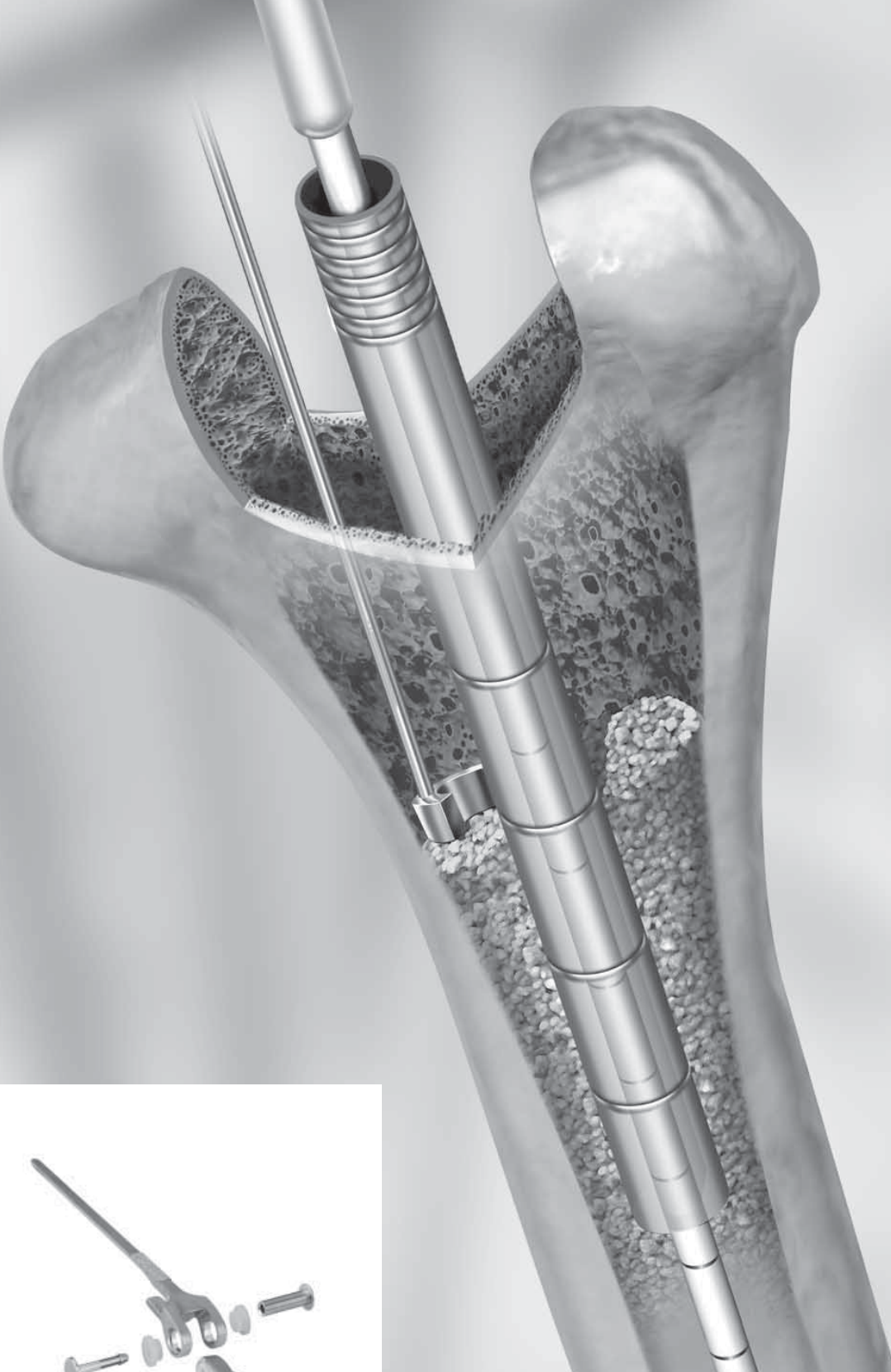


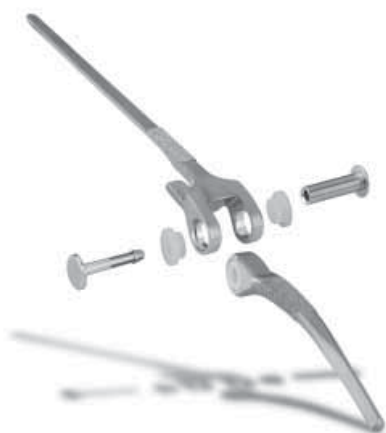


Zimmer® Coonrad/Morrey Total Elbow Revision

Surgical Technique



Anatomic design for clinical success



zimmer
Confidence in your hands®

Coonrad/Morrey Total Elbow Revision Surgical Technique

Developed in conjunction with

Bernard F. Morrey, M.D.
Chairman Emeritus,
Department of Orthopaedics
Mayo Clinic
Rochester, Minnesota

Table of Contents

Rationale	2
Indications/Contraindications	7
Preoperative Considerations	8
Exposure	8
Component Removal	10
Cement Removal	11
Bone Preparation	11
Treatment Options	11
Cortical Strut Allograft Augmentation Technique	11
Impaction Grafting Technique	12
Revision Component Implantation	14
Closure	16
Postoperative Management	16

Rationale

The design of the *Zimmer Coonrad/Morrey Total Elbow Prosthesis* is based on the complex kinematics of the elbow joint. It is a semiconstrained, hinge-type device consisting of a humeral stem and an ulnar stem joined by a two piece locking pin. The prosthesis is designed for use with bone cement, and can be used in both primary and revision arthroplasty.

The prosthesis permits approximately 7° of mediolateral hinge laxity (toggle) which conforms to the average laxity of the normal elbow joint. This is designed to minimize the effect of forces transmitted to the bone/cement interface as the center of the axis of rotation changes during flexion and extension. The laxity limit of the prosthesis is greater than the varus/valgus movement that occurs during normal flexion and extension. This allows the muscles to provide the varus/valgus constraint rather than the prosthesis.

The prosthesis is manufactured from *Tivanium*® Ti-6Al-4V Alloy. This material provides the necessary strength and flexibility, yet is lightweight.

The humeral and ulnar components are available in a variety of sizes. The component sizes are completely interchangeable through a common articulation, allowing the surgeon to provide a more exact fit for specific patient needs.

Humeral Component

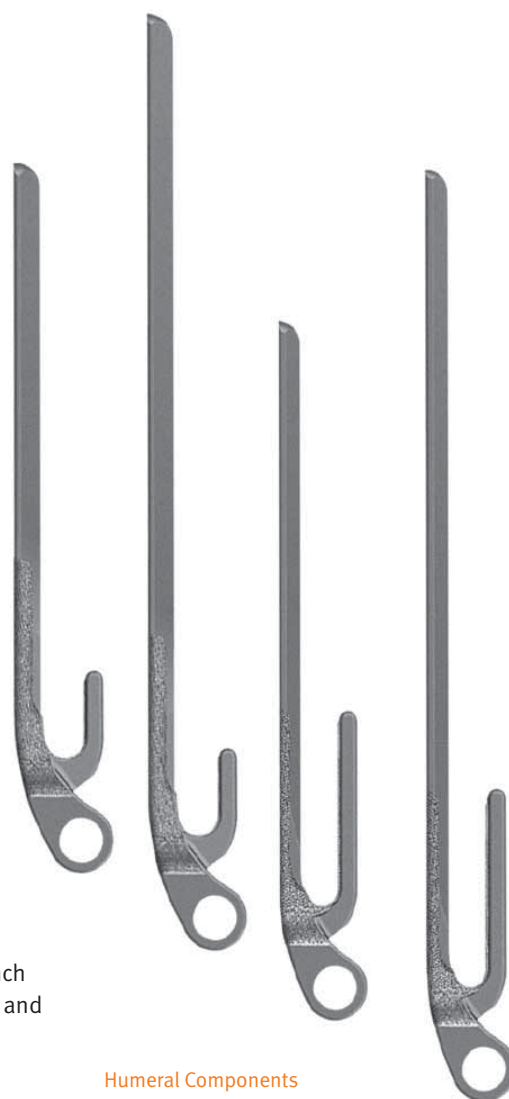
The humeral component is symmetrical, with a triangular cross section to match the triangular shape of the humeral canal. This cross-sectional shape is designed to help provide stability by minimizing the potential for rotation of the stem in the canal.

Beads are applied to distal portions of the humeral implant in a pattern that is designed to enhance cement fixation without reducing strength in high-stress areas. Beads are not applied to the anterior surface of the humeral stem, which is the area of highest stress on the implant.

The distal end of the humeral stem has an anterior flange just above the hinge. This flange is designed to be used in conjunction with a bone graft to help reduce stresses that are believed to contribute to loosening at the bone/cement interface. These include torsional (rotational) stresses in the medullary canal, and forces that tend to displace the stem posteriorly. The bone graft is placed under the flange so the flange can help hold it in place during healing.

The humeral component is manufactured in three sizes (regular, small, and extra-small), and three lengths. The regular and small sizes are available in 4-inch, 6-inch, or 8-inch stem lengths, and the extra-small size is available in 4-inch or 6-inch stem lengths. The 4-inch and

6-inch lengths are commonly used in primary elbow arthroplasty while the 8-inch length provides an option for revision arthroplasty. The 4-inch stem should be used when the shoulder has been or may be replaced with a humeral prosthesis. The 6-inch and 8-inch lengths in both the small and regular humeral components are also available in a longer flange option to address situations where there is bone loss.



Humeral Components

Ulnar Component

The contoured ulnar component is curved laterally to facilitate implantation and to establish the correct anatomical carrying angle. The cross section of the ulnar component is quadrangular to match the landscape of the canal and help minimize intramedullary rotation in the ulna.

The ulnar component has a band of titanium plasma spray proximally to provide a rough surface for enhanced cement fixation without affecting fatigue strength.

The ulnar component also is manufactured in three sizes (regular, small, and extra-small), and is available in right and left configurations. The regular size ulnar component is available in 3.5-inch and 4.5-inch lengths. The small and extra-small components are available in 3-inch and 4.5-inch lengths.



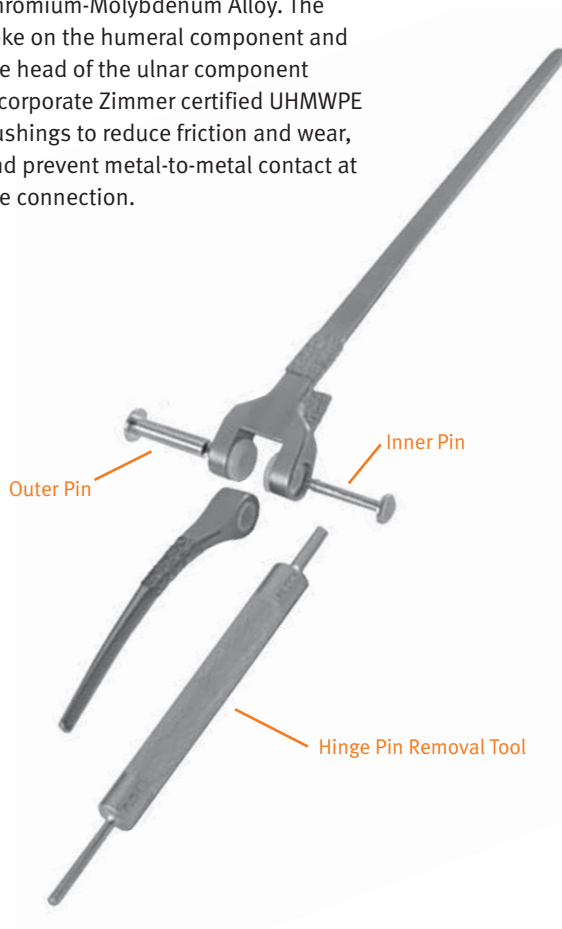
Ulnar Components

Linking Mechanism

The humeral and ulnar components are joined by a pin mechanism that creates an axis for the hinge. The locking pin assembly consists of two pieces — a solid inner pin that fits inside a hollow outer pin. The two pins snap together by means of an expandable tip on the inner pin.

The hinge mechanism can be easily disassembled with a simple instrument to enhance interchangeability in revision cases. The Hinge Pin Removal Tool is part of the instrument set.

The hinge pin is manufactured from *Tivanium* Alloy and *Zimaloy*® Cobalt-Chromium-Molybdenum Alloy. The yoke on the humeral component and the head of the ulnar component incorporate Zimmer certified UHMWPE bushings to reduce friction and wear, and prevent metal-to-metal contact at the connection.



Instrumentation

The Coonrad/Morrey Revision Elbow Instruments are designed to address the unpredictability of revision arthroplasty. They are straightforward and easy to use. Because there is no standard procedure that addresses all revision elbow situations, the revision instruments are designed to be flexible, allowing the surgeon to adapt them to the specific conditions presented, and to a variety of prostheses.

Extraction Instruments

These instruments are designed to extract the previous prostheses more efficiently by reducing the procedure time and potentially reducing blood loss and anesthesia time. They are designed to be used with the most common elbow prostheses; however, the devices can also be used with a variety of other prostheses.

The extraction instruments are also designed to obtain secure attachment to the implants, and to allow the extraction force to be applied in line with the long axis of the implant. This not only facilitates removal of the implant, but also helps avoid the need for excessive bone removal to extract the implant. In addition, it allows for the removal of much of the cement mantle during the extraction of the stem.

Pin Remover

This instrument can be used to remove the hinge pin on the Elbow Prosthesis. One end has a beveled tip that releases the locking mechanism. The opposite end is grooved to grasp the pin and pull it out.



Pin Remover

Angled Extractor

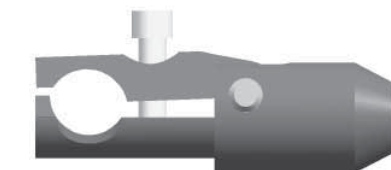
This instrument fits through the hinge axis holes on the yoke of the Coonrad/Morrey Humeral Component and the hinge axis hole on the head of the Coonrad/Morrey Ulnar Component. It allows for an extraction force to be applied in line with the stem of the prosthesis. The narrow tip can be used to remove the plastic inserts on the hinge of the Coonrad/Morrey Prosthesis.



Angled Extractor

Clamp A

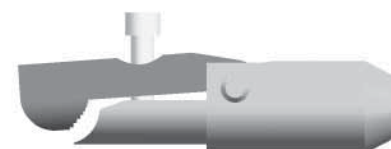
This clamp is designed to grasp the humeral component of Kudo and/or Souter Strathclyde style prostheses. The threaded barrel has adjustable jaws that allow the clamp to fit virtually all standard prosthesis sizes. The teeth on the jaws are designed to grip the smooth end of the prosthesis without impinging on the stem.



Clamp A

Clamp B

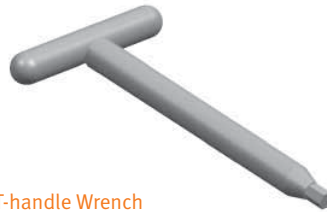
This clamp is contoured to fit the ulnar component of the Kudo and/or Souter Strathclyde style prosthesis. Like the humeral clamp, it has a threaded barrel that allows the jaws to fit all prosthesis sizes. It also has a serrated edge to optimize its grasp on the plastic that lines the prosthesis.



Clamp B

Hex T-handle Wrench

This wrench is used to tighten the Ulnar and Humeral Clamps around the prosthesis.



Hex T-handle Wrench

Slide Hammer

This instrument attaches to the extraction device for use in dislodging a prosthesis.



Slide Hammer

Coonrad/Morrey Elbow Extractor

This instrument consists of a shaft, hammer, and hook. It helps the surgeon to remove a provisional or implant from the humeral or ulnar canal.



Coonrad/Morrey Elbow Extractor

Hinge Pin Removal Tool

This instrument is used to release and extract the link pin on the Coonrad/Morrey Prosthesis. One end has a beveled tip that releases the locking mechanism. The opposite end is used to push the pin out.



Hinge Pin Removal Tool

Impaction Grafting Instruments

Impactor Sleeve

This polyethylene sleeve is inserted into the shaft of the humerus to maintain an appropriate canal diameter for bone cement during the placement and impaction of morselized bone graft within the cortical shell. It also serves as a conduit for cement delivery.



Impactor Sleeve

Tapered Impactor

This instrument is used initially to impact bone deep in the canal. The tapered end compresses bone downward and outward.



Tapered Impactor

Straight Impactor

This instrument is used to fill in small areas with bone graft. The straight end primarily compresses bone downward into small voids and can be used deep within the canal or at the top surface.



Straight Impactor

Cylindrical Impactor

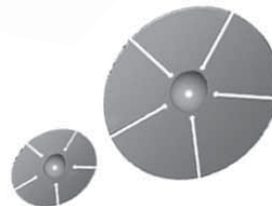
The Cylindrical Impactor is used to level off bone graft at the top of the canal. The flat end compresses bone downward and provides an even bone graft surface prior to cementing.



Cylindrical Impactor

Cement Restrictors

Cement Restrictors are designed to provide cement retention at the appropriate depth in the medullary canal. They are available in two sizes: 16mm and 25mm. The restrictors are flexible so they can be inserted through the narrow opening of the canal, and then expand as the canal flares. If desired, the 16mm restrictor can be inserted through the Impactor Sleeve.



Cement Restrictors

Cortical Augmentation Instruments

Wire Passers

The Wire Passers are used to easily pass wires around the bone during the use of cortical strut allografts. Two Wire Passers, medium and large, accommodate the ulna and humerus respectively. They have cannulated hooks that can be passed around the bone. The ergonomic design positions the hook so it can be easily manipulated around the bone. The wire is then threaded through the cannulation so it, too, wraps around the bone.



Large Wire Passer



Medium Wire Passer

Indications/ Contraindications

Indications include: post-traumatic lesions or bone loss contributing to elbow instability; ankylosed joints, especially in cases of bilateral ankylosis from causes other than sepsis; advanced rheumatoid or degenerative arthritis with incapacitating pain; revision arthroplasty; and instability or loss of motion when the degree of joint damage precludes less radical procedures.

The candidate for total elbow arthroplasty should exhibit joint destruction which significantly compromises the activities of daily living. Patients with single joint involvement (generally those with traumatic or degenerative arthritis) or significant lower extremity disability which require walking aids are less amenable to treatment than patients with advanced and predominately upper extremity involvement. If possible, elbow replacement should be done after hip or knee surgery to avoid excessive stress to the prosthesis required by crutch walking during total hip or knee rehabilitation.

Prior infection, paralysis, joint neuropathy, significant hand dysfunction, or excessive scarring of the skin which could prevent adequate soft tissue coverage are each distinct contraindications.

Use of the Coonrad/Morrey Total Elbow should not be considered for patients whose activities would subject the device to significant stress (i.e., heavy labor, torsional stress, or competitive sports).

Additionally, distant foci of infection, such as genitourinary, pulmonary, skin (chronic lesions or ulcerations), or other sites, are relative contraindications because hematogenous dissemination to the implant site may occur. The foci of infection should be treated prior to, during, and after implantation.

Joints that are neuropathic because of diabetes or other disease involving peripheral neuropathy are relative contraindications to total elbow arthroplasty.

Preoperative Considerations

Performing revision elbow arthroplasty is a technically demanding procedure that requires an understanding of the options available for reconstruction. Moreover, the surgeon should have considerable experience with primary elbow arthroplasty before attempting a revision procedure.

Careful preoperative planning is also important in meeting this challenge.

Determine the requirements for removal of the existing implants and cement that will minimize additional bone loss. A prosthesis that appears to be loose radiographically may not be easy to remove.

The surgeon should be familiar with the previous implant. In particular, be aware of the coupling mechanism and the technique for disarticulating the two stems at the hinge joint.

Assess the amount and location of bone loss, as well as the quality of the remaining bone. Determine the complexity of the reconstruction, and the need for bone grafting or adjunctive fixation. Then select the technique that provides appropriate reconstruction of the bone.

Evaluate A/P and lateral radiographs, and use the templates (97-8105-254-00) to determine the anticipated revision component sizes. If only one of the two implants requires revision, consider replacing only the failed implant.

Revision elbow arthroplasty typically requires the use of longer stems in both the humerus and ulna compared to the primary implants. Select a component size that is long enough to extend at least one inch beyond any areas of cortical deficiency. Also, the stem should extend beyond proximal or distal wires applied around a shaft with thin cortices because the wires may act as a stress riser unless a strut graft is applied.

Exposure

Position the patient according to preference. The recommended position is supine with a sandbag under the scapula and the arm placed across the chest. Make a straight incision approximately 15cm in length and centered just lateral to the medial epicondyle and just medial to the tip of the olecranon (Fig. 1).

Identify the medial aspect of the triceps mechanism and isolate the ulnar nerve using ocular magnification and a bipolar cautery. Mobilize the ulnar nerve to the first motor branch and very carefully translocate it anteriorly into the subcutaneous tissue (Fig. 2). The nerve must be protected throughout the remainder of the procedure.

Make an incision over the medial aspect of the ulna and elevate the ulnar periosteum along with the forearm fascia (Fig. 3). Then retract the medial aspect of the triceps along with the posterior capsule. Remove the triceps from the proximal ulna by releasing Sharpey's fibers from their insertion. Further reflect the extensor mechanism laterally including the anconeus, allowing complete exposure of the distal humerus, proximal ulna, and the radial head (Fig. 4). Sublux the entire extensor mechanism laterally.

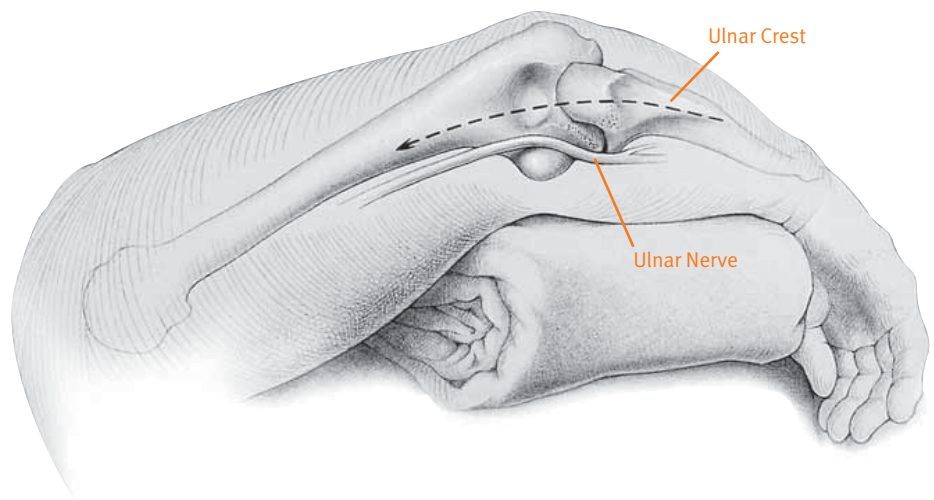


Fig. 1

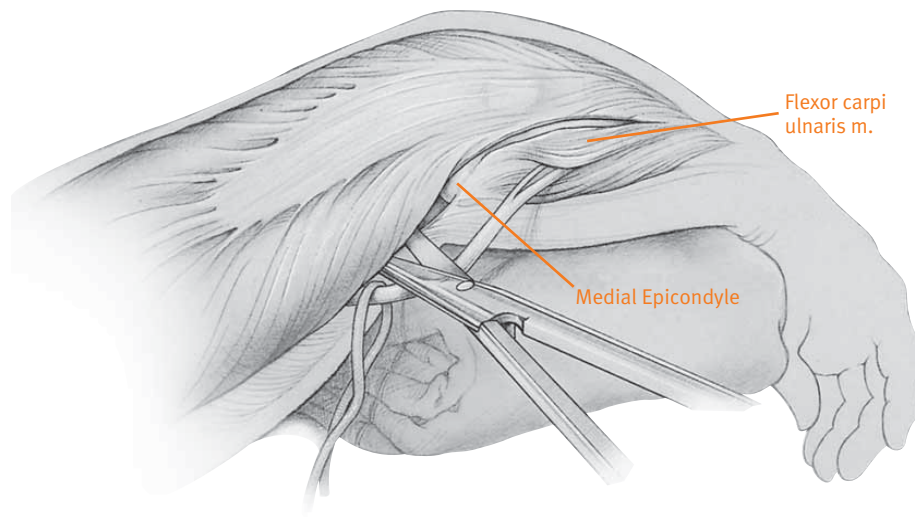


Fig. 2

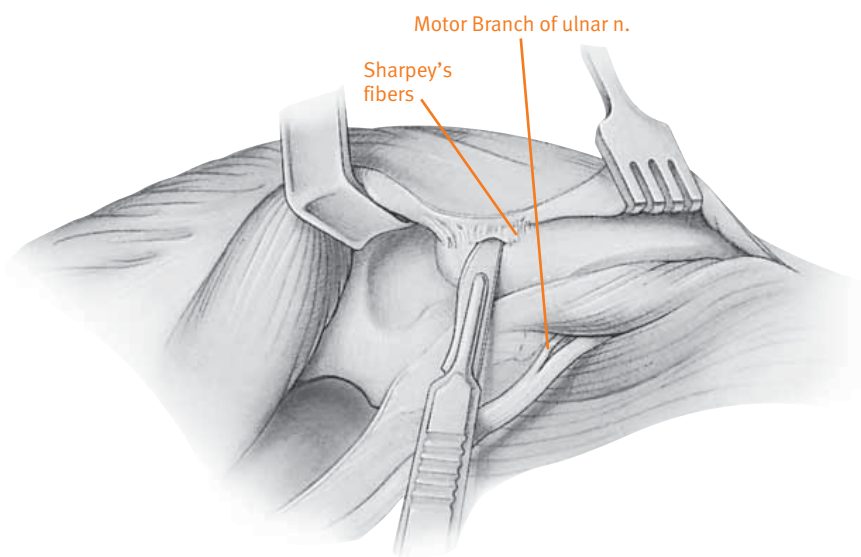


Fig. 3

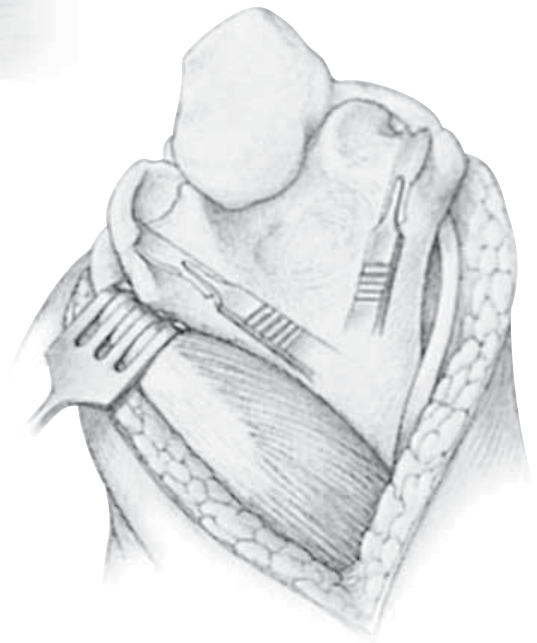


Fig. 4

Component Removal

Although implants to be revised are sometimes sufficiently loose for easy removal, most are still well-fixed and require an extraction force for removal. Grasping the implant is often difficult because the implant may not be sufficiently exposed to obtain a firm grip with the instruments. Often, significant bone tissue must be removed to obtain an adequate grip.

Disarticulate the prosthesis, using the method recommended by the implant manufacturer. Then remove the previous components using the appropriate instrumentation. The Coonrad/Morrey Revision Instrument Set includes instruments for the removal of a variety of implants. The instruments are designed to obtain secure attachment to the implants, and to allow the extraction force to be applied in line with the long axis of the implant.

If there is concern about potential fracture or excessive bone loss during extraction, create a cortical window at the tip of the implant, and tap the prosthesis out in a retrograde fashion. Alternatively, an extended window is created to remove well fixed devices and is replaced and fixed with cerclage wire after implant reinsertion.

Coonrad/Morrey Prosthesis Removal

Clear bone and soft tissue as needed from the distal humeral epicondyles to access the hinge pin (Fig. 5). For the Coonrad/Morrey Elbow which utilizes the inner and outer locking pins, insert the beveled tip of the Hinge Pin Removal Tool into the head of the hollow outer axis pin and release the locking mechanism. Use the long end of the Hinge Pin Removal Tool to push the link pins apart and pull them out.

For the previous Coonrad/Morrey hinge pin design, the Locking Ring Spreader can be used to remove the C-ring, and then to pull out the pin.

After removing the hinge pin, disarticulate the humeral and ulnar components. Then use the narrow tip of the Angled Extractor to remove the plastic inserts.

Insert the Angled Extractor through the hinge axis holes on the yoke of the Coonrad/Morrey Humeral Component. Attach the opposite end of the hook to the Slide Hammer. Align the extractor/slide hammer assembly with the axis of the stem and use the Slide Hammer to dislodge the component.



Fig. 5

Insert the Angled Extractor through the hinge axis hole on the head of the Coonrad/Morrey Ulnar Component. Attach the Slide Hammer and dislodge the ulnar component in the same manner.

If preferred, use the Coonrad/Morrey Extractor. Insert the hook through one of the hinge axis holes on the component. Then align the extractor so it is parallel with the axis of the stem, and dislodge the component.

Kudo and Souter Strathclyde Style Prostheses Removal

Remove the locking pin and disarticulate the humeral and ulnar components. Slide the jaws of Clamp A over the humeral prosthesis and adjust the gap between the jaws to fit the prosthesis. Use the Hex T-handle Wrench to tighten the clamp until the teeth firmly grip the prosthesis. Ensure that the clamp does not impinge on the stem.

Attach the Slide Hammer to the opposite end of the clamp barrel. Align the clamp/slide hammer assembly with the axis of the stem, and use the slide hammer to dislodge the component.

Use Clamp B to remove the ulnar component in the same manner.

Cement Removal

Because the Coonrad/Morrey extraction instruments use an axial force to extract the implants, much of the cement mantle remains attached to the prosthesis when it is removed. Use osteotomes or other instruments to remove the remaining cement with caution as the medullary canal is small and the cortex is typically thin. Then, using a pulsating lavage irrigation system, thoroughly clean and dry the medullary cavity.

Bone Preparation

Use the provisional components to assess implant fit. If additional reaming or rasping is necessary, use the appropriate reamer or Humeral Rasp.

Treatment Options

Cortical Strut Allograft Augmentation Technique

Use allograft struts to augment stem fixation in patients with periprosthetic fractures and/or cortical defects.

Place the struts parallel to each other, and secure them with a cerclage wire technique. First, select the Wire Passer that matches the curve and diameter of the bone to be wrapped, and maneuver it around the bone. Thread the 16-gauge wire through the hole at the tip of the Wire Passer until the wire exits at the shaft. Then withdraw the Wire Passer, leaving the wire wrapped around the bone.

Do not yet fully tighten the wires. If impaction grafting will also be performed, go to the Impaction Grafting Technique on page 12. If impaction grafting is not desired, inject cement into the canal in a retrograde fashion.

Impaction Grafting Technique

Shield the surrounding tissues with gauze. A cerclage wire may be applied for protection of the cortical shaft during impaction. The wire may be removed at the end of the procedure.

Bone Graft Preparation

The ideal size of cancellous bone chips ranges from less than 1mm up to 4mm for intramedullary impaction. There are a number of techniques to further prepare bone. One technique is to wash the bone chips in saline heated to 45° C, then strain over a 200ml strainer or pack. Add antibiotic powder if desired. It is always advisable to have additional allograft material available in case it is needed intraoperatively. During impaction, bone chips should be delivered 5cc at a time by using a spoon or alternating 10cc syringes with their ends cut off.



Fig. 6

Step 1

Cut the Impactor Sleeve to the length of the deficient canal. Select an implant length that extends at least one inch beyond the deficiency and is one inch longer than the Impactor Sleeve (Fig. 6). Then cut the Cement Nozzle at least one inch longer than the length of the implant.

Step 2

Insert the Cement Nozzle through the Impactor Sleeve to the end of the nozzle. Insert the Cement Restrictor onto the tip of the Cement Nozzle, which extends past the Impactor Sleeve. Note the length the Cement Nozzle extends past the Impactor Sleeve. Then insert the assembly into the humeral canal so the distal end of the Impactor Sleeve is even with the capitulum (Fig. 7).

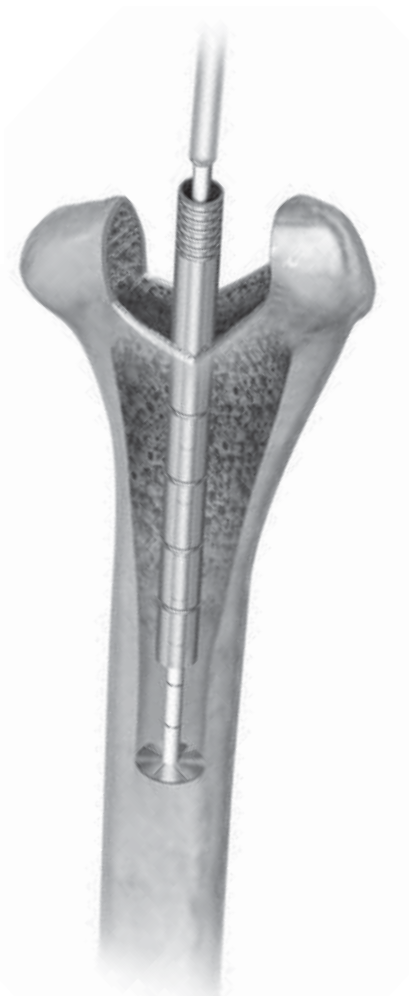


Fig. 7

Step 3

Insert morselized bone chips into the humeral canal and use the appropriate impactors to impact the graft circumferentially around the Impactor Sleeve (Fig. 8) up to the confines of the cortex.

**Fig. 8****Step 4**

Connect the Cement Nozzle to the cement cartridge or Universal Adaptor. Deploy the Cement Restrictor, by extruding low viscosity cement into the canal (Fig. 9). Withdraw the Cement Nozzle two inches so that the tip is even with the Impactor Sleeve proximally. Then slowly withdraw the Impactor Sleeve and Cement Nozzle in unison until the canal is completely full of cement.

**Fig. 9**

Note: The restrictor is not intended to pressurize the cement. Pressurization of the cement will move the Cement Restrictor deeper into the canal, thus lengthening the cement column.

Revision Component Implantation

Prepare a bone graft for the humeral component flange. The graft should measure about 2mm to 3mm in thickness and be about 1.5cm in length and 1cm in width.

If revising both components, insert the ulnar component first as far distally as the coronoid process. The center of the ulnar component should align with the projected center of the greater sigmoid notch (Fig. 10). The flat of the ulnar component should be parallel to the flat of the olecranon.

After the cement has hardened and excess has been removed from around the ulnar component, prepare the humeral canal and inject cement. Place approximately one-half of the bone graft anterior to the anterior cortex of the distal humerus, and expose the other half through the resected trochlea. Insert the humeral component down the canal to a point that allows articulation of the device, and the flange to contact the graft or struts anteriorly. At this position the bone graft is “captured” by the flange (Fig. 11).



Fig. 10

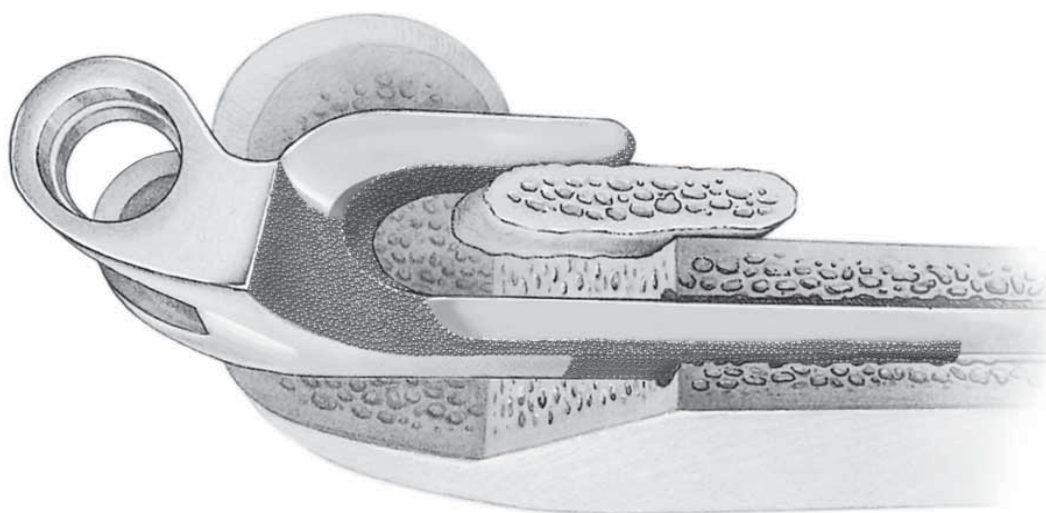


Fig. 11

Articulate the ulnar and humeral components, and connect them by placing the hollow, outer axis pin across the two components and securing it with the solid internal axis pin (Fig. 12). Be sure that the two pins are fully engaged. A click should be heard and felt when the two pins are connected. If not, soft tissue is likely trapped between the pin and the implant preventing complete engagement.

When a revision is performed on an earlier design Coonrad/Morrey Implant, and only one of the stems is to be revised, revision kits are available to accommodate the mismatch between the older, well-fixed component and the new style implant. These kits will contain 2 humeral bushings, 1 ulnar bushing and an inner and outer locking pin. A Revision Replacement Reference guide is available to assist with these situations (97-8106-004-00).

After the prosthesis has been coupled, use the Humeral Impactor to impact the humeral component (Fig. 13). Typically, the component should be inserted so that the axis of rotation of the prosthesis is at the level of the normal anatomic axis of rotation. This is approximately where the base of the flange is flush with the anterior bone of the coronoid fossa. Flex and extend the elbow to identify areas of impingement, and remove any impinging bone with a rongeur.

Remove excess cement and/or bone graft. If cortical struts are used, gradually tighten the wires securing the struts to the humeral shaft.

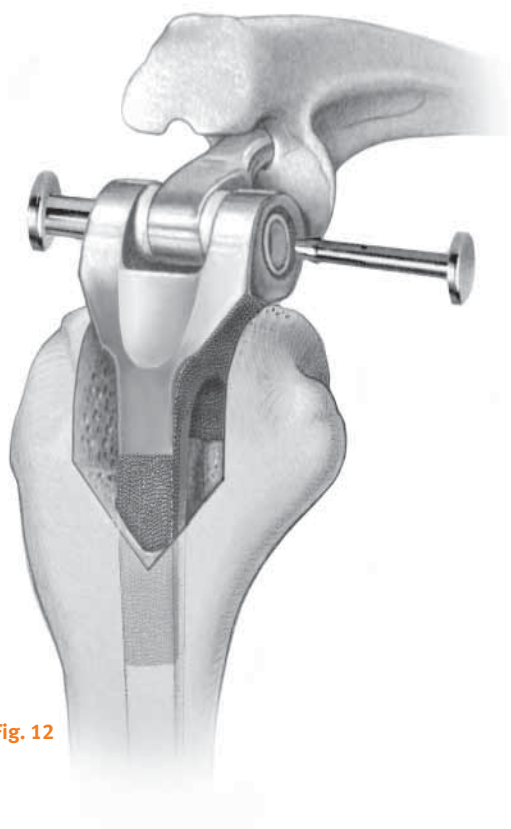


Fig. 12

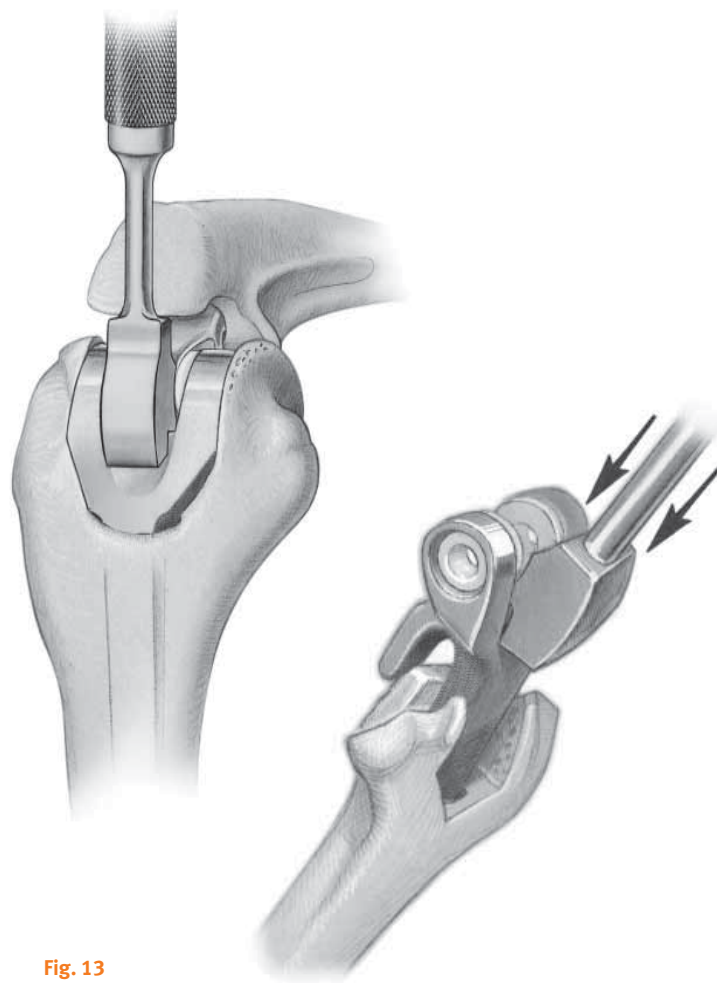


Fig. 13

Closure

Deflate the tourniquet and obtain hemostasis. Insert a drain, if desired, and close the wound in layers. Return the triceps mechanism to its anatomic position and secure it with sutures placed through cruciate and transverse drill holes in the proximal ulna. Place a heavy #5 nonabsorbable suture in a crisscross fashion in the triceps, and a second suture in a transverse

manner. Tie these sutures with the elbow flexed at 90 degrees (Fig. 14). To protect the ulnar nerve, place it in a subcutaneous pocket (Fig. 15). There is no need to repair the collateral ligaments. Use absorbable sutures to repair the remaining portion of the triceps mechanism. Then complete the closure in a routine fashion. Apply a compressive dressing with the elbow in full extension.

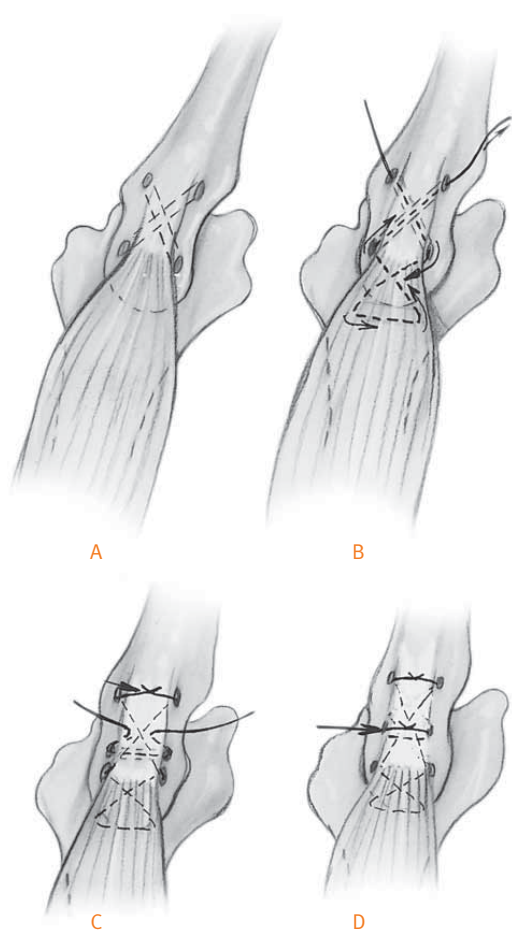


Fig. 14

Postoperative Management

Elevate the arm postoperatively for two to four days with the elbow above shoulder level. Remove the drains, if used, at approximately 24 to 36 hours, and the compressive dressing on the second day after surgery. Apply a light dressing and allow elbow flexion and extension as tolerated. Use a collar and cuff, and instruct the patient on activities of daily living. Typically, no formal physical therapy is required unless necessary for the shoulder or hand. Avoid strengthening exercises. The patient should be advised not to lift more than one pound during the first three postoperative months and not lift more than five pounds with the operated arm.

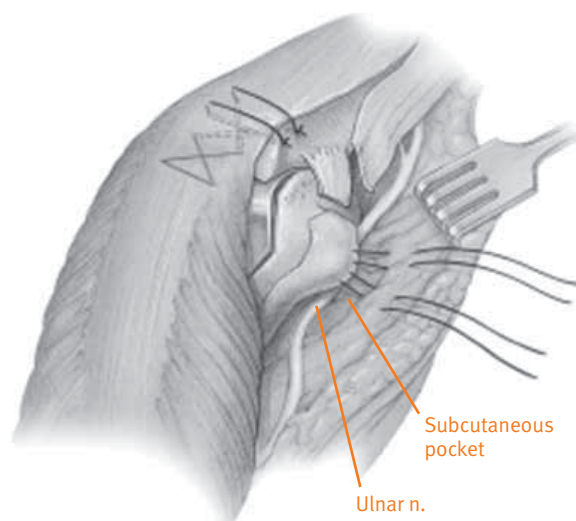


Fig. 15

Please refer to package insert for complete product information, including contraindications, warnings, precautions, and adverse effects.



97-8106-106-00 Rev. 1 5MM Printed in USA ©2004, 2006 Zimmer, Inc.

Contact your Zimmer representative or visit us at www.zimmer.com

