STAINLESS STEEL

or

TITANIUM PLATE

Rental or Purchase options are available.

Surgical Videos are also available online at: www.rayhack.com

RAYHACK® OSTEOTOMY SYSTEMS

Disclaimer: This precision oblique radial levelling procedure is NOT RECOMMENDED for LICHTMAN STAGE IV (RADIAL-CARPAL ARTHRITIS) Kienbuck’s disease.

Note: This updated manual supersedes all previously produced surgical technique manuals.
RADIAL SHORTENING IN KIENBÖCK’S DISEASE SUMMARY

1. KIENBOCK’S Saw Guide
2. Slot 1
3. Slot 2

4. Specialized Saw Blade
5. Pass Through™ Plate Bender Slots

6. Osteotomy Compression
7. Allen Wrench
8A. 2.7mm Drill Bit
8B. 2.0mm Drill Bit
8C. 2.7mm Tap
9. Interfragmentary Cortical Lag Screw
10. Divergent Drill Guide

OSTEOTOMY WIDTH (Perpendicular to Osteotomy)
- Slots 1-2: 2.0 mm
- Slots 2-3: 3.0 mm

HYPOTENUSE (Theoretical Linear Shortening)
- 2.8 mm
- 4.2 mm

Note: Specialized KIENBOCK’S Stainless Steel or Titanium Bone Plate

Specialized KIENBOCK’S Saw Guide

1/4” Hub Size

Rental or Purchase options are available.

CREATIVE MEDICAL DESIGNS, INC

13914 Shady Shores Drive
Tampa, Florida 33613
(813) 875-9999 • FAX (813) 961-5543
Web Site: www.rayhack.com
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## Precision Oblique Radial Shortening Osteotomy in Kienböck’s Disease

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### Rental Users

A standard small fragment and mini fragment instrument set will be needed to supply drills, taps, and screws. A Hall®, Microaire® or Linvatec® sagittal saw will be needed to fit the specialized saw blade used in the osteotomy. Consult [www.rayhack.com/instrumentation.htm](http://www.rayhack.com/instrumentation.htm) for specifics.

### Disclaimer

The Rayhack® Osteotomy Systems have been carefully designed to ensure a precision osteotomy when used properly. Failure to carefully follow directions and to use the appropriate equipment in the prescribed manner may result in an unsatisfactory outcome. Creative Medical Designs, Inc., cannot be held responsible for inappropriate use of the Rayhack® Osteotomy Systems or for failure to adequately protect soft tissues and surrounding bones at all times. No activity against resistance or load bearing is permitted prior to confirmation of a healed osteotomy. Failure to protect the osteotomy until healing is confirmed may result in a non union and possibly plate breakage.

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**Creative Medical Designs, Inc.**

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**Step 1**

**Placement of the Kienbock Saw Guide**

A **volar approach** is used to expose the radius. While this volar approach may be slightly more technically demanding, it has the advantage of applying the plate in a position in which it will probably not need to be removed once the osteotomy has healed. The distal end of the saw guide is placed just at the origin of the volar flare of the radius.

**Note** Due to the flare of the volar surface of the radius the inflexible saw guide is inhibited from being placed too far distally in the volar approach. This by consequence, dictates that the radial osteotomy must be placed far enough proximally to avoid cutting into the distal radial-ulnar joint. **The surgeon must be sure that the oblique cut of the saw blade does not enter the distal radial-ulnar joint.**

This osteotomy should be clearly through diaphyseal bone and it would be highly unlikely to enter the distal radial ulnar joint. **An x-ray** may be taken after application of the saw guide in order to help confirm the proper position prior to making the saw cuts.

**Precautions** Be sure to protect all soft tissues from potential injury from the saw blade, drill bits, depth gauge, and taps. The median nerve is especially vulnerable and must be identified and protected.

**Note** The saw guide does not “capture” the saw blade in the radial osteotomy system. The saw blade serves as its own guide once it enters the radius. Soft tissues must be protected from the saw blade on the medial and lateral sides as well as the dorsal cortex of the radius, and underlying tissues.

**Disclaimer** This precision oblique radial levelling procedure is **not recommended** for Lichtman Stage IV Kienböck’s disease (Radial-Carpal Arthritis).

---

**FIG. 1**

- Fixation hole for straight drill guide
- Small fixation hole for straight drill guide

To judge approximate sawguide placement:

First apply the Keinbock plate (after contouring) to the volar radius. Be sure the two distal plate holes are aligned to permit good bone purchase. Mark hole number one on the bone and align the saw guide hole #1 over this mark.
Positioning of the Straight Drill Guide

► While manually holding the saw guide centered over the radius, first drill hole #2 with a 2.5 mm drill bit through the straight drill guide. The proximal portion of the straight drill guide has a small prong proximally and a larger prong distally to allow proper positioning on the saw guide. (Refer to Step 1 to visualize these fixation holes on the surface of the saw guide.)

► Remove the drill guide and tap the hole with a 3.5 mm tap after measuring the screw depth. Place the appropriate size screw in hole #2. (This avoids proximal - distal-shifting of the saw guide.) Reapply the drill guide and drill hole #4. Be sure that the saw guide remains centered on the radius, and does not displace medially or laterally.

NOTE: Proper depth measurement of the screw holes is critical. These same screws holding the saw guide will hold the Kienbock plate in position. Excessively long screws may be palpable on the patient’s dorsal forearm.

Measure, tap, and insert screw #4. Once the saw guide is firmly attached, drill and tap screw holes #1 and #3, and gently apply the appropriately sized screw.

CAUTION: Do not overtighten the fixation screws (1-4) of the saw guide. This could lead to stripping of the screw head sockets upon removal of the saw guide.

NOTE: The distal end of the Kienbock saw guide is to be placed at the beginning of the radial volar flare. See step 1 for the method to choose this saw guide placement position.
The stated distances between the slots are measured perpendicular to the osteotomy surfaces and represents the actual machined distances in the saw guide. The theoretical linear shortening of the bone, calculated as the hypotenuse of the right triangle is this perpendicular measurement times the square root of 2: (1.414). Clinical experience has shown that the mathematically possible bone shortening (hypotenuse) is probably not completely achieved. The surgeon should be aware that due to various clinical factors (amount of plate pre-bending, use of the specified saw blade, degree of linear compression, etc.) the actual degree of bone shortening is expected to be slightly less than the theoretical linear shortening.

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STEP 4  Performing the Oblique Radial Shortening Osteotomy

**NOTE** Once the amount of bone to be removed is determined, the appropriate slots to be used are chosen according to Step 3 on the previous page.

**CAUTION** Slots 1 and 3 should not be used together to perform any osteotomy in this radial levelling procedure.

**IMPORTANT** To create two parallel bone cuts it is recommended that the distal cut be made first 50% of the way through the radius. Next cut through the proximal slot with a 50% bone cut. Now continue the distal cut 75% and then the proximal cut 75% in this order. Next complete the distal cut and then the proximal cut. Always complete the distal cut first. This will help to maintain two parallel bone cuts without the saw blade “glancing” into the distal cut surface from the proximal cut. Please carefully observe these steps visually to assure parallel bone cuts.

**CAUTION** It is important to protect all soft tissues from the cutting area. The median nerve is particularly vulnerable in this procedure.

Periosteum must be stripped off the radius at the osteotomy site only.

**CAUTION** Never pass the saw blade beyond the marked line: "Radial Max Depth" on the saw blade. Do not allow this line to pass the top of the Kienbock’s saw guide without extreme caution.

**Note:** Only use a Hall®, Microaire® or Linvatec® sagittal saw. Consult www.rayhack.com/instrumentation.htm for detailed saw descriptions.

Failure to use the specific saw blade provided with the set may damage the saw guide and result in non-parallel bone surfaces.

**CAUTION** Only pass the saw blade beyond the line marked “Radial Max Depth” on the saw blade with extreme care. The surgeon may allow this line to pass the top of the Kienbock’s saw guide a few mm to complete the osteotomy of a large caliber radius. Failure to pay strict attention to this detail, may result in soft tissue and bone damage.

Once both osteotomy cuts are made, all screws are removed and placed in the appropriately numbered temporary holding slots in the tray. The osteotomy bone fragment is removed.

**CAUTION** In removing the Kienbock’s saw guide there may be a great deal of tension on the screws. Be sure to carefully apply the screwdriver and apply dorsal forearm counter pressure to avoid stripping of the 2.5mm hexagonal slot in the screw head. If the screw head socket becomes “stripped” the saw guide cannot be removed and it may be necessary to carefully remove the screw head with Midas Rex instrumentation. (Not provided by Creative Medical Designs, Inc.)
Kienbock Bone Plate Fixation

Due to the volar flare of the radius the surgeon should slightly pre-bend the radial plate to the concave contour of the radius. This may be performed at the beginning of the procedure prior to saw guide placement (see step 1).

Bending of the plate is facilitated by using the specialized RAYHACK® OSTEOTOMY SYSTEMS' plate benders. The unique “pass through™” slots in the plate benders will help minimize plate scratching. Be sure to avoid torquing of the plate benders to avoid longitudinal and rotational distortion of the plate.

**NOTE**
The elongated slot in the plate is positioned distally.

➤ Fix the plate by reapplying screws #1 and #2 respectively taken from the temporary holding slots in the tray. These two screws should be firmly tightened at this time.
STEP 6 Application of the Compression-Distraction Device

- Locate the compression-distraction device* on the plate over the osteotomy site.
- The compression device is initially compressed in the tray. For approximate spacing of the compression device, place the compression - distraction device over the saw guide. Loosen the compression screws so that the holes coincide with the 3rd and 4th holes of the saw guide.

Using two additional 3.5 mm cortical screws, fix the compression device through holes #3 and #4 as shown.

- These two additional temporary screws should be 4.0 mm longer than the measured length of screws #3 and #4 that were used to hold the Kienbock saw guide.

- It may be easier to apply the screw in hole #4 first and then apply screw #3.

**NOTE:** Make sure that the screw at the distal end of the elongated slot of the plate is slightly loose and is free to move proximally along the plate slot.

Temporary screws 4 mm longer than original screws 3 & 4.

* Compression-Distraction Device
U.S. Patent # 4,929,247

**NOTE** The hexagonal head of the adjusting screw has been modified to help prevent “stripping” of the socket over time. Be sure to fully seat the screwdriver shaft into the socket before tightening. This socket should be periodically checked for signs of excessive wear and replaced if necessary.

Rental sets have a replacement pair of screws in the unlikely event that they are needed.
**Compression of the Radial Osteotomy**

Observe the osteotomy for proper medial-lateral angulation while tightening the compression screws in a clockwise direction. If dissatisfied, back up the adjusting screws counterclockwise and repeat the procedure. If the osteotomy appears to be separating on the opposite cortex (dorsal radial surface), loosen the adjusting screws in the compression-distraction device and try loosening cortical screw #4 in the slotted hole and recompress the osteotomy. If this still results in separation of the osteotomy, consider pre-bending the plate an additional small amount.

A fixed angulated Allen wrench with a 2.5mm hexagonal screwdriver tip is provided to compress the osteotomy. This will need to be removed from the adjusting screw’s hexagonal slot with each 90-180 degrees of turning but this should only be necessary over a very short distance. Spacing of the blocks of the compression device should be approximated as noted in Step 6 prior to application over the Kienbock plate.

**Observe** the osteotomy surface while tightening the adjusting screws. Alternate between the two adjusting screws to provide even compression.

**Note** Make sure that no soft tissues are interposed between the osteotomy surfaces.

**Caution: Over Compression** will only bend the temporary long screws in holes #3 and #4 and will not further compress the osteotomy surfaces. This could also cause stripping of screw holes #3 and #4 and prevent drilling of the interfragmentary screw hole.

**Adjusting Screw Binding** If bone debris causes locking or binding of the adjusting screws, remove the long screws 3 and 4 and remove the compression device. Reapply 28 mm screws in holes 3 and 4 through the plate leaving 10 mm of screw length exposed. Compress the osteotomy with a clamp applied to these screws and manually drill and apply the interfragmentary screw. Apply the two distal screws as in step 10. Then remove the clamp and replace the original screws 3 and 4.
**STEP 8: Drilling the 22 Degree Interfragmentary Lag Screw Hole**

Place the angled drill guide on the fixed proximal block of the compression device once the osteotomy surface has been compressed. Press and hold the drill guide firmly on to the fixed block to ensure that the guide is in position prior to drilling the interfragmentary lag screw hole. Hold this guide during the drilling procedure.

**NOTE** Only one hole exists in the angled drill guide. This hole position is calculated on the assumption that the radius is 11 mm thick, anterior to posterior, and that the 2 mm osteotomy (slots 1 & 2) is used for the saw cuts. The most important part of this drill hole is the interfragmentary screw’s far cortex (dorsal and proximal radius) which will be threaded to allow compression of the osteotomy. If a 3 mm osteotomy is performed (slots 2 & 3) the interfragmentary screw will be slightly distal to the mid-line of the osteotomy but the critical threaded screw hole should allow firm compression by the interfragmentary screw. A thicker radius will make the interfragmentary screw fall proximal to the midline of the osteotomy in both the 2 and 3 mm osteotomies but it should still assure firm screw fixation at the osteotomy site.

**CAUTION** If the surgeon feels that the interfragmentary screw will not “capture” enough cortical bone on the tapped (far) side of the hole when the angled drill guide is used, (for example in a very large or very small radius) or that it does not fall within the desired site of the osteotomy, a free hand drilling technique may be substituted. **NOTE** The surgeon should visualize the site of the drill hole with the drill bit in place before the hole is drilled in order to make this decision.

A. Drill the first cortex with a 2.7 mm drill bit.

**CAUTION** Hold the angled drill guide firmly on the fixed block while drilling. Be sure not to drill the second (dorsal) cortex. Such a mistake can be salvaged by using a 3.5 mm lag screw. Since this 3.5 mm screw would project above the slotted plate in this narrowed area, be sure to check for appropriate screw length.

B. Apply the drill sleeve through the angled drill guide and volar radial cortex, and drill the opposite cortex with the 2.0 mm drill bit. Measure the depth of the hole.

C. Reapply the angled drill guide and tap the far cortex with a 2.7 mm tap—(reapplication of the angled drill guide helps guide the tap to the opposite cortex).
STEP 9 Oblique 2.7 mm Interfragmentary Lag Screw Application

2.7 mm interfragmentary cortical lag screw

Insert the appropriately sized 2.7 mm interfragmentary cortical lag screw and gently tighten.

FIG. 9

IF A MISTAKE IS MADE at the time of drilling the interfragmentary lag screw hole, by unintentionally drilling the opposite cortex with the 2.7 mm drill bit, or if this screw becomes “stripped,” it is possible merely to insert a 3.5 mm cortical screw. (See step 8a.)

CAUTION: Do not overtighten the lag screw as this may crack the cortical bone.

NOTE Do not remove the compression device before the interfragmentary screw and two divergent 3.5 mm distal screws have been applied.
Drilling of the Two Distal Screw Holes

Complete the fixation of the plate by drilling the two distal screws. These screws must be “divergent.” The specialized guide which is applied over the plate to drill the two distal screw holes will ensure this divergence. This guide prevents converging of the screw holes. The under surface of this drill guide is “cut out” to permit direct placement on the Kienbock plate. Be sure that this guide is firmly held in position while this drilling occurs.

Alternatively, a hand held drill guide may be used to drill these divergent holes.

Measure and tap the holes and insert two 3.5 mm cortical bone screws of appropriate size.

**NOTE** With excessive bending (contouring) of the distal aspect of the plate on the distal radial flare it may be difficult to use the divergent drill guide as it may impinge against the distal aspect of the compression-distraction device. The divergent drill guide has been “contoured” on its proximal aspect in order to clear the compression-distraction device. Also soft tissue interference may prevent the divergent drill guide from firmly seating on the plate. In case the divergent drill guide cannot be used, the hand held drill guide will permit the surgeon to “free-hand” the drilling of these 2.5 millimeter drill holes. Make sure to diverge the drill holes to avoid “crossing” of the screws.

**NOTE** 3.5 mm Cortical screws are preferred for these last two holes as the fixation is bi-cortical. Cancellous screws are not recommended.
Final Fixation of the Radial Osteotomy

Remove the compression-distraction device by loosening the adjusting compression screws first and then removing temporary screws #3 and #4. Replace the appropriate original cortical screws #3 and #4 from the temporary holding slots in the tray. **DISCARD THE TEMPORARY FIXATION SCREWS.**

**CAUTION** Do not reinsert the temporary fixation screws that were used to hold the compression-distraction device (these temporary screws are 4mm longer than the measured hole and were used solely to fix the compression-distraction device). Make sure all screws are tight.

**CAUTION** Do not over-tighten to avoid thread stripping of the tapped bone hole.

**CHECK X-RAY** A final xray should confirm that no screws are too long or too short. Excessively long screws may be palpable on the patient’s dorsal forearm and should be replaced with screws of appropriate length.

Note that the 2.7mm interfragmentary screw head seats at the top of the plate surface. The 3.5mm screw heads also seat flush on the surface of the plate.
Post Operative Care

In most cases a volar and dorsal plaster splint can be used to immo-
bilize the forearm until the sutures are removed at two weeks post
surgery. Most patients can be placed in a short arm removable thermo-
plastic splint at this time and pro-
tected until fracture healing has
occurred. \textbf{No activity resulting in
loading or activity against resis-
tance is permitted until fracture
healing is assured.} In those
patients who are felt to have reck-
less tendencies, it is recommended
that a sugar tong splint be applied
at surgery and a short or long arm
cast applied at the two week follow-
up appointment. This can be con-
verted to the thermoplastic splint
when the surgeon is convinced that
healing is satisfactory.

STEP 12 Care and Cleaning of the Instruments

The used saw blade may be
manually placed in the saw
guide slots in order to remove
any bone debris. Visually inspect
these slots to make sure that these
slots are completely clean by
looking down the slot at a light
surface. Clean any bone debris
from the other instruments.

\textbf{Sterilize the tray and instru-
ments.}

\textbf{CAUTION: It is important to
clean and thoroughly dry all
instruments before replacing in
the tray. Any rust spots that may
appear may be lightly buffed using
Scotch-Brite".}

The tray cover is locked into posi-
tion by pushing down on the but-
ton located on the cover and push-
ing this toward the top of the tray.

\textbf{DISCARD} the used saw blade
in an appropriate biohazardous
container.

\textbf{DISCARD} the temporary screws
used to fix the compression-
distraction device through holes
#3 and #4.

\textbf{RENTAL USERS: Complete the
"RETURNED GOODS STERILIZATION FORM"}

Scotch-Brite is a registered trademark
of the 3M Corporation.

Return of Instruments for Rental Users

Enclose the "RETURNED GOODS
STERILIZATION FORM" with the
instruments and place a copy in
the packing slip envelope and
apply to the outside of the
express package.

Please return the equipment by
Federal Express or other next day
carrier immediately following
surgery. Please have your office per-
sonnel check with your surgical
service or hospital shipping and
receiving department to ensure that
this important function has been
properly performed. Past experi-
ence confirms excessive delays
often occur if the surgeon does not
become directly involved.

Thank you.

\textbf{ALSO AVAILABLE:}
\textbf{Ulnar Shortening System}
\textbf{Radial Malunion Distraction System.}