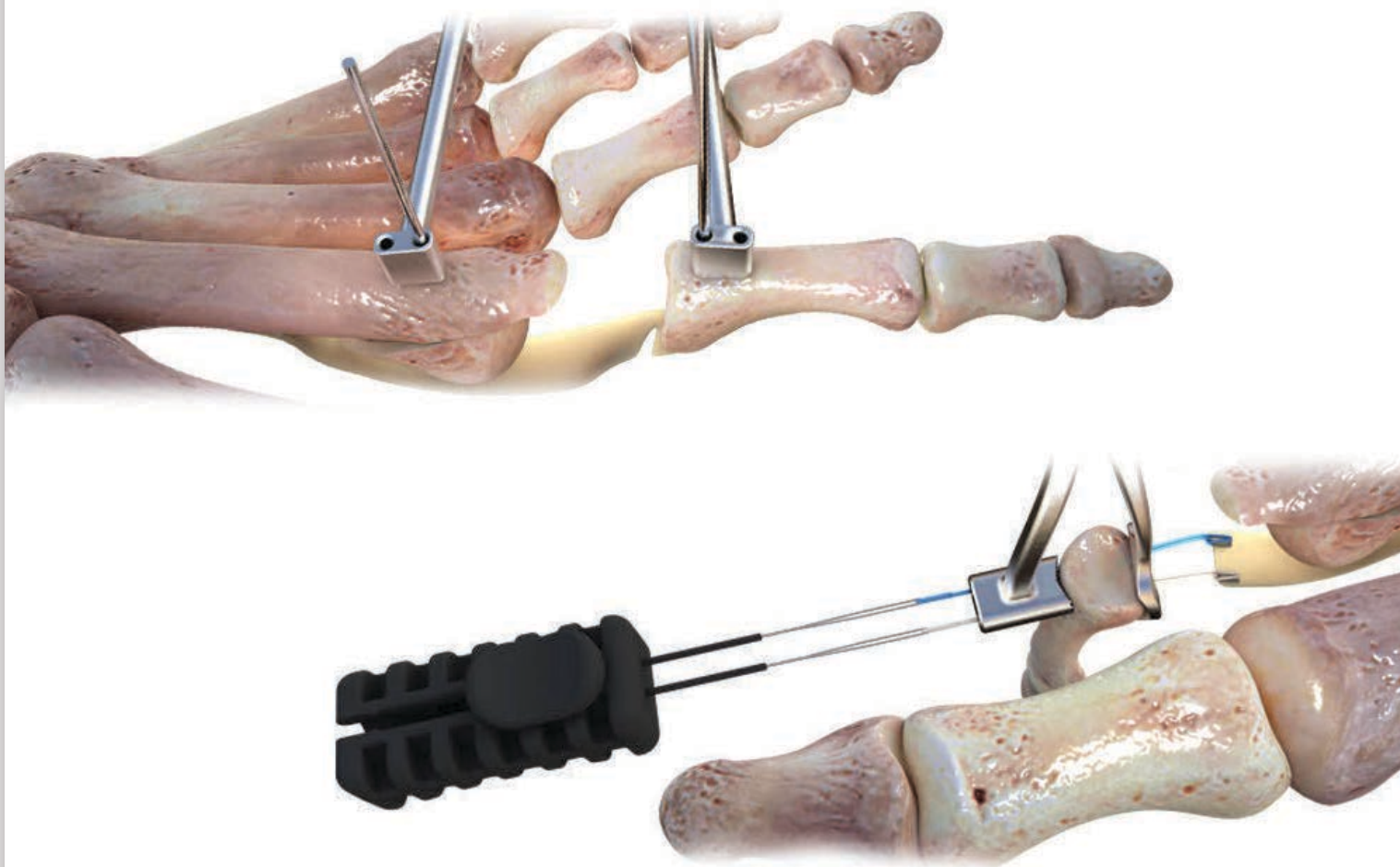


Gravity[®]

Plantar Plate Repair System

Operative technique





Plantar Plate Repair System

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Proper surgical procedures and techniques are the responsibility of the medical professional. The following guidelines are furnished for information purposes only. Each surgeon must evaluate the appropriateness of the procedures based on his or her personal medical training and experience. Prior to use of the system, the surgeon should refer to the product package insert for complete warnings, precautions, indications, contraindications and adverse effects. Package inserts are also available by contacting the manufacturer. Contact information can be found on the back of this surgical technique and the package insert is available on the website listed.

Caution: Federal law restricts this device to sale by or on the order of a physician.

Please contact your local Stryker representative for product availability.

Introduction

For DPMS, DOs and MDs, the Gravity® Plantar Plate Repair System addresses a common difficulty encountered by foot and ankle surgeons: an attenuated or torn plantar plate. This system surgical technique eliminates two typical surgical steps - suture reloading and sequential suture retrieval through the phalanx – which can potentially reduce OR time. This technique further uses a novel Gravity Double Barrel® Drill Guide that enables reproducibility and can enable greater visualization while addressing the phalanx. The system incorporates two low profile Gravity Needle Drivers with a tapered tip corkscrew needle that are pre-loaded with loops of #0 Force Fiber® ultra-high molecular weight polyethylene (UHMWPE) suture, as well as two Charlotte® Snap-Off Screws for permanent osteotomy fixation.

Indications

The Gravity Soft Tissue Repair System is indicated for the following:

Gravity Plantar Plate Repair System:

- Distal metatarsal osteotomy (screw)
- Plantar plate repair (suture)

Gravity Needle Driver:

Approximation of soft tissues, including the use of allograft tissue for orthopaedic surgeries

Contraindications

There are no product-specific contraindications.

Prior to use of the system, the surgeon should refer to the product package insert for complete warnings, precautions, indications, contraindications and adverse effects. Package inserts are also available by contacting the manufacturer. Contact information can be found on the back of this surgical technique and the package insert is available on the website listed.

Preoperative planning

Preoperative planning is based upon surgeon discretion.

Step 1: Incise, dissect and ligament release

The patient is placed in a supine position on the operating room table. A dorsal longitudinal incision is centered over the metatarsophalangeal (MTP) joint. The extensor digitorum longus and brevis are lengthened or split and a self-retaining retractor is placed deep of the tendons to allow for visualization of the dorsal capsule of the MTP joint.

After entering the MTP joint, the dorsal capsule and collateral ligaments are released from the proximal phalanx. A McGlamry Elevator (86PP0001) is used plantarly to release the plantar plate from the distal metatarsal. This step will aid in the necessary exposure and advancement of the plantar plate. **(Figure 1)**

Note: Care is taken when releasing the plantar plate tissue from the distal metatarsal so as not to advance the McGlamry Elevator excessively proximally, medially or laterally in order to spare sufficient ligament to bone connection.



Figure 1

Step 2: Distal metatarsal osteotomy

A distal metatarsal osteotomy is performed to increase the working area and to shorten the metatarsal. It is recommended not to remove the metatarsal dorsal lip until after the permanent osteotomy fixation in a later step.

Once the osteotomy is complete, the Metatarsal Head Pusher (86PP0002) is used to translate the capital fragment far enough proximally in order to provide a large working area in the joint space.

The capital fragment is temporarily fixed with a .062in / 1.6mm dual-trocar K-wire. **(Figure 2)** The K-wire should be sufficiently proximal on the dorsal fragment in order to provide ample room for permanent fixation. Do not penetrate the plantar surface of the capital fragment.

Note: To reduce waste and cost, all K-wires in the system are sharp on both ends so that they can be cut in half with one being used for the metatarsal head and one used for the proximal phalanx.



Figure 2

Step 3: Distraction

The Gravity Plantar Plate Repair System Distractor (86PP0003) is utilized to gain optimal visualization of the plantar plate. **First**, remove the self-retaining retractor (if used). **Second**, pass one of the proximal distractor holes over the .062 in / 1.6mm K-wire previously used to temporarily secure the osteotomy. **Next**, extend the Distractor until the distal holes are sufficiently distal to the articular surface of the proximal phalanx. This ensures optimal room for drilling bone tunnels. **Fourth**, place a second .062 in / 1.6mm K-wire through one of the two distal Distractor holes in order to fixate the proximal phalanx. **Fifth**, distract in order to gain dorsal access to the plantar capsular tissue of the MTP joint. **Finally**, replace the retractor over the arms of the Distractor (if desired). If a partial tear of the distal plantar plate is observed, completion of the tear with a scalpel as distally as possible is recommended before proceeding. This step may allow for additional distraction.



Figure 3

Note: Care is taken not to transect the flexor digitorum longus tendon which runs immediately plantar to the plantar plate ligament.

Note: Ensure the Distractor is completely seated against the bone before distracting in order to avoid bending the K-wires during distraction.

Optional secondary fixation

Cut the two .062 in / 1.6mm K-wires in half. Do not yet discard the cut halves.

To fully lock the phalanx in place and to prevent medial/lateral laxity, the saved K-wire halves may be used. First, rotate the phalanx to the desired orientation, then drive one or both of the saved halves through the remaining Distractor holes. If this optional secondary fixation step is not necessary, the cut K-wire halves may be discarded.

Step 4: Suturing

The two included Gravity Needle Drivers are pre-loaded with a #0 Force Fiber® ultra-high molecular weight polyethylene (UHMWPE) suture loop and a corkscrew needle. They are designed to make a single pass through tissue where workspace is limited and to create a luggage tag knot.

First, stabilize the plantar plate tissue with a forceps or similar device. **Second**, hold the Needle Driver like a pencil and use a twisting or rotating motion to insert the corkscrew needle into the medial or lateral half of the tissue. A surgeon can pass the needle from dorsal to plantar or plantar to dorsal based upon anatomy and surgeon preference.

It is recommended to not approach the joint space strictly dorsally with the Needle Driver, approach from the medial or lateral side as much as possible to ensure the corkscrew needle twists back into view where it can be grabbed in the next step. **(Figure 4)**

Note: Use a twisting or rotating motion to pass the needle through the tissue. Avoid pulling on the Needle Driver.

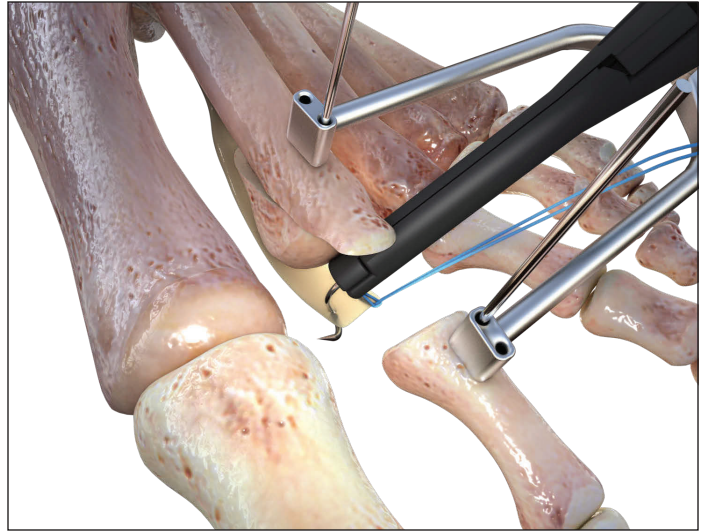


Figure 4

Third, grasp the needle with a forceps or other similar device. **Fourth**, press the release button on the Needle Driver then gently pull the Needle Driver away from the joint space. Now, the needle is free of the Needle Driver housing and the suture contained within the Needle Driver can be seen. **Next**, pass the needle through the open loop of suture and create a luggage tag knot around the tissue. Finally, repeat these suturing steps using the second Needle Driver for either the medial or lateral half of the plantar plate (whichever was not done in the previous steps). (**Figure 5**)

Note: The needles may be left attached to the suture to aid in later passing through the Suture Retriever snares. Additionally, one Needle Driver will contain a blue Force Fiber® suture loop and the other will contain a white Force Fiber suture loop. This color differentiation aids in distinguishing the medial suture from the lateral suture.

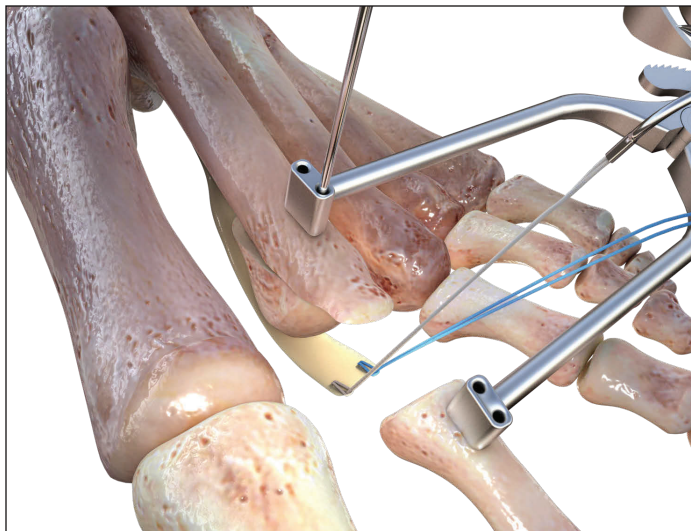


Figure 5

Optional needle driver reloading (if necessary)

In situations where the user unintentionally pushes the release button early and the needle prematurely unseats, it is useful to have the ability to reseat the needle by retightening the preloaded suture within the Needle Driver. **First**, turn the cap counterclockwise one quarter turn and fully remove the Driver. Now, the preloaded suture is exposed from beneath the cap. **Next**, gently pull on this exposed suture to return the needle to its housing. It may be necessary to rotate the needle to ensure that it fully seats back into the Needle Driver. **Finally**, with the needle properly seated, maintain tension on the suture and press the release button back to its original locked position.

If the preloaded suture and needle are deployed too far to be visible when the cap is removed, or if the needle and suture are fully deployed and completely separated from the Needle Driver, there is a sterile, individually packed Needle Driver (86PP00N0) available. The Needle Driver should only be used to pass the preloaded needle and suture one time. After a successful pass and deployment of the needle and suture from the Needle Driver, the driver housing should be discarded.

Step 5: Phalanx drilling and suture passing

Once suturing of the Plantar Plate is complete, the Distractor and the phalangeal K-wires can be removed in preparation for drilling the bone tunnels. A Gravity Double Barrel Drill Guide (86PP0004) is placed around the base of the proximal phalanx and clamped tightly. The Drill Trajectory Guide (86PP0005) is used in conjunction with the Gravity Double Barrel Drill Guide.

When viewed sagittally the guide post indicates the path of the drill holes. Use the Drill Trajectory Guide to ensure the drill holes will not violate the articular surface of the phalanx. The guide post may be placed medially or laterally to assess positioning of the Drill Guide. Adjust Drill Guide positioning as necessary.

Utilize the leverage gained with the Gravity Double Barrel Drill Guide to plantarflex the phalanx 90 degrees. Using a rongeur or curette, remove residual soft tissue from the plantar surface of the phalanx.

While maintaining plantarflexion, utilize the 3rd .062in / 1.6mm K-wire to drill two holes in the proximal phalanx through the holes in the Gravity Double Barrel Drill Guide. Ensure the K-wire completely exits the plantar surface of the proximal phalanx. Depicted in **Figure 6** is the 2nd proximal phalanx plantarflexed 90 degrees.

Note: Remove any residual plantar soft tissue obstructing the bone tunnel exits to allow full passing of both Suture Retriever diamond-shaped snares in the next step.

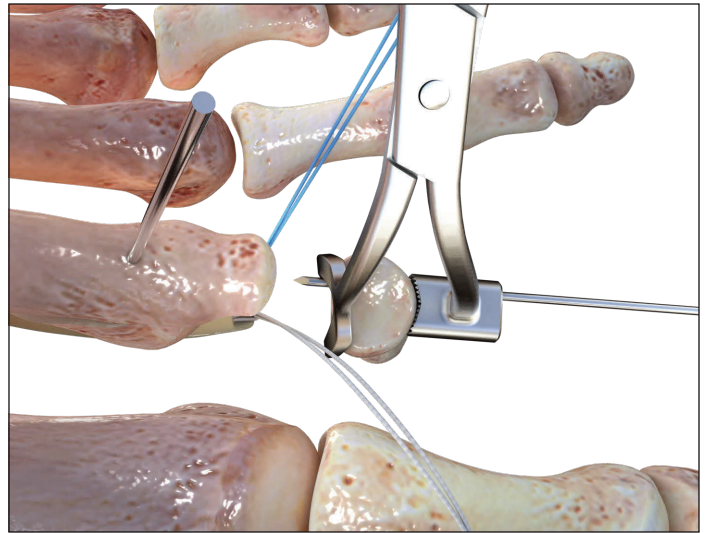


Figure 6

While maintaining 90 degree phalanx plantarflexion, insert the Suture Retriever with its diamond snares retracted into the Gravity Double Barrel Drill Guide until fully seated. **Next**, slide the button toward the phalanx. As the button is slid forward, the two diamond-shaped snares will advance through the bone tunnels and then exit the bone tunnels. **(Figure 7)**

Now, feed the lateral needle of the Force Fiber® suture through the lateral diamond-shaped snare, and the medial needle through the medial diamond-shaped snare. If the needles have already been removed, utilize the suture color for medial/lateral distinction. **Next**, pull adequate suture through the diamond-shaped snares. **Finally**, cut the needles off the sutures (if not previously done) and gently pull the Suture Retriever out of the Gravity Double Barrel Drill Guide until the suture ends are completely through the snares. **(Figure 8)**

Unclamp and remove the Gravity Double Barrel Drill Guide and dispose of the Suture Retriever.

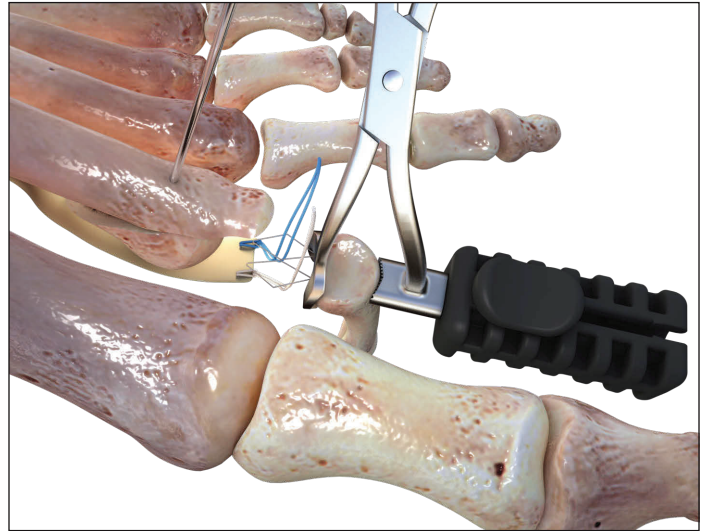


Figure 7

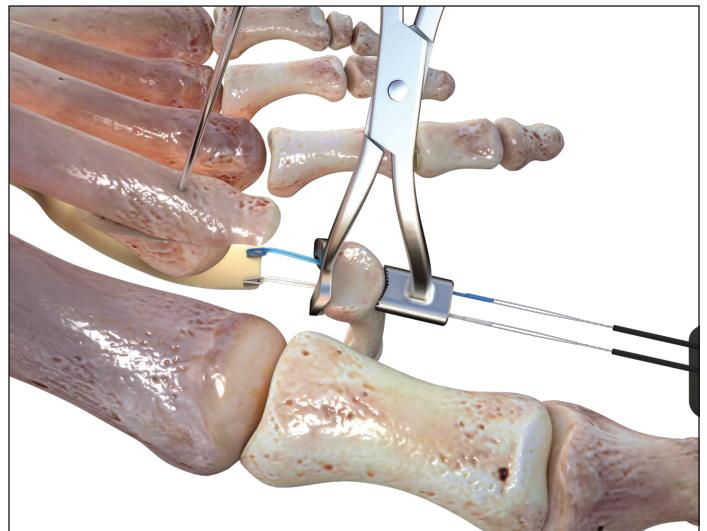


Figure 8

Step 6: Metatarsal head fixation, tensioning and knot tying

Remove the K-wires from the Metatarsal.

Translate the capital fragment of the metatarsal to the desired final position. The Osteotomy Clamp (86PP0006) is used to maintain compression and prevent rotation between the fragments until fixation is achieved. For reference, a groove is located at 3mm on the plantar tip of the clamp over which the dorsal metatarsal lip will protrude.

Fixate the osteotomy with a 2.0 × 12mm and/or 2.7 × 13mm Charlotte Snap-Off Screw across the fragments using a Charlotte Snap-Off Screwdriver (45112000). **(Figure 9)** Using a rongeur, remove the protruding lip of the distal metatarsal fragment until flush with the capital fragment.

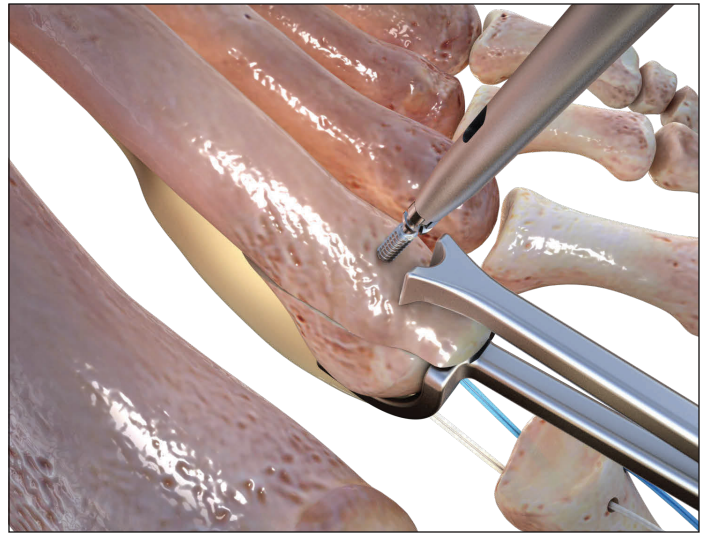


Figure 9

Note: If using the hole left by the .062in / .062mm K-wire for permanent fixation, use of the larger 2.7 × 13mm screw is recommended for improved purchase.

Note: It is recommended to perform any adjunct procedure (e.g. PIP fusion with Phalinx® Hammertoe Fixation) before tensioning the suture and tying knots. This will ensure proper plantar plate approximation is not altered after knots have been tied. Please reference the Phalinx Operative Technique for PIP fusion.

After completing any adjunct procedures, reduce the MTP joint to the desired position. Pull the sutures tight to ensure any slack is removed and to advance the plantar plate onto the proximal phalanx. The sutures are tied over the cortical bridge between the two drill holes. A double throw, followed by five single throws (surgeon's knot followed by two square knots) is recommended, but specific knot tying technique is at surgeon discretion. Proceed with capsular repair, extensor tendon repair (if applicable) and wound closure per surgeon preference. **(Figure 10)**



Figure 10

Explant information

To remove the Charlotte Snap-Off screws, engage the screws with the Charlotte Snap-Off Screwdriver (45112000) and rotate counterclockwise. Explantation of the Force Fiber® suture requires no product specific instrumentation. Cut the suture if necessary and remove.

If removal of the implant is required due to revision or failure of the device, the surgeon should contact the manufacturer using the contact information located on the back cover of this surgical technique to receive instructions for returning the explanted device to the manufacturer for investigation.

Post-operative care

Post-operative care is based upon surgeon discretion.

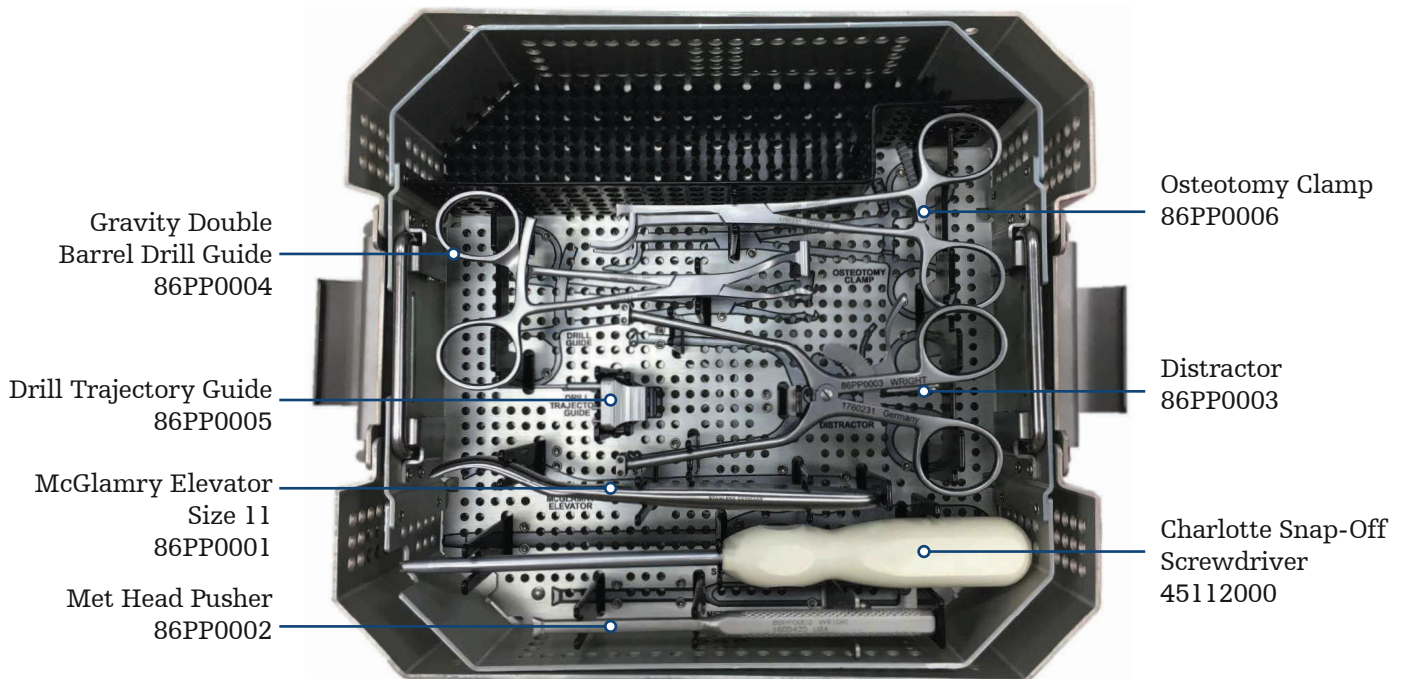
Ordering information

Instruments

P/N	Description
86PPKIT1	Gravity Plantar Plate Instrument Set
86PP0001	McGlamry Elevator
86PP0002	Met Head Pusher
86PP0003	Distractor
86PP0004	Gravity Double Barrel® Drill Guide
86PP0005	Drill Trajectory Guide
86PP0006	Osteotomy Clamp
45112000	Charlotte Snap-Off Screwdriver

Implants

P/N	Description
86PPS1N0	Gravity Plantar Plate Implant Set
86PP00N0	Gravity Needle Driver



Packaging guide

Sterile consumables

86PPS1N0 Implant set

One 2.0 × 12 mm and one 2.7 × 13mm
Charlotte Snap-Off Screw

Bundle of three dual-trocar
K-wires with tip protectors



Two Gravity Needle Drivers, one with blue
and one with white Force Fiber® suture

Suture Retriever with twin
nitinol diamond snares

86PP00N0 Gravity Needle Driver



Gravity® Needle Driver with blue Force Fiber® suture

The Implant Set contains all consumables needed to complete the Gravity® Plantar Plate Repair System surgical technique. Force Fiber® is a Registered Trademark of Teleflex, Inc.

Foot & Ankle

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