Surgical Technique

smith&nephew

COFIELD° 2

Shoulder System

Contents

Nota Bene:
The technique description herein is made available to the healthcare professional to illustrate the author's suggested treatment for the uncomplicated procedure. In the final analysis, the preferred treatment is that which addresses the needs of the specific patient.

Design Surgeon
Robert H. Cofield, MD
Consultant in Orthopedics
Mayo Clinic
Professor of Orthopedics
Mayo Clinic School of Medicine

Introduction

Design of a shoulder implant is complex. First and foremost, the implants replace absent cartilage surfaces. For many reasons there must be considerable deference to human anatomy. Additionally, one must account for biomechanical theory and testing, understand the limitations of materials, have knowledge about manufacturing processes, and among all these complexities, recall that simplicity and ease of application are needed for consistent and reproducible results[1].

Robert H. Cofield, MD
Consultant in Orthopedics
Mayo Clinic
Professor of Orthopedics
Mayo Clinic School of Medicine

With these parameters in mind and a deep attachment to bone conservation, it seemed useful, in 1980, to design a shoulder implant system having more versatility than the initial designs and a more complete set of instruments for precise insertion. Major design decision points center around what will be standard (the average of the human spectrum) and what should be variable. It was decided, and we still feel this to be reasonably so, that the surface curvature of the implant would remain the same throughout the spectrum of sizes, but there would be variable humeral head widths and thicknesses, with later additions of offsets to increase thickness without increasing width, and eccentricity to address a lack of concordance between the humeral shaft and head relationship. The humeral stem should be relatively narrow (conserving bone or space for bone), with only a small proximal expansion, and be long enough to have purchase on the cortex of the humeral shaft. There should be multiple fins proximally for rotational stability, each with rounded holes for suture fixation. There should be an optimum surface finish proximally with texturing or ingrowth material, yet a polished surface distal to the metaphysis for ease of application and removal—if necessary. There should be a variety of stem lengths to address extensive fractures and oncologic needs. The glenoid component was initially congruent with the humeral head but experience and biomechanical theory and testing suggested a slight mismatch would be better. The surface radius and the radius adjacent to the glenoid bone are different and were designed as such. Variable sizes were created to mirror human anatomy. Keels were used initially to not deviate too far from clinical experience; peg options were later added to further conserve bone and facilitate insertion. Throughout the period of designing and through the time that included all these evolutionary changes, the instrumentation has remained ample and exacting; for example: using an intramedullary and extramedullary guide for humeral resection; designing exact reamers for canal preparation; precise guides, drills, and reamers for glenoid application- all encased in well-organized and sequenced instrument trays. Throughout all these sequential changes over the past 25+ years, patient outcomes have been continually assessed via Joint Registry methods and with focused studies to delineate nuances of shoulder joint replacement. These implants and this ongoing clinical experience give one great confidence in application of shoulder arthroplasty to a large variety of patient care needs, be they for fractures, residuals of injuries, arthritis, or oncologic conditions. A sound, solid foundation has been formed for continuing advancements in arthroplasty, be they in changes of the fixation to bone, bearing surfaces or in other directions.

Unmatched for intraoperative options

- Four stem lengths ranging from 115-245mm
- Six stem diameters ranging from 6-16mm
- Porous proximal surface allows use in press-fit or cemented applications
- Twenty-six modular head options with concentric, eccentric, lateral offset and unipolar designs
- Three sizes of pegged and keeled all-poly glenoids

Humeral stem features

- Cylindrical design for bone conservation
- Bullet style distal tip to minimize distal humeral injury
- Cement grooves for rotational stability in cement mantle
- Polished distal stem to simplify implant removal if required
- 5° proximal conical flare to optimize proximal fit
- A/P and M/L fins to maximize stability
- Proximal porous coating to enhance bone in-growth or cement fixation
- A/P and M/L suture holes to aid in reconstruction of proximal humeral fractures
- Secure and proven low profile locking taper
- 140° head-shaft inclination angle replicates normal humeral head orientation

Product overview

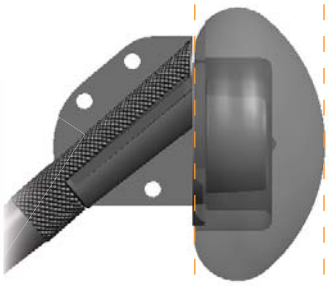
With over 25 years of clinical history, the COFIELD® 2 Shoulder System has proven itself a leader in the field of shoulder arthroplasty. Incremental design improvements over the years have kept the system at the forefront of technology while adhering to Dr. Cofield's original design principles of a stable, anatomically correct, bone sparing system with a simplified surgical technique. From the community surgeon to the shoulder specialist, the clinical success of the system has been documented in numerous peer reviewed articles.[1,2,3]

The modular COFIELD 2 system was designed to provide surgeons with the confidence required from a system to allow them to restore quality of life to their patients. With four stem lengths, six stem diameters, three sizes of keeled and pegged glenoids and twenty six head options, the system provides virtually unmatched intraoperative options. Eight sizes of concentric, lateral offset and eccentric offset heads allow for proper positioning of the humeral head to assure correct tissue tensioning thoughout the range of motion.

Although the following surgical technique documents the use of the system in an elective joint replacement procedure, the COFILED 2 system is also used in trauma settings following proximal humeral fractures. The system's cylindrical design allows for easy setting of height and retroversion while its proximal porous coating and medial/lateral and anterior/posterior suture holes allow for optimal anatomic stabilization of the fragments during the healing process. As with all surgical techniques, the actual steps used will vary somewhat depending on the individual clinical situation. The following technique description is intended solely as a general guide for shoulder joint replacement with the COFIELD 2 system.

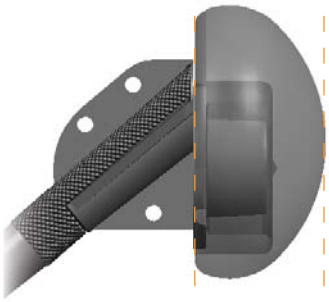
Humeral head features

Multiple head options



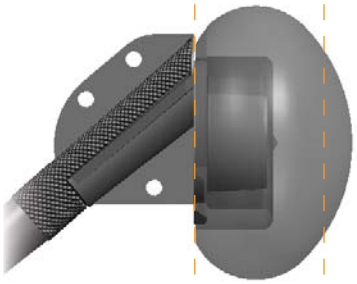
Standard

25.4mm radius of curvature on articular surface.



Eccentric

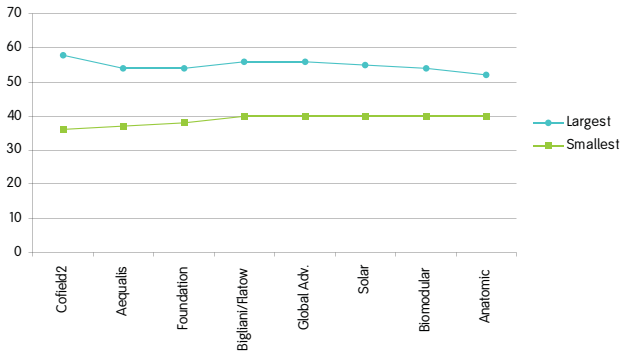
Articular geometry provides better range of motion and less stress on surrounding tissue.



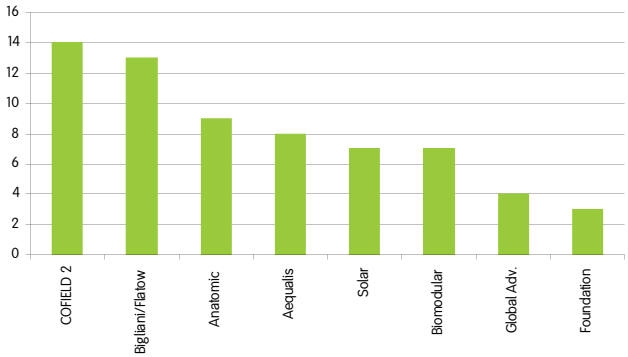
Lateral Offset

Numerous head options allow optimized soft tissue tensioning throughou range of motion.

Head diameter range



Number of head height options



Surgical technique

Figure 1

Figure 2

Step 1: Preoperative planning

Use physical examination to assess range of motion, stability and strength. Templates with 7.5% magnification are available to assist in analyzing plain radiographs in determining implant size and position. CT imaging can be helpful with bone deformity or erosion. (Figures 1 and 2)

7128-0330 COFIELD 2 Humeral Templates

7128-0958 COFIELD 2 Glenoid Template

Step 2: Patient positioning

The beach-chair position (Figure 3) is used and is facilitated by incorporation of a head rest into a standard operating table or a specialized table. During the operative procedure a small Mayo-table can be used to support the limb when it is positioned away from the side of the body. The arm should be draped free.

Figure 3

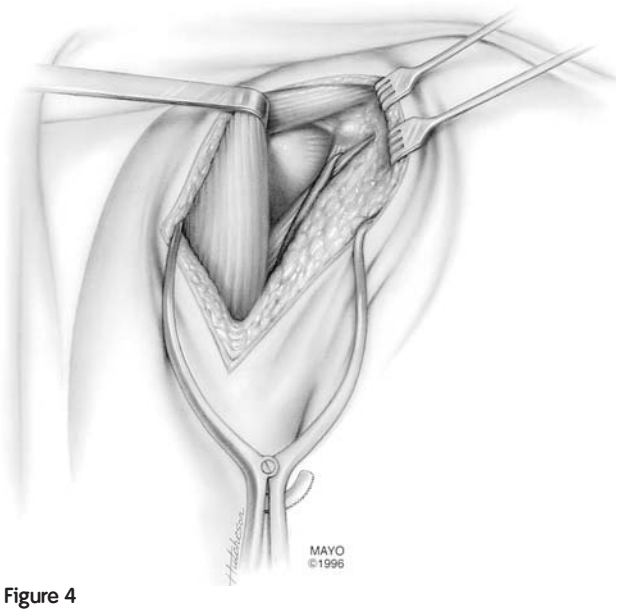


Figure 4

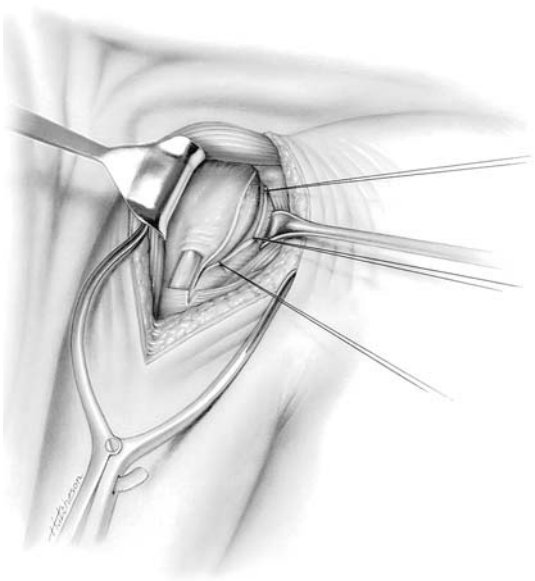


Figure 5

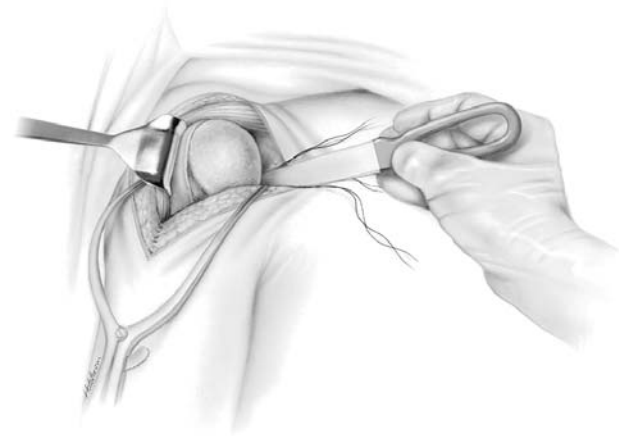


Figure 6

Step 3: Surgical approach

After performing an anterior incision, the deltopectoral interval is developed. (Figure 4)

Free the subdeltoid, subacromial and subconjoined group spaces of scar and place retractors. A deltoid retractor is quite helpful. (Figure 5)

Incise the lower portion of the rotator interval and divide the subscapularis and anterior shoulder capsule through tendon if there is greater than 20 to 30 degrees of passive external rotation. If external rotation is less than this, release the subscapularis and anterior shoulder capsule from bone.

Carefully release the inferior shoulder capsule from the humeral neck and remove osteophytes. Sublux the humeral head forward by arm extension and external rotation. (Figure 6)

Surgical technique

Step 4: Humeral preparation
Enter the humerus at a point on the superior aspect of the humeral head typically 1cm medial to the junction of the rotator cuff with the humeral head and 1 cm posterior to the posterior aspect of the groove for the long head of the biceps. This distance may vary somewhat depending on the patient size. Removal of a portion of the subchondral plate in this region facilitates tactile sensation during humeral canal preparation.

Ream the humeral canal in 2mm increments typically beginning with the 6mm reamer. Leave the largest reamer used in position.

Slide the humeral head resection guide over the upper aspect of the reamer and lower to 1 mm above the inside attachment of the rotator cuff superiorly and rotated typically to 30 degrees of retroversion as determined by a parallel position between the alignment rod and the flexed forearm. (Figure 7) Retroversion is adjusted slightly depending upon the specific anatomic situation, glenoid position and shoulder stability. However, it is rare that the retroversion would be less than 20 degrees or greater than 40 degrees (alignment selection is also available on the cutting guide). Use one or both of the comma guides to make fine adjustments to the height of the cutting block. The comma guide, when placed laterally, should rest just above the insertion of the rotator cuff. Fix the resection guide in position with 2 pins placed in previously prepared drill holes and remove the intramedullary reamer. Resect the humeral head.

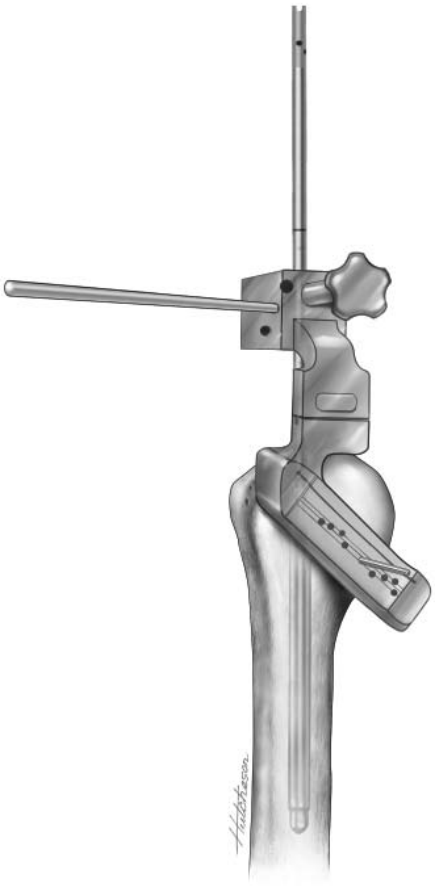


Figure 7

Place the trial humeral stem, **2mm smaller in diameter than the last used reamer**, into the canal. (Figure 8) Select a provisional humeral head size based upon the amount of humeral head removed, the size of the patient, and to a lesser extent, on tissue flexibility. If required, use a saw or osteotome to cut a slot for the lateral fin of the trial.

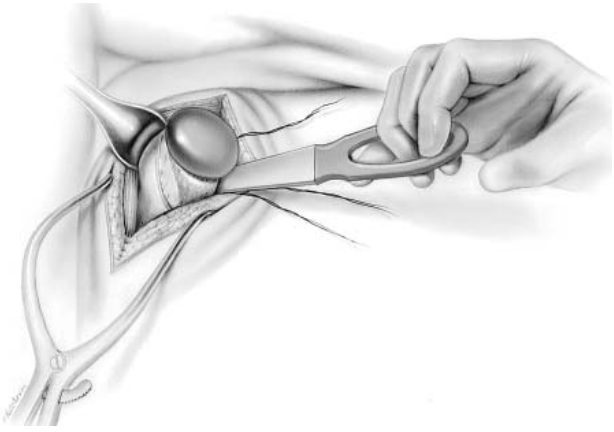
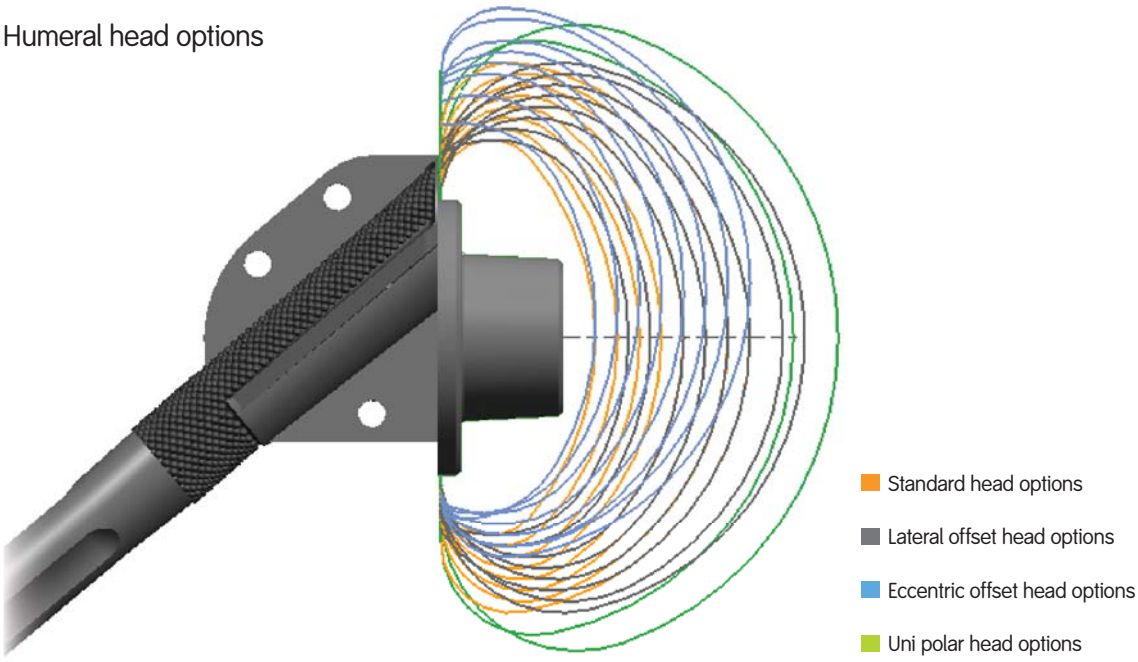


Figure 8

Humeral head options



Trim the metaphysis around its anterior, inferior, and postero-inferior periphery so the bone does not extend beyond the width of the inferior third of the humeral head.

Perform a trial reduction to assess range of motion and stability.

Assess the position of the trial humeral head against the glenoid. Ordinarily, it should sit opposite the center of the glenoid — when there is very little glenoid bone erosion. Test the component for translation posteriorly and inferiorly. Typically, the amount of translation posteriorly that is possible would be one-half the width of the humeral head or less when the arm is in neutral rotation. The amount of translation inferiorly would be one-quarter the width of the humeral head or less when the arm is in 15 degrees to 20 degrees of abduction. Then assess the range of motion.

The COFIELD 2 system has a series of concentric humeral heads, a series of offset humeral heads and a series of eccentric humeral heads. The offset humeral heads are thicker without any increase in diameter and the eccentric humeral heads allow positioning of the humeral head away from the axis of the humeral stem in any direction. These heads are typically used in patients with lax tissues to allow tensioning the tissues without having the width of the humeral head impinge on the surrounding capsule and rotator cuff tendons. This is occasionally useful in arthroplasty for degenerative arthritis but most commonly a necessity for those patients with old trauma and slight malunion. When using an eccentric offset head, it is critical to note the location of the trial head's laser mark line. This location should be marked with a surgical marker or a cautery knife on the proximal humerus.

For hemi arthroplasty proceed to Step 6.

Surgical technique

Step 5: Glenoid preparation and placement

After trial reduction of the humeral component to assess range of motion and stability, remove the humeral head trial but leave the stem in place. If desired, the trial stem may be removed and the Humeral Canal Protector can be inserted to protect the humerus and allow better access to the glenoid. Distract the joint using a bone hook on the humeral metaphysis and inspect the joint for loose bodies or redundant soft tissue which are removed. Push the humerus posteriorly and hold in that position with a Fukuda or humeral neck retractor. (Figure 9) To affect greater flexibility of the anterior capsule and subscapularis, the anterior capsule may need to be released from the anterior aspect of the glenoid. A retractor is then placed in this interval facilitating further exposure of the glenoid.

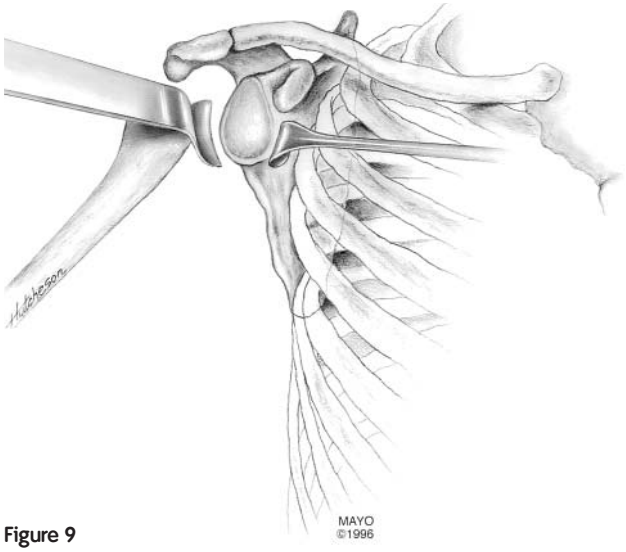


Figure 9

Determine the glenoid size by using Drill Guide 1. A centering hole is made by using a bone awl or small burr and modified as necessary. The centering hole is completed using Drill 1 (longer drill with short drill stop). (Figure 10)

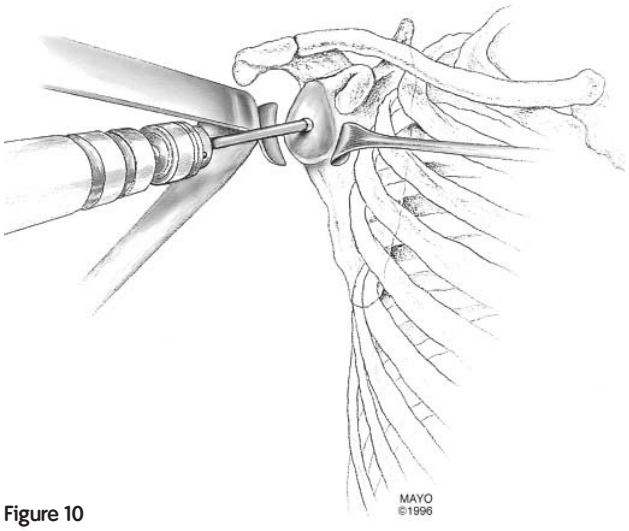


Figure 10

Use the appropriate sized reamer to recontour the face of the glenoid and create a mixture of cortical and cancellous bone. (Figure 11)

Position the drill guide and carefully deepen the centering hole using Drill 2 (short drill with long stop). (Figure 12)

Leave Drill 2 in place while drilling remaining holes.

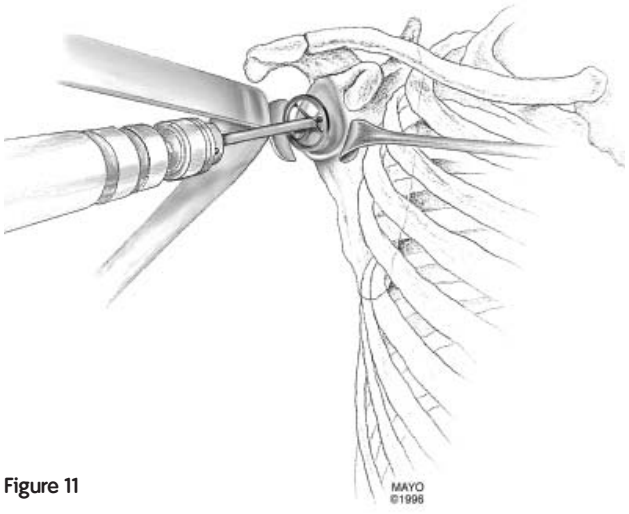


Figure 11

Rotate the drill guide to match the long axis of the scapula. Make a peripheral hole using Drill 1. Place the glenoid alignment peg in that hole and then make the second peripheral hole with Drill 1. (Figure 13)

Remove the drills and template. Use the peg rasp to slightly expand the drill holes. Remove fibrous tissue from the glenoid if necessary. Undermine the drill holes with a burr and further prepare the glenoid with pulsed lavage and packing.

Compress cement into the drill holes and onto the surface of the glenoid. Insert the glenoid and hold it in position with the glenoid Impactor until cement sets. (Figure 14) [4]

If there is central bone deficiency compromising peg fixation, or if a keel type glenoid is preferred, after drill preparation place Drill Guide 2 into the glenoid and use the keel cutter router tip to prepare the keel slot by connecting the 3 drilled holes. Next use a burr to carefully deepen the amount of bone resection without perforating the cortical walls of the glenoid neck. A keel sizer/rasp is available to further refine keel slot preparation. Further glenoid preparation and cementing the component is then performed similar to the technique for the pegged component.

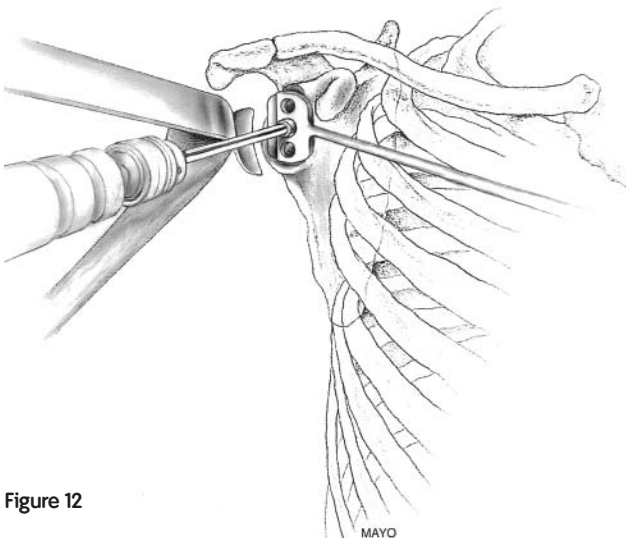


Figure 12

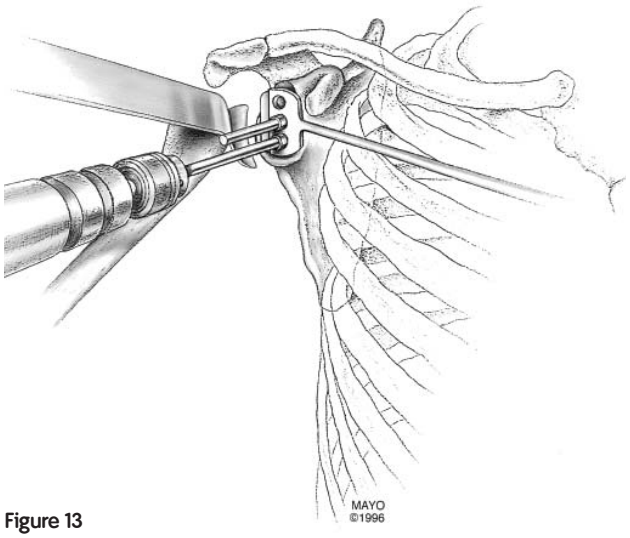


Figure 13

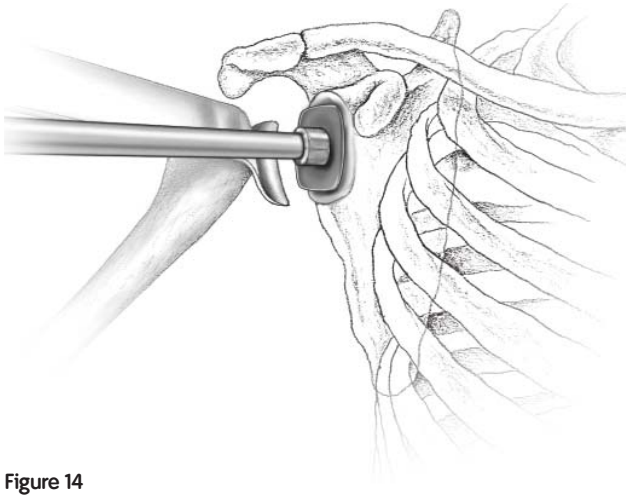


Figure 14

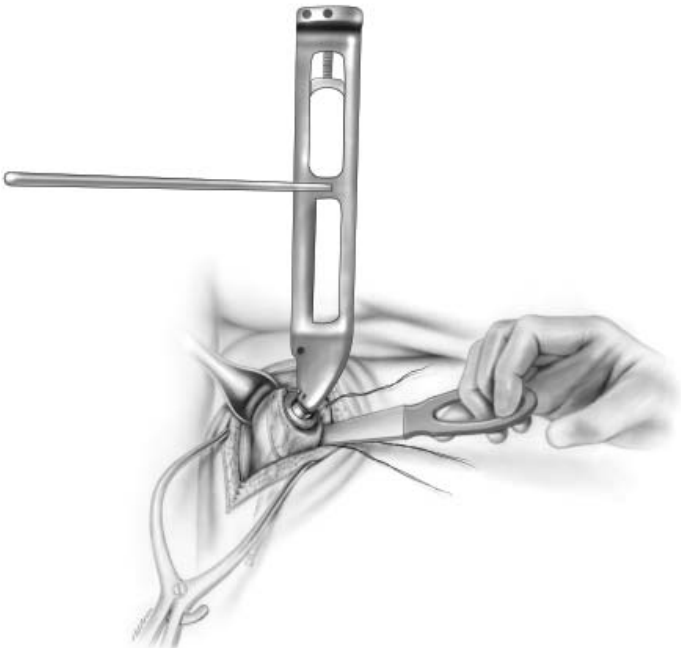


Figure 15

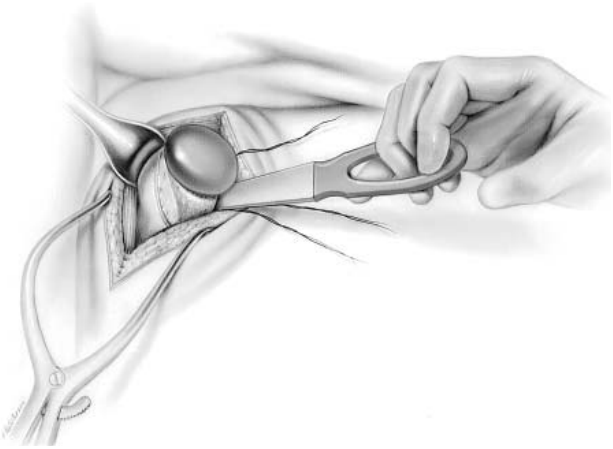


Figure 16

Step 6: Trial reduction

After glenoid implant fixation, reposition the humeral head trial and inspect the joint for range of motion and stability. Typically the size of head selected closely matches the size of the patient and their native bone. There should be slight tension on the superior aspect of the rotator cuff with the arm near the side, but the rotator cuff should not be tented upward. Posteriorly, there is typically translation approximately half the humeral head width with a strong tendency for the humeral head to reseat itself opposite the glenoid. Range of motion overhead is typically nearly normal. With the arm in 70 degrees of abduction, downward rotation is typically to 90 or 100 degrees. When traction is placed on the subscapularis and anterior shoulder capsule, external rotation is typically greater than 30 degrees. With these parameters met, the appropriate style and size of humeral head is selected.

Step 7: Positioning of final implant

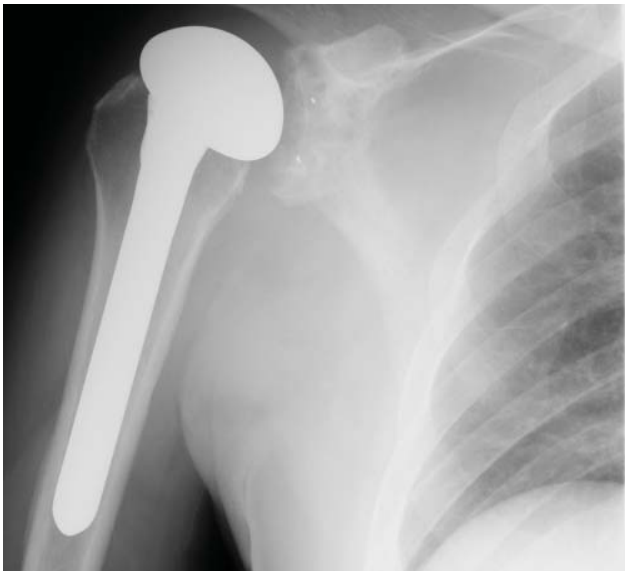
Cement fixation

For cement fixation, **place a humeral stem 2mm smaller than the final reamed diameter** on the humeral impactor and insert into the previously created space. If desired, the guide rod can be used to verify retroversion determined during trialing. (Figure 15) After cement curing, remove the impactor and impact the previously selected humeral head onto the fixed stem. (Figure 16) If using an eccentric offset head, make sure to orient the laser mark line of the final implant with the location previously determined during trialing.

Press-fit fixation

If press-fitting is desired, typically the head and stem are impacted together on the back table and then inserted as a single unit. **Select a stem diameter identical to the final reamer.** The stem's porous coating and proximal conical flare provide a pressfit with the reamed canal. If using an eccentric head, make sure to orient the laser mark line of the final implant with the location previously determined during trialing.

Reduce the joint and again assess motion and stability. Repair the rotator interval area and the subscapularis. Again assess movement to determine the safe arcs of passive movement that can be performed prior to tendon and capsule healing.



Step 8: Postoperative Management

Place the arm in a shoulder immobilizer to be used at night during the first 4 to 6 weeks and during the day and night for the first week. Following this, a sling is used during the day for the remainder of the first 4 to 6 weeks.

The day following surgery the patient should be instructed in active hand, wrist, forearm, and elbow exercises that are done gently throughout the day. The patient should be instructed in a passive range of motion program within the limits of the repair determined at the time of surgery. This might include external rotation to 20 to 30 degrees, and elevation to 140 degrees.

At 5 to 6 weeks begin an active assisted motion program and isometric strengthening. At 8 to 10 weeks add stretching as necessary and advance strengthening to the use of elastic straps.

Catalog information: implants/trials

Set numbers

7125-1001	COFIELD 2 Humeral Stems	115 & 145mm
7125-1002	COFIELD 2 Humeral Stems	195mm
7125-1003	COFIELD 2 Humeral Stems	245mm
7125-1004	COFIELD 2 Humeral Heads	
7125-1009	COFIELD 2 Pegged Glenoids	
7125-1014	COFIELD 2 Keeled Glenoids	

Humeral stems: cobalt chrome (ASTM F75)*

Catalog no.	Diameter	Length (mm)	Trial cat. no.
71259006	6mm	115mm	7124-9506
71259008	8mm	145mm	7124-9508
71259010	10mm	145mm	7124-9510
71259012	12mm	145mm	7124-9512
71259014	14mm	145mm	7124-9514
71259016	16mm	145mm	7124-9516
71259108	8mm	195mm	7124-9108
71259110	10mm	195mm	7124-9110
71259112	12mm	195mm	7124-9112
71259114	14mm	195mm	7124-9114
71259116	16mm	195mm	7124-9116
71259208	8mm	245mm	7124-9208
71259210	10mm	245mm	7124-9210
71259212	12mm	245mm	7124-9212

*** Trial stems are made of stainless steel. Intermediate and revision length trials consist of stem extensions which attach to the primary length trials. All implants are one piece.**

Glenoids: ultra high molecular weight polyethylene (ASTM F648)

Catalog no.	Description	Trial cat. no.
71259501	Keeled Small	7124-9501
71259502	Keeled Medium	7124-9502
71259503	Keeled Large	7124-9503
71259601	Pegged Small	7124-9601
71259602	Pegged Medium	7124-9602
71259603	Pegged Large	7124-9603

Standard heads: cobalt chrome (ASTM F799)*

Catalog no.	Thickness	Diameter	Trial cat. no.
71259314	14mm	36mm	7124-9314
71259316	16mm	38mm	7124-9316
71259318	18mm	40mm	7124-9318
71259320	20mm	42mm	7124-9320
71259322	22mm	44mm	7124-9322
71259324	24mm	46mm	7124-9324
71259326	26mm	48mm	7124-9326
71259328	28mm	50mm	7124-9328

Eccentric offset heads: cobalt chrome (ASTM F799)*

Catalog no.	Thickness	Diameter	Eccentric offset	Trial Cat. No
71259614	14mm	36mm	1.5mm	7124-9614
71259616	16mm	38mm	3mm	7124-9616
71259618	18mm	40mm	4mm	7124-9618
71259620	20mm	42mm	4mm	7124-9620
71259622	22mm	44mm	4mm	7124-9622
71259624	24mm	46mm	4mm	7124-9624
71259626	26mm	48mm	5mm	7124-9626
71259628	28mm	50mm	5mm	7124-9628

Lateral offset heads: cobalt chrome (ASTM F799)*

Catalog no.	Thickness	Diameter	Lateral offset	Trial cat. no.
71259717	17mm	36mm	3mm	7124-9717
71259719	19mm	38mm	3mm	7124-9719
71259722	22mm	40mm	3mm	7124-9722
71259724	24mm	42mm	4mm	7124-9724
71259726	26mm	44mm	4mm	7124-9726
71259728	28mm	46mm	4mm	7124-9728
71259731	31mm	48mm	5mm	7124-9731
71259733	33mm	50mm	5mm	7124-9733

Unipolar hemiarthroplasty humeral heads: cobalt chrome (ASTM F799)*

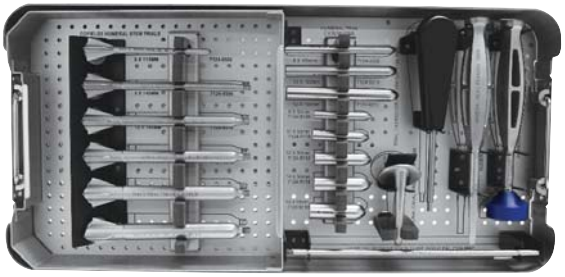
Catalog no.	Thickness	Diameter	Trial cat. no.
71259332	32mm	54mm	7124-9332
71259336	36mm	58mm	7124-9336

*** All trial heads are made from an acetal copolymer.**

Catalog information: instruments

Humeral Prep Set

7124-9680



Humeral end cutting drill—6mm

Cat. no.	7124-8806

Humeral side cutting reamers

Cat. no.	Size
7124-8908	8mm
7124-8910	10mm
7124-8912	12mm
7124-8914	14mm
7124-8916	16mm

T-handle quick connect

Cat. no.	7124-9920

Humeral resection guide

Cat. no.	7124-9864

Retroversion guide rod

Cat. no.	7124-9662

Kirshner wire pliers

Cat. no.	37497

Pin & drill set

Cat. no. 11-4968

Comma guide (QTY=2)

Cat. no. 7124-9865

Humeral stem impactor/extractor

Cat. no. 7124-9706

Humeral head removal tool

Cat. no. 7124-9705

Humeral canal protector

Cat. no. 36308

Humeral head impactor

Cat. no. 7124-9712

Slotted hammer

Cat. no. 7124-9915

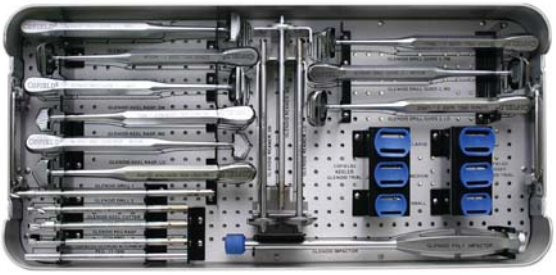
Hex screwdriver

Cat. no. 7124-9646

Catalog information: instruments

Glenoid Tray

7124-9680



Glenoid reamers

Cat. no.	Size
7124-9801	small
7124-9802	medium
7124-9803	large

Glenoid drill guide 1

Cat no.	Size
7124-9851	small
7124-9852	medium
7124-9853	large

Glenoid drill guide 2

Cat. no.	Size
7124-9821	small
7124-9822	medium
7124-9823	large

Keel sizer/rasp

Cat. no.	Size
7124-9831	small
7124-9832	medium
7124-9833	large

Glenoid drills

Cat. no.	
7124-9835	Glenoid drill 1
7124-9836	Glenoid drill 2

Glenoid keel cutter

Cat. no.	7124-9837

Glenoid alignment peg

Cat. no.	11-1030

Glenoid peg rasp

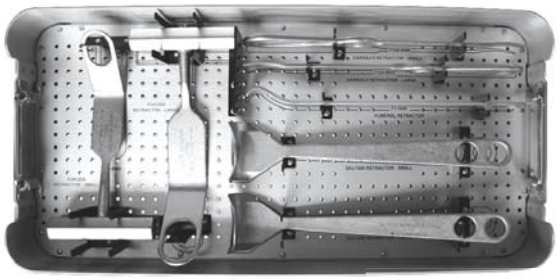
Cat. no.	7124-9863

Glenoid impactor

Cat. no.	7124-9841

Shoulder Retractor Set

7124-9680



Cofield humeral retractor

Cat. no.	11-1040

Darrach style retractors

Cat. no.	Size
7124-9908	small
7124-9910	large

Deltoid retractors

Cat. no.	Size
7124-9904	small
7124-9906	large

Fukuda style retractors

Cat. no.	Size
7124-9900	small
7124-9902	large

References

1. Mileti J, Sperling JW, Cofield RH, Harrington JR, Hoskin TL. Monoblock and modular total shoulder arthroplasty for osteoarthritis. J Bone Joint Surg – British Volume 2005 Apr; 87B(4):496-500

2. Chin PY, Sperling JW, Cofield RH, Schleck C. Complications of total shoulder arthroplasty: Are they fewer or different? J Shoulder Elbow Surg 2006 Jan-Feb; 15(1): 19-22

3. Sperling JW, Cofield RH, O'Driscoll SW, Torchia ME, Rowland CM. Radiographic assessment of ingrowth total shoulder arthroplasty. Journal of Shoulder & Elbow Surgery 2000 Nov-Dec; 9(6):507-13

4. Mileti J, Boardman ND, Sperling JW, Cofield RH, Torchia ME, O'Driscoll SW, Rowland CM. Radiographic analysis of polyethylene glenoid components using modern cementing techniques. Journal of Shoulder & Elbow Surgery 2004 Sep-Oct; 13(5):492-8

Orthopaedic Reconstruction
Smith & Nephew, Inc.
1450 Brooks Road
Memphis, TN 38116
USA

www.smith-nephew.com

Telephone: 1-901-396-2121
Information: 1-800-821-5700
Orders and Inquiries: 1-800-238-7538

47510103 05/07