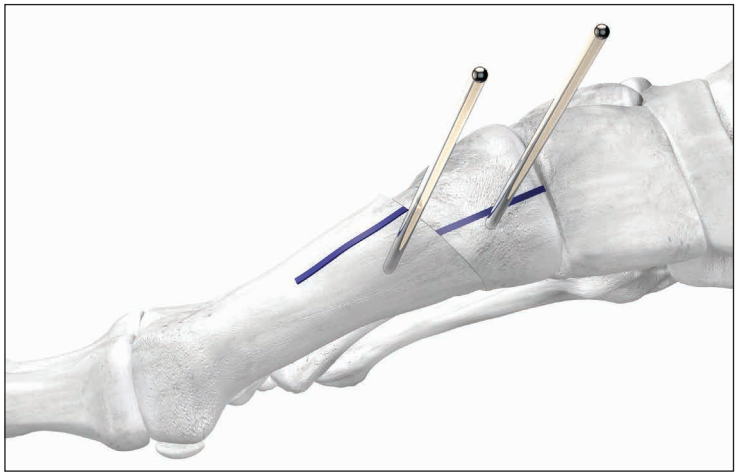
Insert the rotation guide on the distal K-wire of the metatarsal at the "0" measurement.



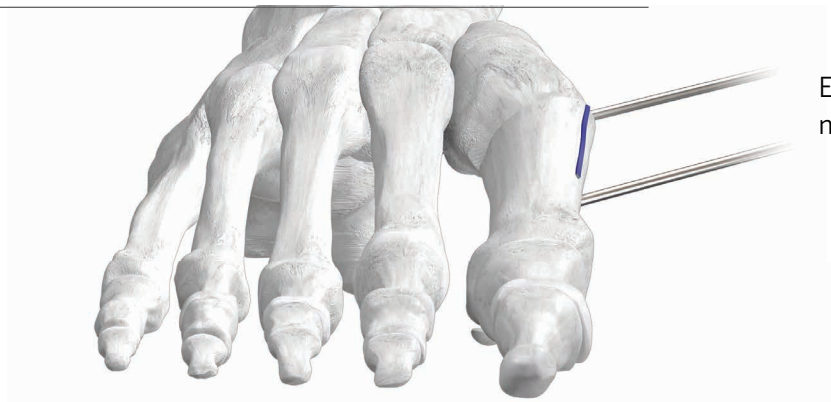
Place a second K-wire in the hole that corresponds to the rotation ∡ (30-39° in this case) that is below the centerline. Remove the K-wire at the "0" measurement.

DE-ROTATION OF OSTEOTOMY AND TEMPORARY FIXATION



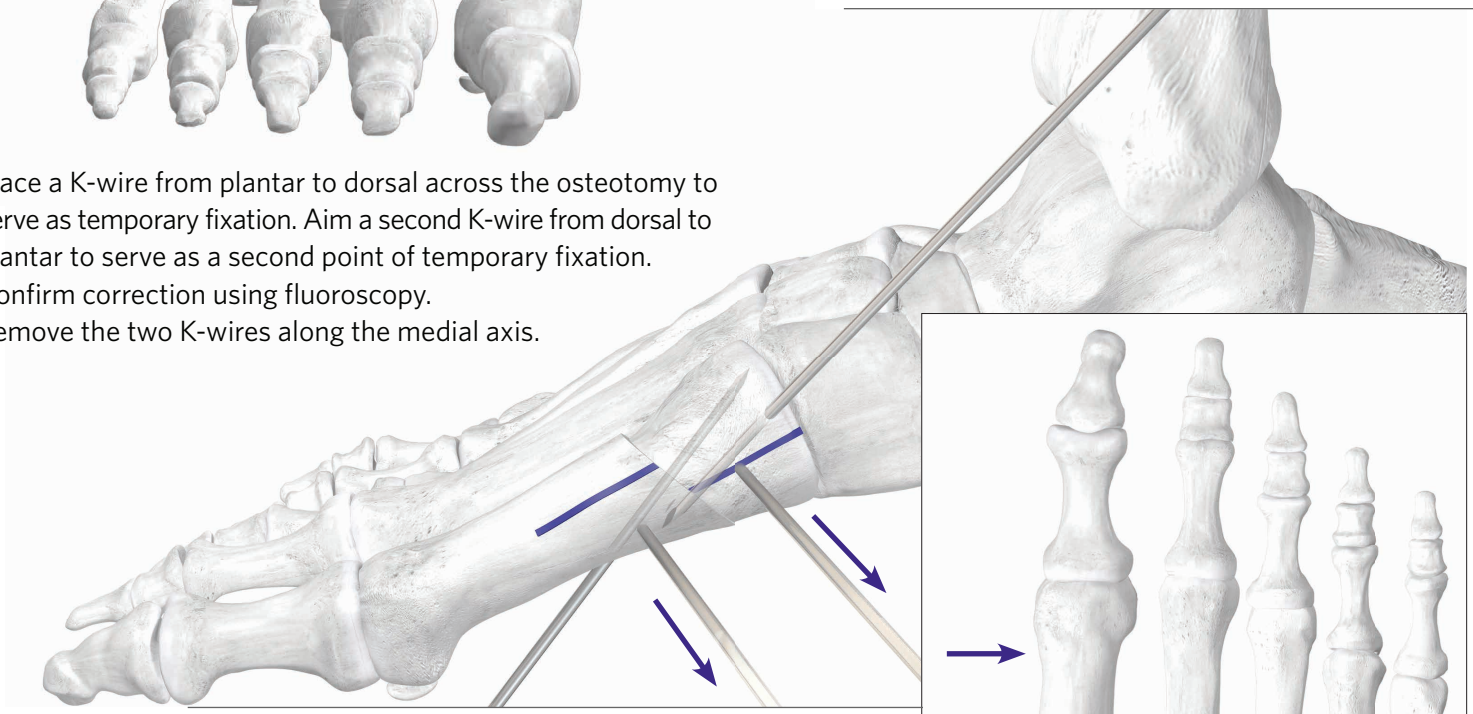


Use a lobster claw clamp or pointed reduction forceps to grasp the distal metatarsal. Rotate the distal 1st metatarsal out of varus until the distal K-wire is parallel with the proximal K-wire along the medial aspect of the 1st metatarsal.



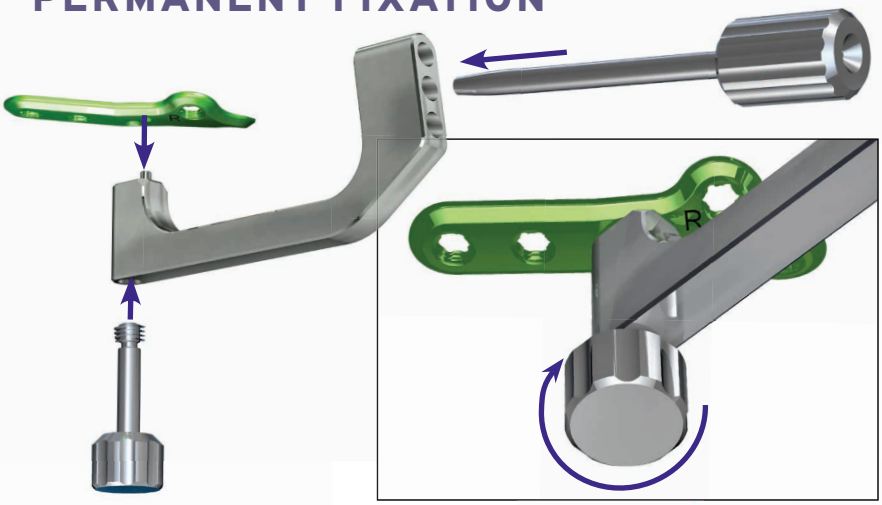
Ensure that the medial cortex is flush without step-off medially. A dorsal step-off may occur.

Place a K-wire from plantar to dorsal across the osteotomy to serve as temporary fixation. Aim a second K-wire from dorsal to plantar to serve as a second point of temporary fixation.
Confirm correction using fluoroscopy.
Remove the two K-wires along the medial axis.

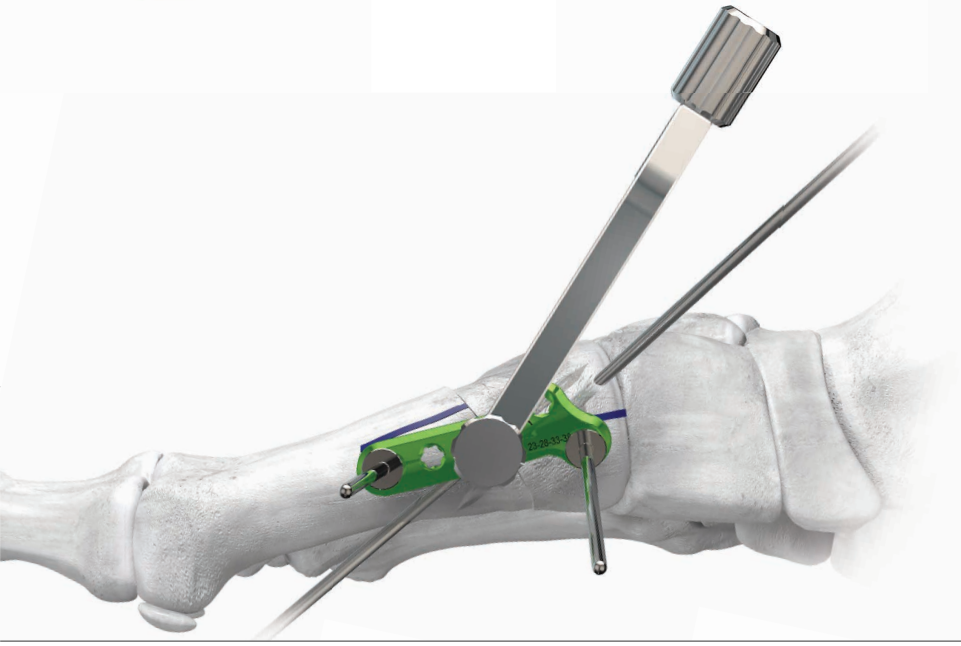


TIP: If under correction is observed, check to ensure that accidental de-rotation did not occur. If it did not and additional correction is desired, displace the metatarsal segment laterally to decrease the intermetatarsal angle. Do not increase rotation beyond the pre-operative planned angle as the metatarsal can become over-plantarflexed.

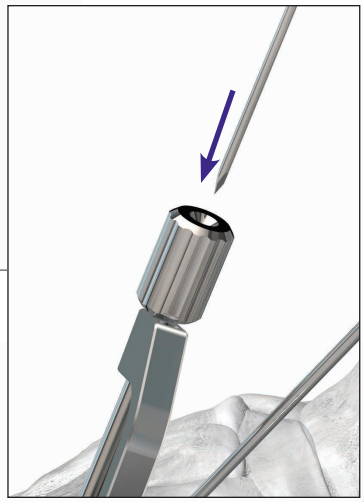
PERMANENT FIXATION



Retrieve the Baby Gorilla PROMO plate that corresponds with the osteotomy cut angle (in this situation, the Angled 23-28-33-38 PROMO Plate). Attach the Precision Guide to the plate by threading the set screw into the central threaded hole of the plate while the alignment peg is inserted into the alignment hole to ensure proper orientation of the Precision Guide. Rotate the set screw clockwise to secure the Precision Guide to the plate. Insert the 1.0 mm or 1.2 mm K-wire guide depending on desired cross-screw diameter (3.0 mm or 3.5 mm, respectively).

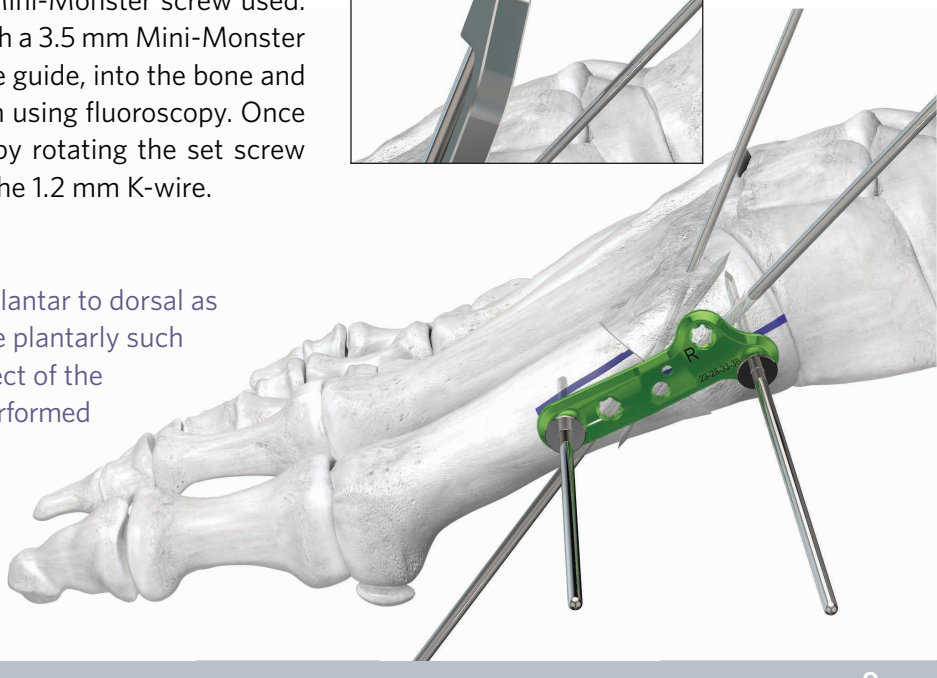


Position the Baby Gorilla PROMO Plate/Precision Guide medially on the 1st metatarsal, centering the plate along the long axis of the 1st metatarsal with the plate holes approximately equidistant from the osteotomy. Secure the plate to the bone using two olive wires. Check plateplacement using fluoroscopy.



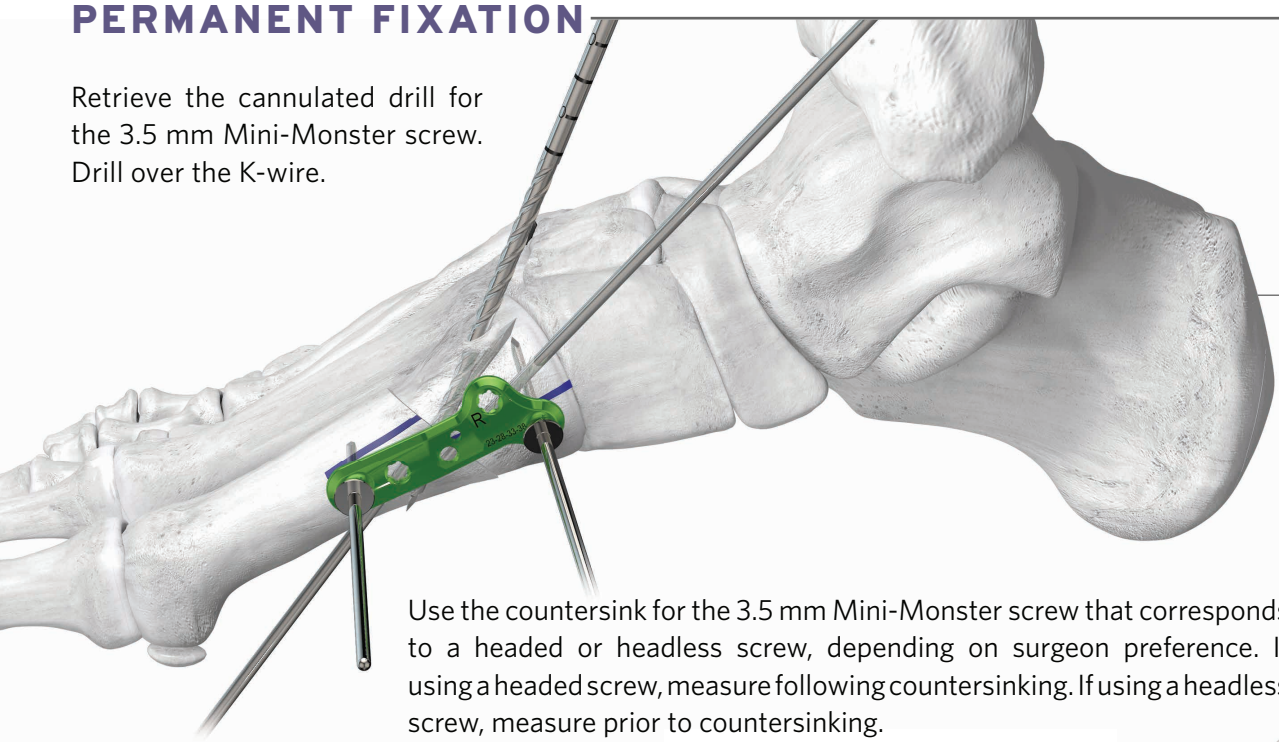
Retrieve a K-wire corresponding to the diameter of Mini-Monster screw used. In this instance, a 1.2 mm K-wire is selected for use with a 3.5 mm Mini-Monster cannulated screw. Drive the K-wire through the K-wire guide, into the bone and across the osteotomy. Check wire position and length using fluoroscopy. Once correct, remove the Precision Guide from the plate by rotating the set screw counterclockwise and sliding the Precision Guide off the 1.2 mm K-wire.

TIP: If it is desired to place the crossing screw from plantar to dorsal as opposed to dorsal to plantar (shown), drive the K-wire plantarly such that only the tip of the wire remains at the dorsal aspect of the first metatarsal. The subsequent steps would then be performed through the plantar aspect of the 1st metatarsal.

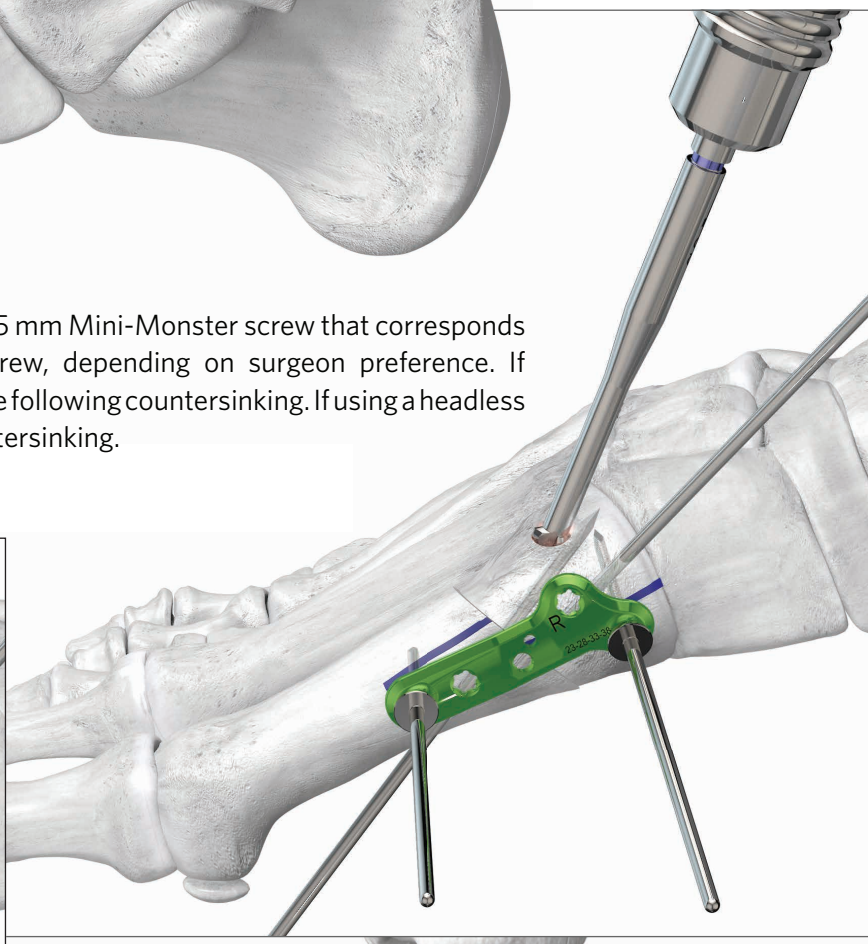


PERMANENT FIXATION

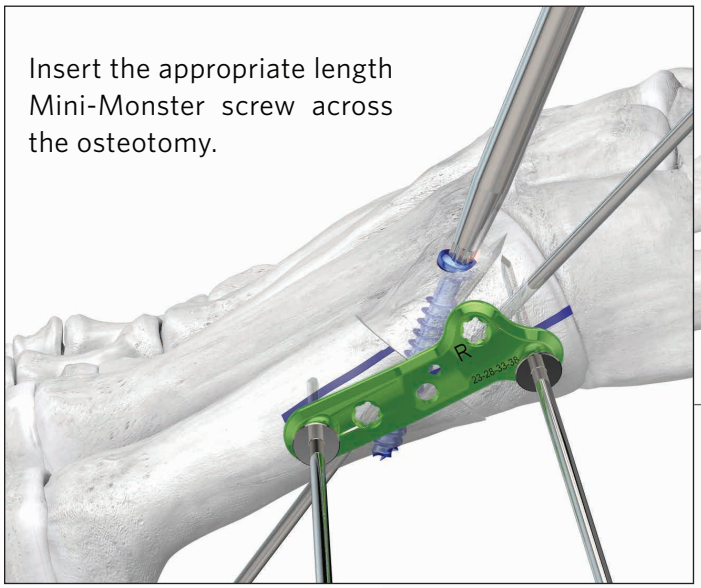
Retrieve the cannulated drill for the 3.5 mm Mini-Monster screw. Drill over the K-wire.

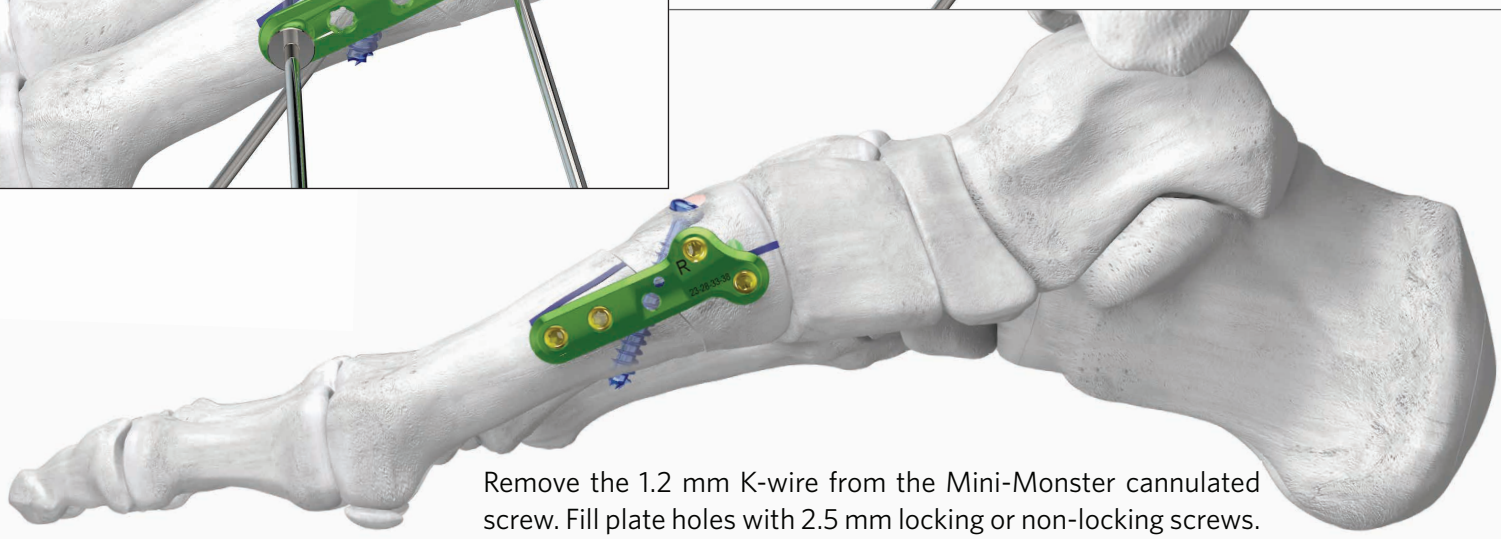


Use the countersink for the 3.5 mm Mini-Monster screw that corresponds to a headed or headless screw, depending on surgeon preference. If using a headed screw, measure following countersinking. If using a headless screw, measure prior to countersinking.



Insert the appropriate length Mini-Monster screw across the osteotomy.





Remove the 1.2 mm K-wire from the Mini-Monster cannulated screw. Fill plate holes with 2.5 mm locking or non-locking screws. Confirm screw position and length using fluoroscopy.

CLOSURE

Proceed to incision closure or concomitant procedures at this time.

Refer to www.paragon28.com/ifus for the complete and most current instructions for use document.

INDICATIONS FOR USE (GORILLA®)

The Baby Gorilla®/Gorilla® Bone Plates and Bone Screws of the Baby Gorilla®/Gorilla® Plating System are indicated for use in stabilization and fixation of fractures or osteotomies; intra and extra articular fractures, joint depression, and multi-fragmentary fractures; revision procedures, joint fusion and reconstruction of small bones of the toes, feet and ankles including the distal tibia, talus, and calcaneus, as well as the fingers, hands, and wrists. The system can be used in both adult and pediatric patients. Specific examples include:

Forefoot:
- Arthrodesis of the first metatarsalcuneiform joint (Lapidus Fusion)
- Metatarsal or phalangeal fractures and osteotomies
- Lesser metatarsal shortening osteotomies (e.g. Weil)
- Fifth metatarsal fractures (e.g. Jones Fracture)

Mid/Hindfoot:
- LisFranc Arthrodesis and/or Stabilization
- 1st (Lapidus), 2nd, 3rd, 4th, and 5th Tarsometatarsal (TMT) Fusions
- Intercuneiform Fusions
- Navicular-Cuneiform (NC) Fusion
- Talo-Navicular (TN) Fusion
- Calcaneo-Cuboid (CC) Fusion
- Subtalar Fusion
- Medial Column Fusion
- Cuneiform Fracture
- Cuboid Fracture
- Navicular Fracture

Ankle:
- Lateral Malleolar Fractures
- Syndesmosis Injuries
- Medial Malleolar Fractures and Osteotomies
- Bi-Malleolar Fractures
- Tri-Malleolar Fractures
- Posterior Malleolar Fractures
- Distal Anterior Tibia Fractures
- Vertical Shear Fractures of the Medial Malleolus
- Pilon Fractures
- Distal Tibia Shaft Fractures
- Distal Fibula Shaft Fractures
- Distal Tibia Periarticular Fractures
- Medial Malleolar Avulsion Fractures
- Lateral Malleolar Avulsion Fractures
- Tibiotalocalcaneal Joint Arthrodesis
- Tibiotalar Joint Arthrodesis
- Tibiocalcaneal Arthrodesis
- Supramalleolar Osteotomy
- Fibular Osteotomy

First metatarsal osteotomies for hallux valgus correction including:
- Opening base wedge osteotomy
- Closing base wedge osteotomy
- Crescentic Osteotomy
- Proximal Osteotomy (Chevron and Rotational Oblique)
- Distal Osteotomy (Chevron/Austin)

Arthrodesis of the first metatarsophalangeal joint (MTP) including:
- Primary MTP Fusion due to hallux ridgidus and/or hallux valgus
- Revision MTP Fusion
- Revision of failed first MTP Arthroplasty implant

Flatfoot:
- Lateral Column Lengthening (Evans Osteotomy)
- Plantar Flexion Opening Wedge Osteotomy of the Medial Cuneiform (Cotton Osteotomy)
- Calcaneal Slide Osteotomy

Charcot:
- Medial column fusion (talus, navicular, cuneiform, metatarsal) for neuropathic osteoarthropathy (Charcot)
- Lateral column fusion (calcaneus, cuboid, metatarsal) for neuropathic osteoarthropathy (Charcot)

In addition, the non-locking, titanium screws and washers are indicated for use in bone reconstruction, osteotomy, arthrodesis, joint fusion, fracture repair and fracture fixation, appropriate for the size of the device.

CONTRAINDICATIONS

Use of the Baby Gorilla®/Gorilla® Plating System is contraindicated in cases of inflammation, cases of active or suspected sepsis/infection and osteomyelitis; or in patients with certain metabolic diseases.

All applications that are not defined by the indications are contraindicated. In addition, surgical success can be adversely affected by:

- Acute or chronic infections, local or systemic
- Vascular, muscular or neurological pathologies that compromise the concerned extremity
- All concomitant pathologies that could affect the function of the implant
- Osteopathies with reduced bone substance that could affect the function of the implant
- Any mental or neuromuscular disorder that could result in an unacceptable risk of failure at the time of fixation or complications in post-operative treatment
- Known or suspected sensitivity to metal
- Corpulence; an overweight or corpulent patient can strain the implant to such a degree that stabilization or implant failure can occur
- Whenever the use of the implant comes into conflict with the anatomical structures of physiological status

Other medical or surgical pre-conditions that could compromise the potentially beneficial procedure, such as:

- The presence of tumors
- Congenital abnormalities
- Immunosuppressive pathologies
- Increased sedimentation rates that cannot be explained by other pathologies
- Increased leukocyte (WBC) count
- Pronounced left shift in the differential leukocyte count

POTENTIAL COMPLICATIONS AND ADVERSE REACTIONS

In any surgical procedure, the potential for complications and adverse reactions exist. The risks and complications with these implants include:

- Loosening, deformation or fracture of the implant
- Acute post-operative wound infections and late infections with possible sepsis
- Migration, subluxation of the implant with resulting reduction in range of movement
- Fractures resulting from unilateral joint loading
- Thrombosis and embolism
- Wound hematoma and delayed wound healing
- Temporary and protracted functional neurological perturbation
- Tissue reactions as the result of allergy or foreign body reaction to dislodged particles
- Corrosion with localized tissue reaction and pain
- Pain, a feeling of malaise or abnormal sensations due to the implant used
- Bone loss due to stress shielding

All possible complications listed here are not typical of Paragon 28®, Inc. products but are in principle observed with any implant. Promptly inform Paragon 28®, Inc. as soon as complications occur in connection with the implants or surgical instruments used. In the event of premature failure of an implant in which a causal relationship with its geometry, surface quality or mechanical stability is suspected, please provide Paragon 28®, Inc. with the explant(s) in a cleaned, disinfected and sterile condition. Paragon 28®, Inc. cannot accept any other returns of used implants. The surgeon is held liable for complications associated with inadequate asepsis, inadequate preparation of the osseous implant bed in the case of implants, incorrect indication or surgical technique or incorrect patient information and consequent incorrect patient behavior.

WARNINGS AND PRECAUTIONS

- Re-operation to remove or replace implants may be required at any time due to medical reasons or device failure. If corrective action is not taken, complications may occur.
- Use of an undersized plate or screw in areas of high functional stresses may lead to implant fracture and failure.
- Plates and screws, wires, or other appliances of dissimilar metals should not be used together in or near the implant site.
- The implants and guide wires are intended for single use only.
- Instruments, guide wires and screws are to be treated as sharps.
- Do not use other manufacturer's instruments or implants in conjunction with the Baby Gorilla®/Gorilla® Plating System.
- If a stainless steel Gorilla® R3LEASE™ Screw is used, it may only be used standalone.
- The device should only be used in pediatric patients where the growth plates have fused or in which active growth plates will not be crossed by the system implants or instrumentation.

MR SAFETY INFORMATION

The Baby Gorilla®/Gorilla® Plating System has not been evaluated for safety and compatibility in the MR environment. It has not been tested for heating, migration, or image artifact in the MR environment. The safety of Baby Gorilla®/Gorilla® Plating System in the MR environment is unknown. Scanning a patient who has this device may result in patient injury.

Refer to www.paragon28.com/ifus for the complete and most current instructions for use document.

INDICATIONS FOR USE (MONSTER®)

The Monster® Screw System is indicated for use in bone reconstruction, osteotomy, arthrodesis, joint fusion, ligament fixation, fracture repair and fracture fixation, appropriate for the size of the device. Specific examples include:

Fractures and Osteotomies
- Fractures of the tarsals, metatarsals and other fractures of the foot (i.e. LisFranc)
- Avulsion fractures and fractures of the 5th metatarsal (i.e. Jones Fracture)
- Talar fractures
- Ankle fractures
- Navicular fractures
- Fractures of the fibula, malleolus, and calcaneus
- Metatarsal and phalangeal osteotomies
- Weil osteotomy
- Calcaneal osteotomy

Hallux Valgus Correction
- Fixation of osteotomies (i.e. Akin, Scarf, Chevron)
- Interphalangeal (IP) arthrodesis
- Proximal, midshaft, or distal osteotomy
- Lapidus arthrodesis

Arthrodesis/Deformity Correction
- 1st MTP arthrodesis
- Metatarsal deformity correction
- Tarsometatarsal joint arthrodesis
- Naviculocuneiform joint arthrodesis
- Talonavicular arthrodesis
- Subtalar joint arthrodesis
- Triple arthrodesis
- Medial column arthrodesis
- Subtalar joint distraction arthrodesis
- Ankle arthrodesis
- Lateralizing calcaneal osteotomy
- Lateral column lengthening
- Hammertoe

Fusion resulting from neuropathic osteoarthopathy (Charcot) such as:
- Medial and lateral column
- Subtalar, talonavicular, and calcaneocuboid

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- Instruments, guide wires and screws are to be treated as sharps.
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PROMO®

PROXIMAL ROTATIONAL METATARSAL OSTEOTOMY

PATENTED, DESIGNED & EXCLUSIVELY DISTRIBUTED BY

Exclusively foot & ankle Paragon 28®

www.PARAGON28.com

1. Wagner et al. Is the Rotational Deformity Important in Our Decision Making Process for Correction of Hallux Valgus Deformity? *Foot Ankle Clin. (2018); 23: 205-217.*

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Paragon 28, Inc.
14445 Grasslands Dr.
Englewood, CO 80112
(855) 786-2828

DISCLAIMER

The purpose of the PROMO™ Surgical Technique Guide is to demonstrate the optionality and functionality of the PROMO™ implants and instrumentation. Although variations in placement and use of the PROMO™ System can be performed, the fixation options demonstrated in this technique were chosen to demonstrate the functionality of the system and for simplicity of explanation. Other uses for the PROMO™ System can be employed, appropriate for the size of the device.