Biologically Oriented Prostheses

BIOPRO

Modular Thumb Implant

Resource Guide

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Patient Selection

Indications

The BioPro Modular Thumb Implant is indicated for a painful, unstable, or limited-motion thumb with trapeziometacarpal (CMC) joint pathology, including:

- Osteoarthritis (Eaton stages II–III) — most common indication
- Rheumatoid arthritis
- Traumatic or post-fracture arthritis with adequate bone stock
- Post-fracture deformation or bone loss

Anatomic Prerequisites

Required

- Healthy scaphotrapeziotrapezoid (STT) joint — no significant adjacent joint disease
- Adequate trapezium bone stock (typical socket depth 4–5 mm achievable)
- CMC joint confirmed as primary pain generator (diagnostic injection if STT degeneration is present: temporary relief = CMC pathology)
- First metacarpal capable of accepting a press-fit stem

Relative Contraindications

- Scapho-trapezium (STT) arthritis — significant degeneration is a contraindication
- Active or recent infection (quiescent < 6 months)
- Insufficient bone stock to support the prosthesis
- Rheumatoid arthritis with severe systemic involvement or deformity
- Metal sensitivity (cobalt chrome / nickel) — titanium alternative available; confirm with MELISA test
- Smokers — significant ingrowth risk; advise cessation pre-operatively
- Poorly controlled diabetes — impairs bone healing and increases infection risk

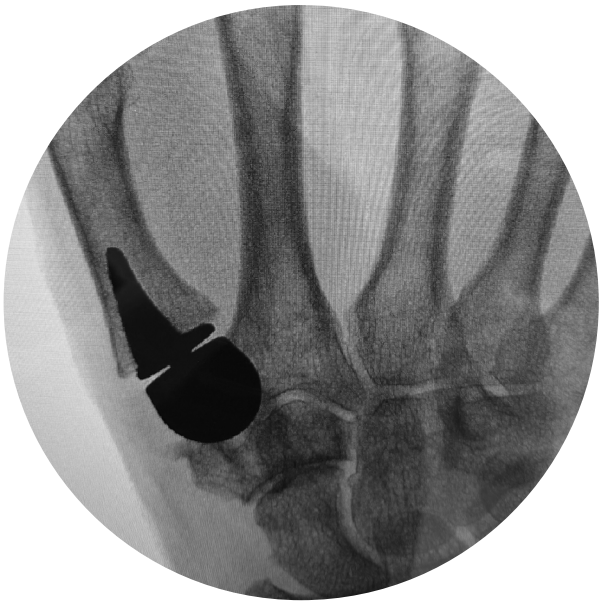
Note: please refer to product IFU for a full list of indications, warnings and precautions.

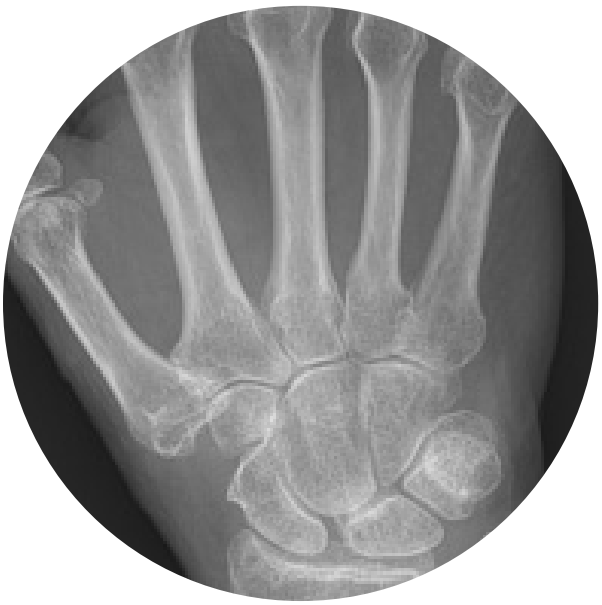
Ideal Candidate Profile

The ideal candidate is an active patient who wants to maintain pinch and grip strength, and who has been specifically referred for or is seeking implant arthroplasty rather than trapezial resection. The patient should understand the recovery timeline, accept that some remodeling discomfort may occur, and commit to post-operative therapy.

Key pre-operative counseling points: recovery timeline, immobilization period, activity restrictions, therapy expectations, potential for remodeling pain, and the possibility of future revision. Patients with poor compliance history should receive a non-removable cast post-operatively.

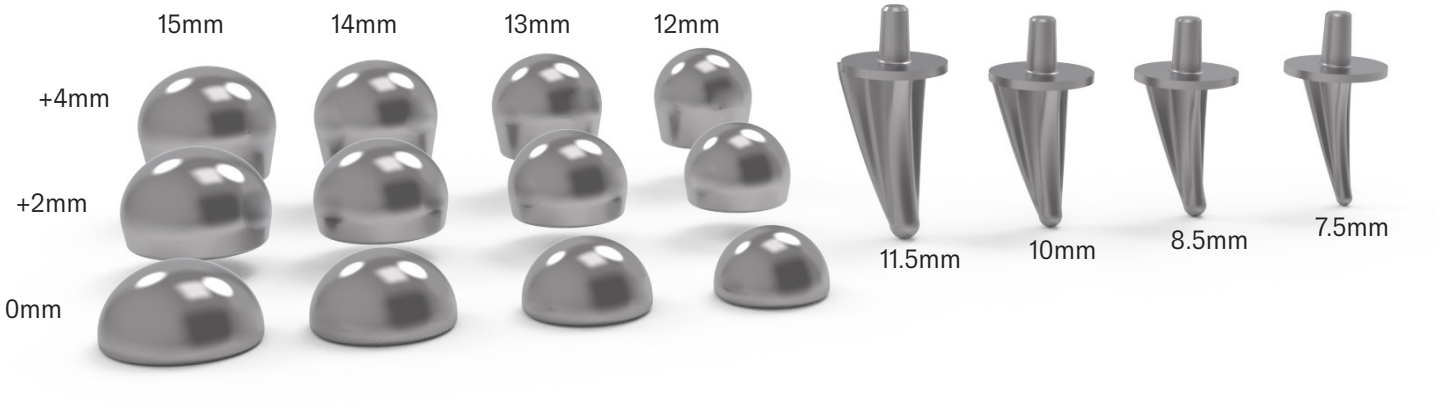
Implant vs. Trapeziectomy (LRTI) — At a Glance





	BioPro Modular Thumb Implant	Trapeziectomy / LRTI
Thumb length	Maintained long-term	Expected shortening
Pinch & grip strength	Preserved / improved	Initial decrease; variable recovery
Biomechanics	Normal joint mechanics restored	Altered ROM and force transmission
Recovery	8–12 weeks to unrestricted use	6+ months
Revision options	Implant exchange or conversion to trapeziectomy	Limited; worse outcomes on revision
MRI compatibility	Not evaluated — caution advised	Not applicable

Implant Overview



Head Component

- Four diameters: 12, 13, 14, 15 mm
- Three neck/height offsets per diameter: 0, +2, +4 mm
- 12 head configurations total
- Color-coded by size: 12mm = Gold, 13mm = Brown, 14mm = Blue, 15mm = Green

Stem Component

- Four widths: 7.5, 8.5, 10, 11.5 mm
- Extended length +4 mm stems available on special request
- Titanium plasma spray (TPS) on dorsal surface enables biological fixation (TPS adds ~0.5 mm to stem diameter vs. trial stem — account for this during broach sizing)
- Ulnar alignment: 15° varus angle + medial offset head maintains head-socket contact during flexion and opposition

Material

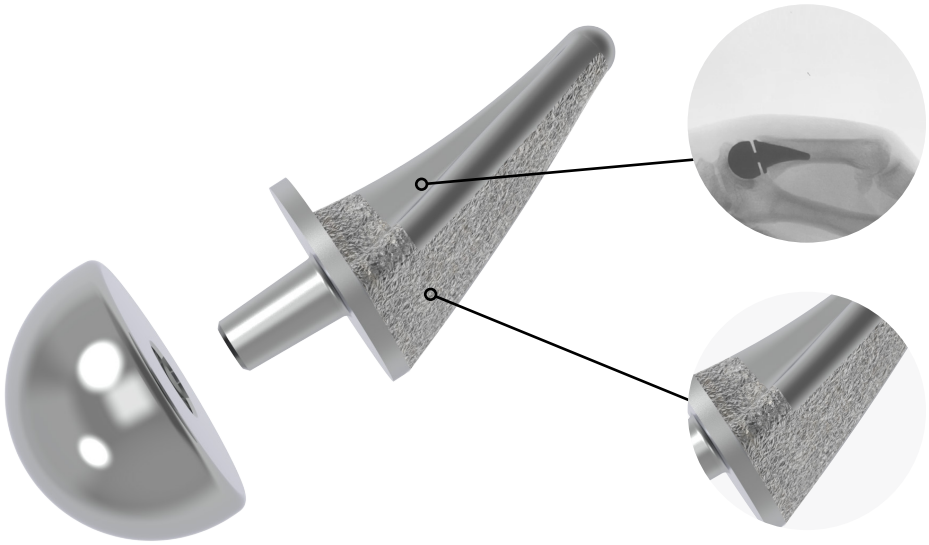
The standard implant is manufactured from cobalt chrome, a highly biocompatible and durable material. A titanium version is available for use in patients susceptible to nickel chromium allergies. The MELISA blood test may be performed to confirm a patient's potential metal sensitivities.

Design Rationale

Ulnar Stem Alignment: The 15° varus cut and medially offset head ensure the ball remains in contact with the trapezial socket during functional thumb positions — particularly flexion and key pinch. Earlier CMC implants used straight stems that allowed the head to migrate out of the socket during these movements. The BioPro design directly addresses this failure mode.

Biological Fixation: The TPS-coated stem achieves osseointegration within the first metacarpal over approximately 6 weeks. The smooth volar surface and coated dorsal surface allow for stem removal if revision is required, while still achieving secure long-term fixation.

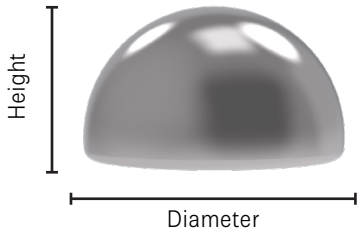
Modularity: Independent head and stem sizing (48 standard configurations) allows the surgeon to optimize both fixation and joint tension separately. This enables intraoperative head upsizing or neck-length adjustment without changing the stem — a critical advantage for managing joint stability.

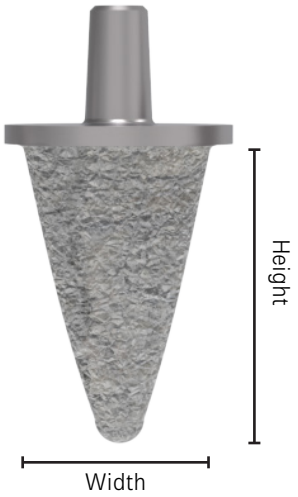


Ulnar Alignment
The stem features a 15 degree angle and medial offset head creating an ulnar alignment of the implant. Unlike implants of the past, this alignment allows the head to maintain contact with the socket during flexion and opposition.

Biological fixation
The collar and dorsal surface of the stem are coated with titanium plasma spray. This allows biological fixation inside the metacarpal while also allowing stem removal if necessary.

Implant Specifications





Description	Diameter	Height
12mm	12mm	7mm
12mm+2	12mm	9mm
12mm+4	12mm	11mm
13mm	13mm	7.5mm
13mm+2	13mm	9.5mm
13mm+4	13mm	11.5mm
14mm	14mm	8mm
14mm+2	14mm	10mm
14mm+4	14mm	12mm
15mm	15mm	8.5mm
15mm+2	15mm	10.5mm
15mm+4	15mm	12.5mm

Description	Width	Height
7.5mm	7.5mm	15mm
8.5mm	8.5mm	15mm
10mm	10mm	16mm
11.5mm	11.5mm	18mm
7.5mm+4mm	7.5mm	19mm
8.5mm+4mm	8.5mm	19mm
10mm+4mm	10mm	20mm
11.5mm+4mm	11.5mm	22mm

+4mm stem are available upon special request

Surgical Technique

Step One
Expose the first carpometacarpal joint through a 3 cm longitudinal incision beginning at the base of the first metacarpal and extending proximally toward the first dorsal compartment.

Develop the interval between the abductor pollicis longus (APL) and extensor pollicis brevis (EPB). Identify and protect the superficial sensory branches of the radial nerve throughout the procedure.

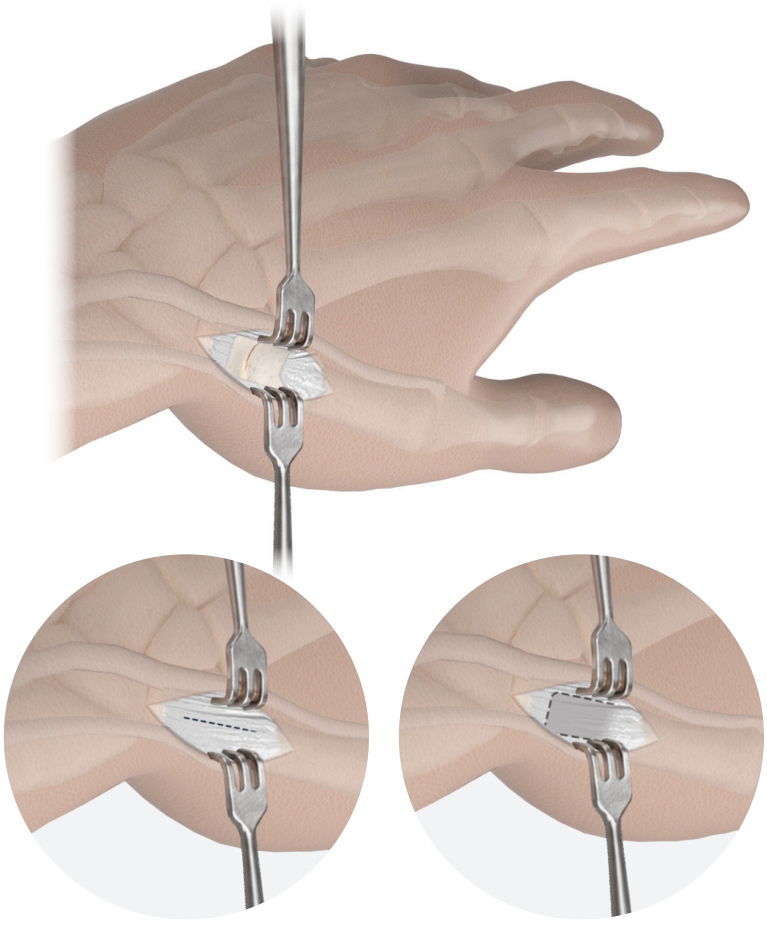


Fig A

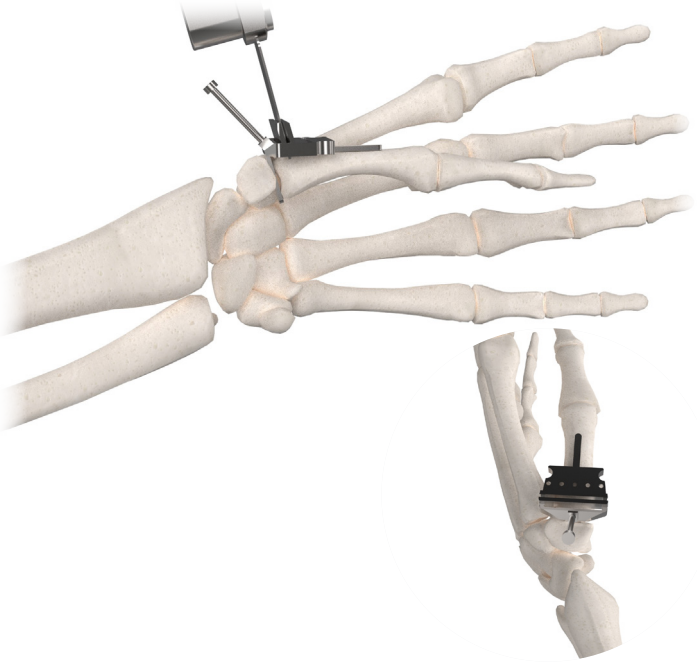
Fig B

Step Two
Perform a capsulotomy of the first carpometacarpal joint to expose the base of the first metacarpal and the distal surface of the trapezium.

Preserve the capsule to allow for subsequent closure and to support implant stability.

Use either a longitudinal capsular incision or a horseshoe (U-shaped) incision. The U-shaped incision is used to create a flap to improve exposure and enable more robust closure.

Surgical Tip
CMC joint arthritis is often accompanied by De Quervain's tenosynovitis. If so, it is recommended to perform a first dorsal compartment release during capsular dissection.



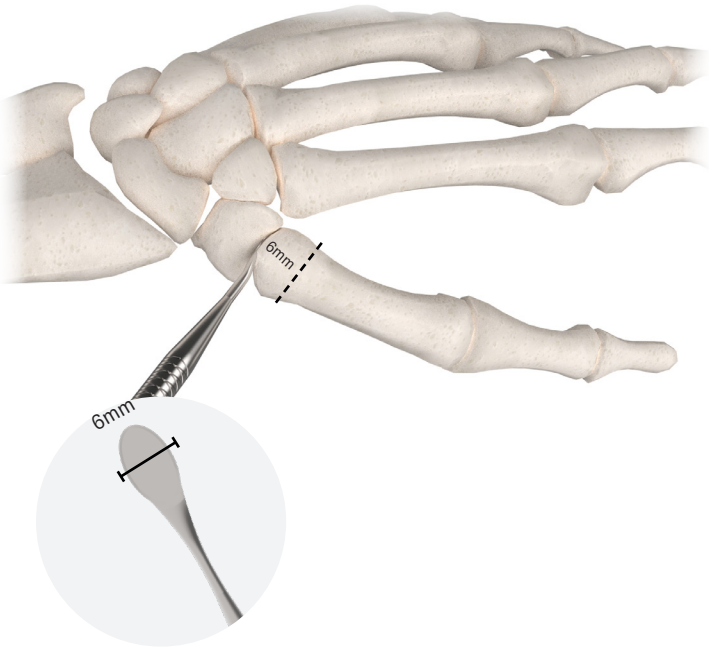
Step Three

The exposed base of the metacarpal is then resected by 5-6mm parallel to the varus positioned articular surface (approximately 15 degrees) in the sagittal plane.

A cutting guide is available to perform the resection. When using the cutting guide, the tail should sit subcutaneous, parallel to the metacarpal with the angled tongue inserted into the joint space. The guide can be clamped down using a towel clamp or simply held in place. Always use the distal cutting slot which allows for a 5mm resection.

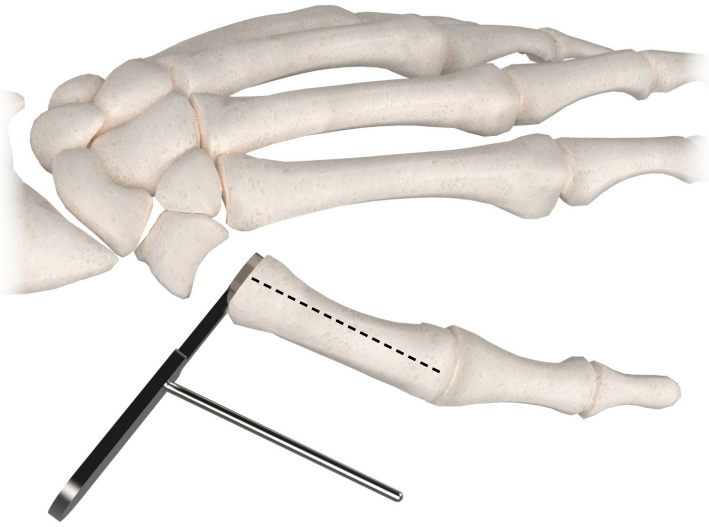
Surgical Tip

It is important to resect approximately 5mm of the proximal metacarpal. The cut should be oriented ulnarly in varus, with a minimum angle of 15°. A greater varus angle is preferred to a lesser one, and angles of up to 20° are acceptable.



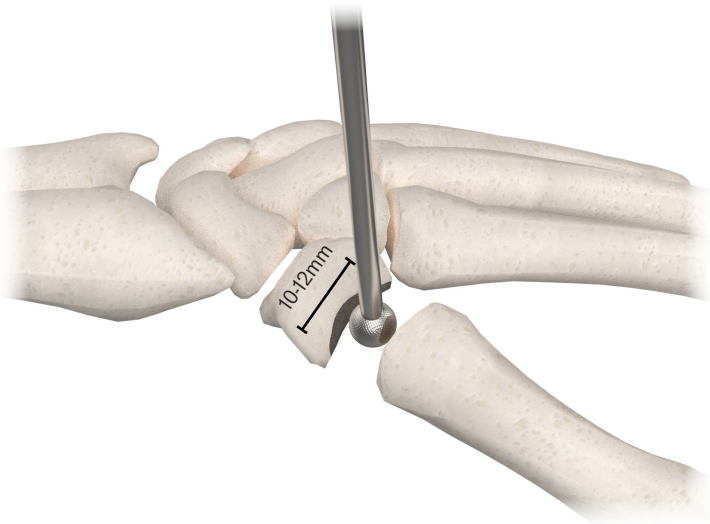
If you choose not to utilize the cutting guide, the bone spatula can be placed into the joint to assist in visualizing the angle before making the 5-6mm resection. The larger side of the bone spatula is 6mm in width and can be used to mark the resection.

If this resection is carried out correctly, equal portions of both condyles are seen in the resected segment of bone.



Step Four

The angle of metacarpal resection should now be verified with the alignment guide. Place the base of this guide flush on the resected surface of the metacarpal, with the pin distal. The pin should be parallel to the metacarpal. If it is not, adjust the angle of the cut.



Step Five

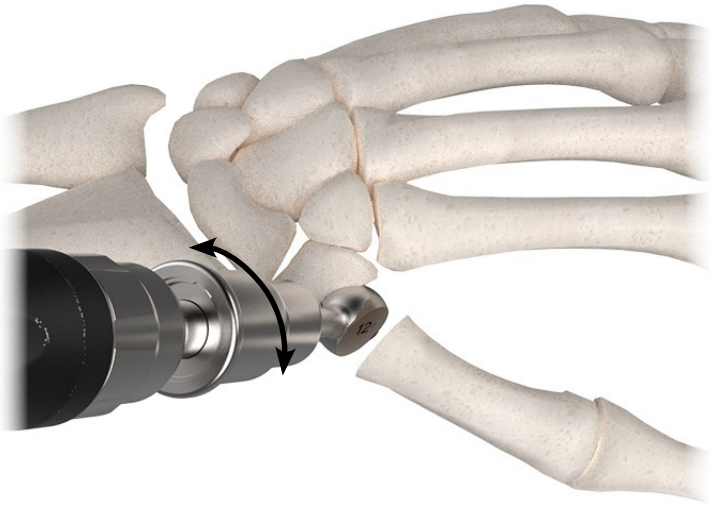
The degenerated CMC joint is frequently radially and laterally subluxated, with impinging osteophytes along the ulnar and medial aspects. When present, extend the capsular dissection ulnarly and excise any impinging osteophytes adjacent to the second metacarpal to facilitate reduction of the CMC joint.

Using a medium rotary burr (4-6mm), create a medialized, concentric concavity in the articulating surface of the trapezium. Preserve the radial and dorsal border of the trapezium. Gradually enlarge the recess to approximately 10–12 mm in diameter, working in a circular pattern from the center outward.

The trapezial socket depth should be approximately 4–5mm. Avoid exceeding a depth of 5mm.

Note

Rotary burrs are not included in the Modular Thumb Implant instrument kit. Sterile burrs are supplied with implant inventory, or the facility may use its own sterile burrs.



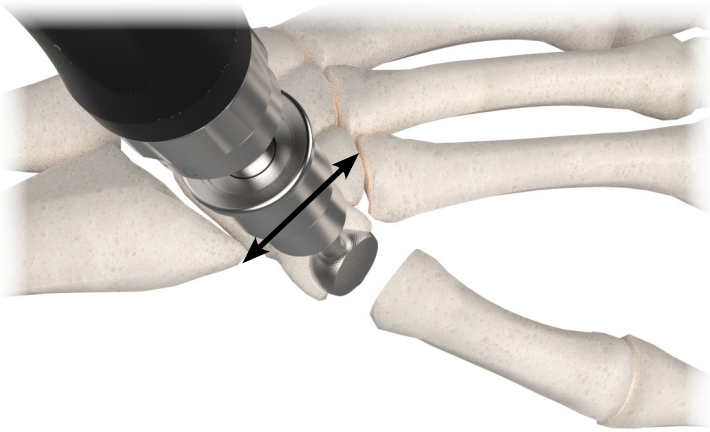
Step Six

Gradually enlarge the socket with the hemispherical burrs, either in the manual hand-piece or using the provided power burr adapters in an oscillating saw. Begin with a twisting motion then, a rotating motion.

Progressively increase the size of the socket with larger burrs until the largest socket possible has been created, while again taking care to preserve the radial and dorsal rim of the trapezium.

Surgical Tip

Both coarse and fine burrs are provided in the instrument set. The fine burrs can be used to polish the socket, creating a smoother articulating surface.

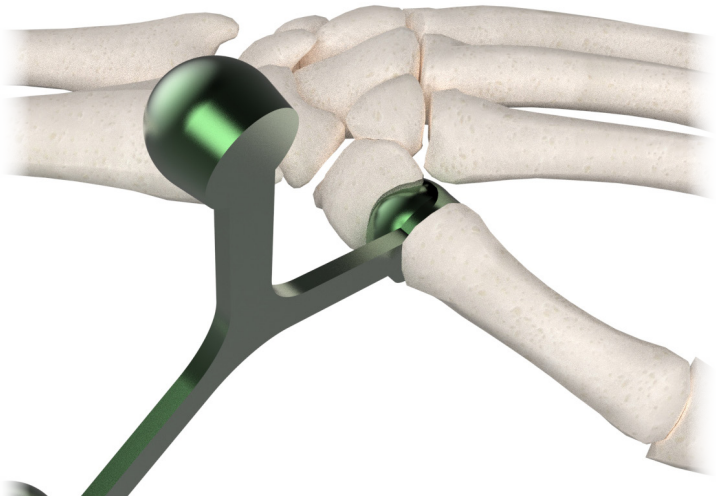


Surgical Tip

Burr for the largest head possible, as this will allow the head to ride on the maximum surface area within the trapezium, distributing forces over a greater area. For example, a 12mm head has a surface area of 226mm^2 compared to a 14mm's surface area of 307mm^2, a 36% increase in surface area. Please note, larger head sizes are strongly encouraged.

Caution

Care must be taken to avoid damaging the proximal metacarpal bone. The depth of the socket need only be sufficient to provide a stable, non-dislocating articulation when evaluated with the trial head component in position, even when positioning the thumb in severe adduction.



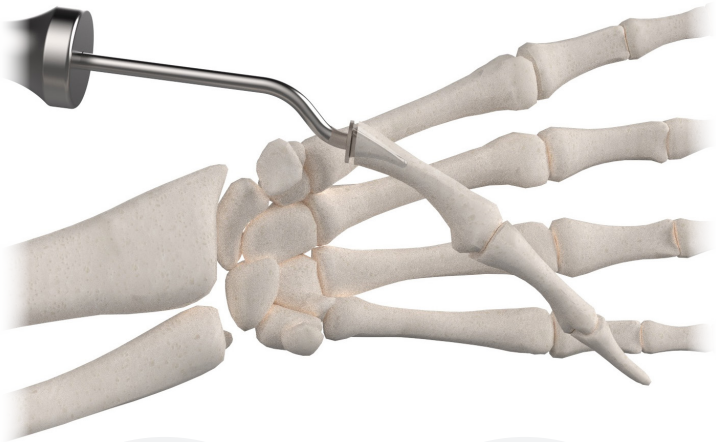
Step Seven

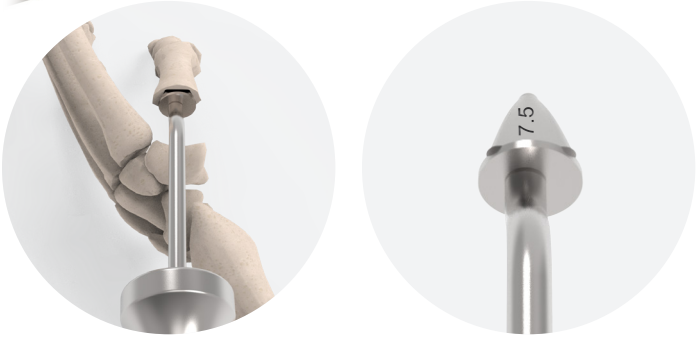
Head sizing guides allow trialing of 0, +2mm, and +4mm neck length heads. This combined sizing and joint tensioning instrument enables assessment of stability, range of motion, and the metacarpal resection angle.

If full abduction cannot be achieved without excessive force, the joint is overstuffed. Correct this by resecting additional bone from the metacarpal or by deepening the trapezial socket if it was initially too shallow. If the joint is overly lax, trial a +2 mm or +4mm neck length head to improve stability.

Important Note

In many cases, a head diameter 1mm larger than the prepared burr size can be used.





Step Eight

Access the longitudinal axis of the metacarpal by adducting and flexing the thumb. If additional exposure to the medullary canal is required, place a Homan retractor along the ulnar aspect of the metacarpal and gently retract the proximal segment outward. Elevate rather than lever to avoid damage to the trapezium.

Initiate broach insertion approximately 2mm dorsal of the center point of the resected base, aligning the flat, engraved surface of the broach with the flat dorsoradial aspect of the metacarpal. Advance the broach until its flare is at or near the cortical surface.

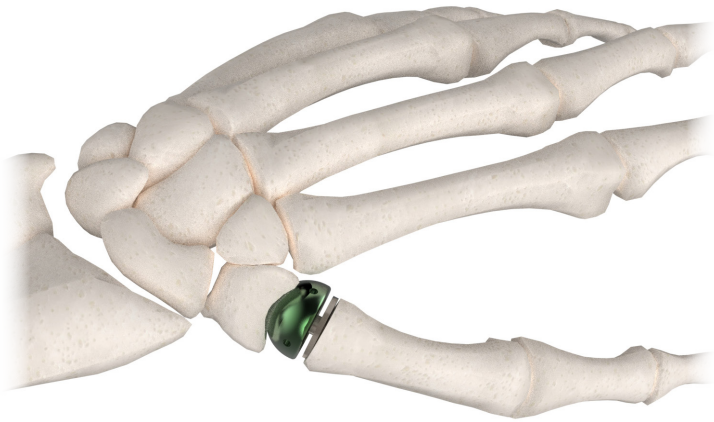
Progressively increase broach size (7.5mm -> 8.5mm -> 10.5mm -> 11.5mm) until the cancellous bone is adequately compacted, achieving a secure interference fit within the medullary canal.

Surgical Tip

Once a stem broach is fully seated, gently rotate it. If the broach moves within the metacarpal, proceed to the next-sized broach. If the metacarpal moves with the broach, this may indicate appropriate stem sizing. A mallet may be used to assist broach insertion; however, avoid forcing an oversized broach, which may compromise the metacarpal.. When the appropriate broach is fully seated, the resected metacarpal surface should be parallel to the stem collar. If the collar is not flush, adjust either the broach insertion angle or the metacarpal resection angle. Intraoperative x-ray will help confirm appropriate metacarpal fill and fit during broaching.

Caution

The plasma spray coating on the final implant increases the stem diameter by approximately 0.5mm. Account for this when selecting broach size.



Step Nine

Once the appropriate stem broach size has been established, exchange the broach for the corresponding trial stem. Assemble the trial head onto the trial stem, matching both the diameter and neck length (0, +2mm, or +4mm) identified in Step Seven as providing optimal stability and range of motion. Seat the assembled trial component into the bone.

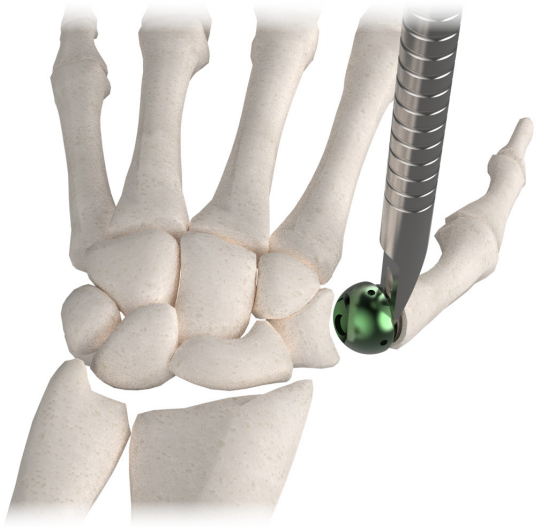
With the trial implant in place, assess joint stability, range of motion, and overall articulation. After confirming satisfactory performance, remove the trial components and prepare for insertion of the final implant.

Surgical Tip

Remove any self-retaining retractors during trialing, as they may artificially increase joint tension and misrepresent implant stability.

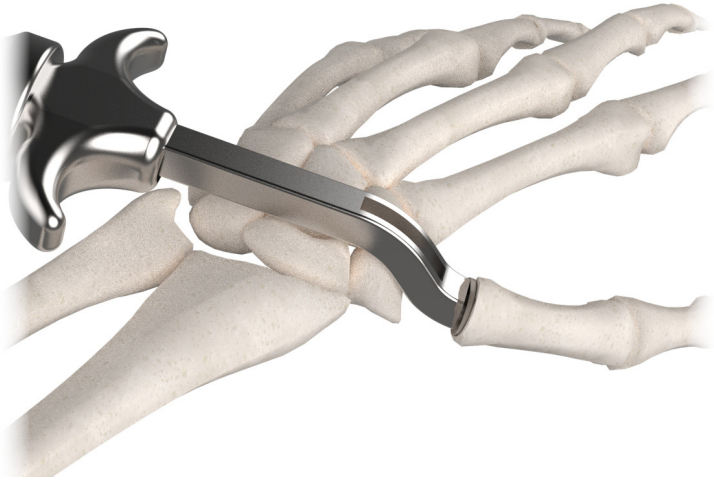
If adequate stability or joint tension is not achieved, consider the following adjustments:

- Increase neck length (e.g., transition from a standard head to a +2mm option)
- Enlarge and/or deepen the trapezial socket (this may necessitate a larger head diameter or altered neck length)
- Confirm that the metacarpal resection is oriented ulnarly in a varus alignment (approximately 15°), using the Alignment Guide as needed



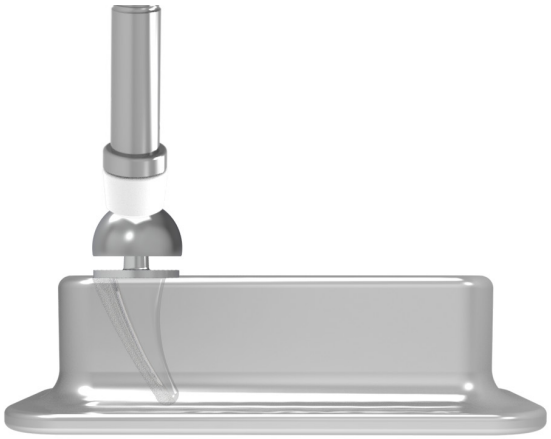
Step Ten

Use the Head Remover to disengage the trial head from the trial stem. The instrument's tapered fork is advanced over the head, applying controlled pressure to separate it from the stem.



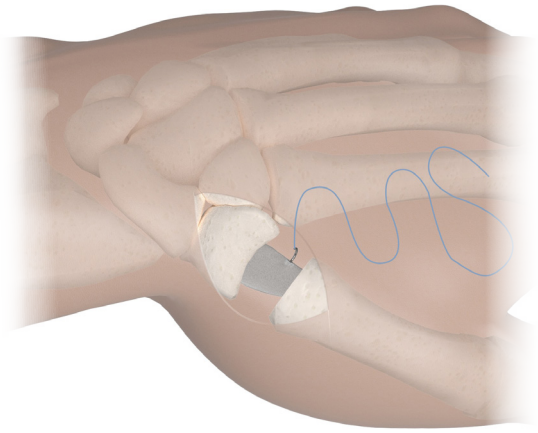
Step Eleven

Use the Quick Connect Impactor to remove the trial stem from the metacarpal. Slide the connector into place with its face parallel to the stem platform to connect. Hemostats or similar clamps may also be used to extract the trial stem if needed.



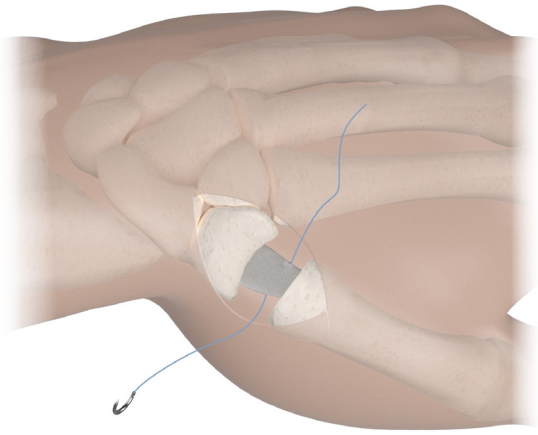
Step Twelve

Assemble the head and stem and place in the assembly block. Impact the head onto the stem using the impactor handle fitted with the impactor tip.



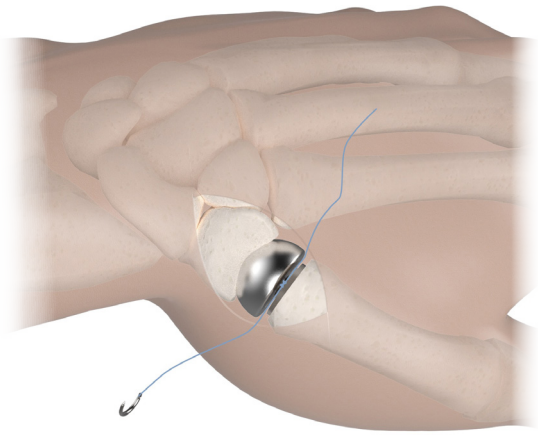
Optional Beak Ligament (Volar Beak Ligament / Anterior Oblique Ligament) Fixation to Implant Trunnion

If concerns exist regarding construct stability secondary to patient anatomy or as a supplementary precautionary measure, augmentation with suture fixation of the volar beak ligament to the implant trunnion is indicated.



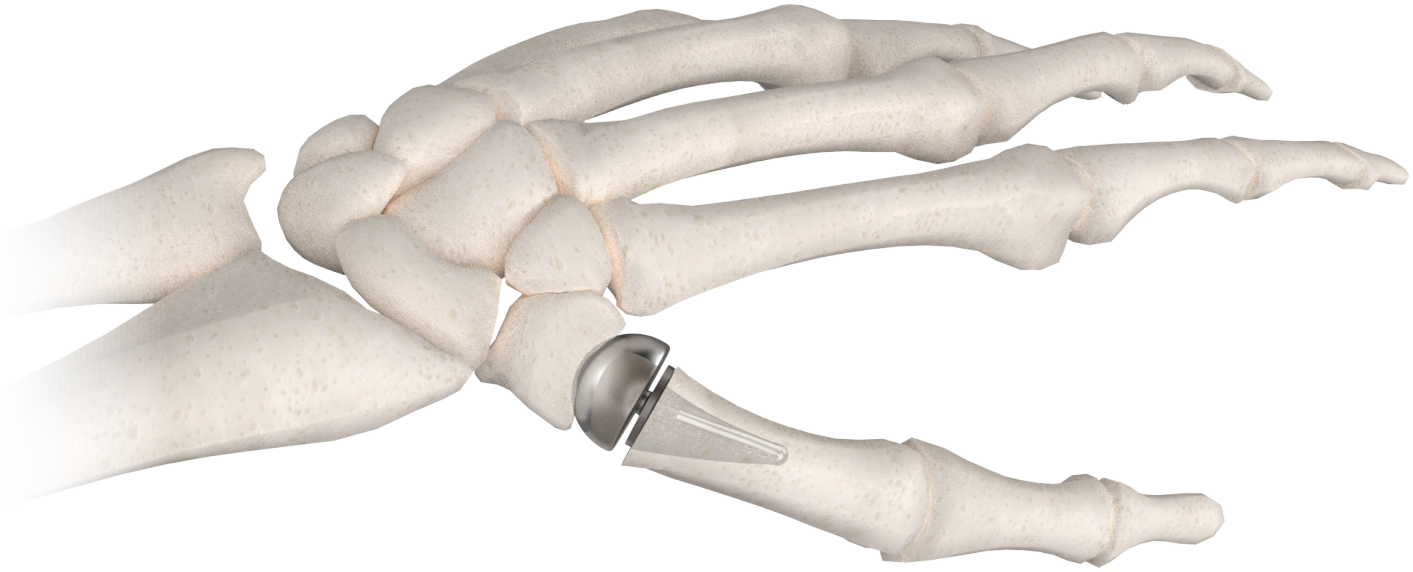
Begin by passing a suture deep to the volar beak ligament (anterior oblique ligament), advancing into the volar capsule. Confirm suture placement transversely across the full width of the volar beak ligament.

Step Thirteen



Insert the implant (head and stem assembly) and impact into the metacarpal until the collar of the prosthesis is flush with the resected surface of the metacarpal. Reduce the implant head into the trapezial socket until it is fully seated. Confirm the implant collar is flush with the metacarpal via x-ray prior to implant reduction, if necessary.

Final Beak Ligament Step
Utilizing both free suture ends, tie a secure knot around the stem trunnion in the interval between the head and the stem platform. This maneuver applies a volar-directed tension vector to the construct, reducing the risk of dorsal dislocation and enhancing overall implant stability.



Step Fourteen

Stability and range of motion should be observed before wound closure. Ensure full range of motion into abduction and opposition without dislocation. The longitudinal contiguous capsule is closed tightly with 4-0 braided suture.

Following the completion of the skin closure the thumb is immobilized in a position of abduction at the carpalmetacarpal joint and slight flexion at the metacarpalphalangeal joint for 4-6 weeks. A removable thumb spica is then worn for three to four weeks. Hand therapy may be required to regain motion and strength. Unrestricted activity is allowed 8-12 weeks post-op. If patient compliance is a potential concern, a non-removable cast is recommended for 4-6 weeks post-operatively.

Pearls & Pitfalls — Technical Emphasis

The Three Most Common Causes of Intraoperative Instability

1. Insufficient Varus Angle on the Metacarpal Cut

The Problem	The Fix
• Less than 15° varus angle increases instability risk • Dorsal cortical flare causes the cutting guide tail to reduce your effective angle • Freehand cuts without confirmation tend to be too radial	• Target 15–20° varus — more is safer than less • Do not seat the cutting guide tail flush if it reduces the angle • Always confirm with the alignment guide — pin parallel to metacarpal in both planes • Minor deviation (1–2°) does not require correction

2. Failure to Remove Ulnar Osteophytes

Metacarpal	Trapezium
• Deep ulnar osteophytes act as a lever promoting dislocation • Also cause persistent post-op pain • Remove with rongeur or osteotome before broaching	• Shift the socket radially • Limit achievable head size • Increase dislocation risk from impingement • Remove aggressively — including those at the 2nd metacarpal base • Flatten the trapezium before socket creation

3. Socket Positioned Too Central (Instead of Ulnar)

Stability derives primarily from ulnar socket positioning and implant alignment — not from depth alone. Begin with a 4mm round burr centrally, then develop toward the ulnar side. Fully dissect the ulnar aspect of the trapezium. Maintain 2–3mm of radial bone stock. Confirm socket position on fluoroscopy before final enlargement.

Dorsal scalloping of the trapezium is common and will appear shallower on visual inspection. The socket will be deeper in the radial/ulnar plane than in the dorsal/volar plane due to the natural shape of the trapezium

Comprehensive Pitfall & Pearl Reference Table

Step / Area	Pitfall	Pearl / Correction
Metacarpal resection	Varus angle < 15° — most common error	Target 15–20°; confirm with alignment guide; more varus is safer than less
Metacarpal resection	Cutting guide tail seated flush — reduces angle	Ignore dorsal flare; seat tongue flat in joint space; verify with pin guide
Osteophytes	Retained metacarpal ulnar osteophytes — lever effect	Remove before broaching; use rongeur or osteotome; confirm on fluoro
Osteophytes	Retained trapezial ulnar osteophytes — socket shift	Remove aggressively including 2nd metacarpal base; flatten trapezium first
Socket creation	Socket too central — head migrates radially	Favor ulnar positioning; confirm on fluoroscopy before enlarging
Socket creation	Dorsal/ulnar ridges or scallops — ball hopping	Flatten before enlarging diameter; use fine burr to smooth
Socket creation	Radial dorsal rim violation — loss of constraint	Preserve 2–3 mm radial dorsal bone stock at all times
Socket depth	Obsessing over depth vs. stability	If stable at the chosen depth, it is sufficient; do not over-burr
Stem broaching	Undersized stem — inadequate cortical fill	Use largest safe stem; verify rotational stability; confirm on fluoro
Stem broaching	Not accounting for 0.5 mm TPS addition	Broach/trial = bare stem; final implant is 0.5 mm larger — plan ahead
Stem broaching	Forcing an oversized broach — metacarpal fracture	Progress incrementally; use side-cutting burr between sizes if needed
Trialing	Assessing stability with self-retaining retractors in place	Remove all retractors before stability assessment — they simulate tension
Trialing	Overstuffing the joint — excessive tension	Aim for 1–2mm joint shuck on distraction; tight = poor ROM and pain
Trialing	Not trialing next size up before final socket enlargement	Always trial one size up; if it fits well, fine-burr and upsize
Closure	Lax capsular closure — primary instability source	Use 4-0 braided suture; provisional sutures during trialing to pre-tension

Intraoperative Instability Checklist

	Check	Action / Correction
☐	Cut angle ≥ 15° varus?	Verify with alignment guide. If inadequate, revise resection angle.
☐	5 mm resection completed?	Measure the resected segment. If insufficient, resect additional bone.
☐	All ulnar osteophytes removed?	Palpate and inspect with fluoroscopy — metacarpal and trapezial.
☐	Socket positioned ulnar?	Confirm on AP and lateral fluoroscopy. Additional ulnar burring if needed.
☐	Radial rim preserved (2–3 mm)?	Protect radial constraint — do not sacrifice for depth.
☐	Socket depth adequate?	Approximately 4 mm. Do not obsess over depth if head is stable.
☐	Stem achieving cortical fill?	Rotate broach: moves alone = upsize. Moves with metacarpal = acceptable.
☐	Joint overstuffed?	Check distraction gap (joint shuck) — should be 1–2 mm, not 0 and not > 3 mm.
☐	Capsular tension simulated?	Place provisional capsular sutures to simulate closure tension before final implant, if necessary.

Advanced Adjuncts for Persistent Instability

Soft-Tissue Reinforcement
Beak Ligament Suture Technique: Place a nonabsorbable suture around the beak ligament within the deep ulnar capsule. After final implant insertion, tie the suture around the trunnion — the junction between the head and stem platform. This creates a constant ulnar-directed force, mimicking the stabilizing function of the native beak (anterior oblique) ligament.

APL Advancement
If additional stability is required, split the abductor pollicis longus (APL) tendon and advance it dorsally across the implant. This reinforces the dorsal capsule and provides a dynamic stabilizing force. Reserve for cases of persistent instability after all other corrections have been made.

Head Sizing Options for Instability
Move up one neck length (+2 mm offset) before changing head diameter.
Enlarge and/or deepen the socket if a larger head diameter is selected — this may require a different neck length.
Larger head diameters improve stability by distributing forces over greater surface area.
A head 1 mm larger than the burred diameter can often be seated — try it before assuming a socket revision is needed.

Post-Operative Complication Management

Dislocation

Causes: Shallow trapezial socket, insufficient varus angle, retained osteophytes, early overuse, trauma, inadequate capsular closure.

Signs: Sudden pain, loss of normal thumb position, visible deformity, instability on examination, change on X-ray.

Management: Initial: immobilization trial. Revision options include upsizing head diameter, increasing neck length/offset (+2 or +4 mm), deepening the socket, and tight capsular. Modular design allows head exchange without stem revision in most cases.

Stem Migration / Failure to Ingrow

Causes: Undersized stem (inadequate cortical fill), poor bone quality (osteoporosis), early high-activity loading, smoking, diabetes, trauma post-operatively.

Signs: Persistent deep thumb pain, instability, proximal migration visible on serial X-rays, painful stem palpation.

Management: Extended immobilization may allow late osseointegration. If revision required: larger-diameter stem, +4 mm extended length stem, or side-cutting burr expansion of proximal canal. HydroSet or bone hardening substitute for inadequate press fit. Conversion to trapeziectomy as last resort.

Trapezial Remodeling Pain

Causes: A normal biological response in 10–20% of patients. Remodeling of the trapezium around the implant head can produce discomfort for 6–12+ months.

Signs: Dull aching at the base of the thumb, variable intensity, worsening with activity, may not correlate with X-ray severity. Extreme remodeling on X-ray can still result in a pain-free, satisfied patient.

Management: NSAIDs, temporary increased splint wear, activity modification. Reassure patient — most resolve. Head up-sizing in revision if remodeling is extreme and symptomatic. Monitor with serial X-rays.

Metal Sensitivity

Causes: Nickel hypersensitivity (affects ~15% of population). Standard cobalt chrome contains ~0.8% nickel.

Signs: Persistent unexplained pain, swelling, or erythema without infection. May not present until months post-operatively.

Management: Clinical evaluation. MELISA blood test to confirm. Revision to titanium implant resolves metal-related reactions. Titanium option is available for all standard head and stem sizes.

Differential Diagnosis — Other Sources of Post-Operative Pain

Not all post-operative pain originates from the implant. Systematically evaluate for:

Condition	Clinical Features & Management
De Quervain's Tenosynovitis	First dorsal compartment tenderness, positive Finkelstein test. May coexist with CMC arthritis or develop post-operatively due to altered load patterns. Treat with splint, NSAID, corticosteroid injection.
Trigger Thumb	Flexor pollicis longus tenosynovitis with catching or locking at the IP joint. Palpable tendon nodule. Treat with injection; surgical A1 pulley release if refractory.
Carpal Tunnel Syndrome	Median nerve compression producing numbness, tingling, and weakness in the thumb and radial fingers. Confirmed with nerve conduction studies. May be concurrent with thumb arthritis.
Radial Sensory Neuritis	Superficial radial nerve irritation from surgical approach especially in tight or scarred anatomy. Burning, hypersensitivity along dorsoradial thumb. Treat with desensitization, neurontin if persistent.
STT Joint Arthritis	Pain on the radial wrist with STT compression test. If undiagnosed pre-operatively, pain may persist post-implant. Diagnostic injection helps differentiate.
Infection	Fever, erythema, warmth, wound breakdown, elevated inflammatory markers. Rare but requires urgent evaluation aspiration, culture, and surgical irrigation/debridement if confirmed.

Post-Operative Rehabilitation Protocol

Stage 1: Immobilization Weeks 1–3 Post-Operative

Days 3–6	• Remove dressings. Fabricate forearm-based static palmar thumb spica splint: wrist neutral radial/ulnar deviation, 10–15° extension; thumb midway between palmar and radial abduction; MP joint 30° flexion; IP joint free. • Splint worn full time day and night — removed only for therapist-assisted ROM in clinic.
Days 7–21	• Therapist-assisted ROM to uninvolved joints (in clinic only): wrist AAROM flexion/extension and radial/ulnar deviation. Therapist-assisted MP and IP joint ROM with CMC joint fully supported in abduction. • Initiate scar mobilization and desensitization. Arm/hand elevation for edema control. • Home exercises within splint: AROM fingers and thumb IP joint only — 10–15 reps, 4–6×/day.
Avoid	Passive CMC ROM · Key/lateral pinching · Thumb adduction · Shearing forces at CMC joint · Any resistive activity

Stage 2: Mobilization — Weeks 4–7 Post-Operative

Weeks 4–5	• Surgeon must confirm adequate biological fixation before advancing. If fixation is not confirmed, continue Stage 1 for 1–2 additional weeks (up to 6 weeks total). • If cleared: supervised therapist-assisted thumb palmar abduction (10–15 reps) and radial abduction (10–15 reps) out of the splint. Gentle active and AAROM wrist exercises. • Splint removed only for exercises and bathing. Reliable patients may perform home exercises 4–6×/day.
Avoid	• Lateral/key pinch position (flexion + adduction of metacarpal) · Resistive gripping or pinching
Weeks 6–7	• With surgeon approval: modify forearm-based splint to hand-based splint. Worn at all times except bathing and exercise. • Begin opposition to each fingertip out of the splint. Progress toward base of 5th metacarpal only after each fingertip is opposed with ease. • Light grasp and prehension permitted within the splint at home.

Stage 3: Strengthening: Weeks 8–12 Post-Operative

Weeks 8–9	• Light strengthening: wrist/forearm and thumb. Rubber band resistance targeting APB, APL, and EPL (palmar abduction, radial abduction, extension). • Light therapy putty for grasp and opposition. Light resistive 3-point pinch in clinic. Light functional self-care out of splint at home. • Patient cautioned to avoid activities requiring strong grasp or pinch.
Weeks 10–12	• Progress grasp and pinch strengthening with therapy putty within pain-free tolerance. • Gradually reduce splint wear as thenar strength improves. Splint worn only for protection during demanding activities by end of Month 3. • By end of Month 3: splint discontinued. Progressive unrestricted use 4–6 months post-op. Strength continues to improve for up to 2 years.

Managing the Recovering Patient — Clinical Decision Guide

Patients	Timeline	Clinical Notes
20%	**3–6 weeks**	Excellent bone quality, highly stable implant, early Stage 1 candidates. Confirm stability clinically before advancing protocol.
60%	**6–12 weeks**	Standard recovery. Confirm biological fixation at Weeks 4–5 before advancing to Stage 2. Most common pathway.
20%	**Up to 12 months**	Extended recovery — revision surgery, fracture, diabetes, smoking, low bone density. Extend immobilization as needed. Monitor with serial X-rays. Remodeling pain expected.
Rare	**Up to 16 months**	Complex complications or significant medical comorbidities. Maintain close follow-up. Consider social work or patient support resources if needed.

Patient Reports Increased Pain

- Rule out infection first: CRP, ESR, WBC, wound inspection
- Assess for dislocation: X-ray AP and lateral
- Evaluate for trapezial remodeling pain: serial X-ray, activity history
- Screen for concurrent conditions: De Quervain's, trigger thumb, CTS, radial neuritis
- If remodeling: NSAID, temporary immobilization, reassurance, serial X-ray
- If dislocation confirmed: see complication management, page 16

Patient Not Progressing as Expected

- Confirm compliance with splint and exercise protocol
- Reassess bone quality on X-ray — confirm ingrowth progress
- Extend immobilization if ingrowth uncertain
- Consider non-removable cast for non-compliant patients
- Refer back to hand therapist for protocol reassessment

X-Ray Findings of Concern

- Proximal stem migration: evaluate ingrowth failure
- Significant bone remodeling around the head: differentiate normal remodeling from pathology; correlate with symptoms
- Radiolucent lines around stem: if asymptomatic, monitor; if symptomatic, evaluate for revision
- Head position change: evaluate for dislocation or subluxation

When to Revise

- Persistent pain unresponsive to conservative management after 12+ months
- Documented dislocation not reducible or recurrent
- Symptomatic stem migration or loosening confirmed on imaging
- Metal sensitivity confirmed on MELISA — revise to titanium
- Head exchange (largest available) before considering full stem revision
- Conversion to trapeziectomy remains available as final option

Key Takeaways for Surgeons

- ✔ Careful patient selection is the foundation of success. Confirm the CMC joint is the pain source.
- ✔ Setting expectations before surgery — remodeling pain, timeline, therapy, restrictions, reduces post-operative dissatisfaction.
- ✔ The most common causes of instability are technical: insufficient varus angle, retained osteophytes, and central socket position.
- ✔ Protect the implant during osseointegration (Weeks 1–6). Early high loading delays or prevents biological fixation.
- ✔ Remodeling pain (10–20% of patients) can take 6–12+ months to resolve. Serial X-rays and reassurance are first-line management.
- ✔ Strength continues to improve for up to two years. Outcomes should not be judged at 3 months.

Implant Removal Technique

Overview

Implant removal is indicated in cases of component failure arising from two primary etiologies: metacarpal stem failure or trapezium cup failure. The surgical approach and technique for removal differ based on the mode of failure. Careful preoperative assessment, including review of imaging, is essential to determine the appropriate course of action and to plan for revision if indicated. Always contact BioPro or your local representative before scheduling revision or removal cases to ensure appropriate instruments and implants are available.

Metacarpal Stem Failure

Metacarpal stem failure is characterized by inadequate osseointegration of the plasma-sprayed stem surface, resulting in a loose component. This failure mode typically presents with stem mobility on imaging and correlating patient symptoms.

Removal Technique

1. Following standard exposure of the implant, dislocate the implant from the trapezium cup.
2. Due to the absence of bone ingrowth into the plasma spray, the stem should withdraw from the metacarpal canal with minimal resistance. Manual extraction is generally sufficient.

Revision Option: BioPro offers a Revision Stem to address metacarpal stem failure cases in which implant revision is appropriate. Stem revision can be achieved by upsizing to the next-sized stem and/or choosing the long (+4mm) revision stem. Request revision stems in advance to ensure the long-stem implants and trials are available.

Trapezium Cup Failure

Trapezium cup failure requires a more deliberate surgical technique for implant removal. The steps below describe the sequential process for safe disassembly and extraction of the modular components while preserving the surrounding osseous and soft tissue structures.

Step 1 - Implant Dislocation

- Following standard surgical exposure, dislocate the implant from the trapezium cup. This is typically accomplished by placing the thumb into flexion and applying directed pressure to the distal aspect of the metacarpal.
- If dislocation cannot be achieved by manual pressure alone, insert a single skin hook between the head and stem. Use the hook to apply traction and lever the implant head out of the trapezium cup.

Step 2 - Head Removal

- Once the implant is dislocated, use the Head Remover instrument from the BioPro instrument set to disengage the head component from the stem.
- Insert the point of the Head Remover between the head and the stem at the taper junction. Using a mallet, impact the instrument between the two components. The resulting force will disengage and free the head from the Morse taper.

Step 3 - Stem Extraction

- With the head removed, obtain purchase on the stem trunnion using an appropriate instrument. Small vise grips are preferred when available. Pliers or a robust pair of hemostats are acceptable alternatives.
- Apply steady proximal traction on the stem. Simultaneously, use the small paddle osteotome from the BioPro instrument set to disrupt the plasma spray bone ingrowth along the dorsal surface of the stem. The paddle osteotome features a 2 mm cutting edge on one side and a 5 mm cutting edge on the reverse; select the appropriate edge based on the anatomical working space.
- Progressively work around the stem with the osteotome to loosen it circumferentially. As the stem mobilizes, advance a small osteotome into the interval between the stem platform and the proximal metacarpal cortex. Use the osteotome as a lever to apply additional extractive force and complete the removal of the stem.
- If converting to a suture suspension device, it is recommended that the trapezium be removed following stem extraction. Morselize the excised trapezium and pack the cancellous graft into the base of the metacarpal canal to fill the void created by the implant stem.

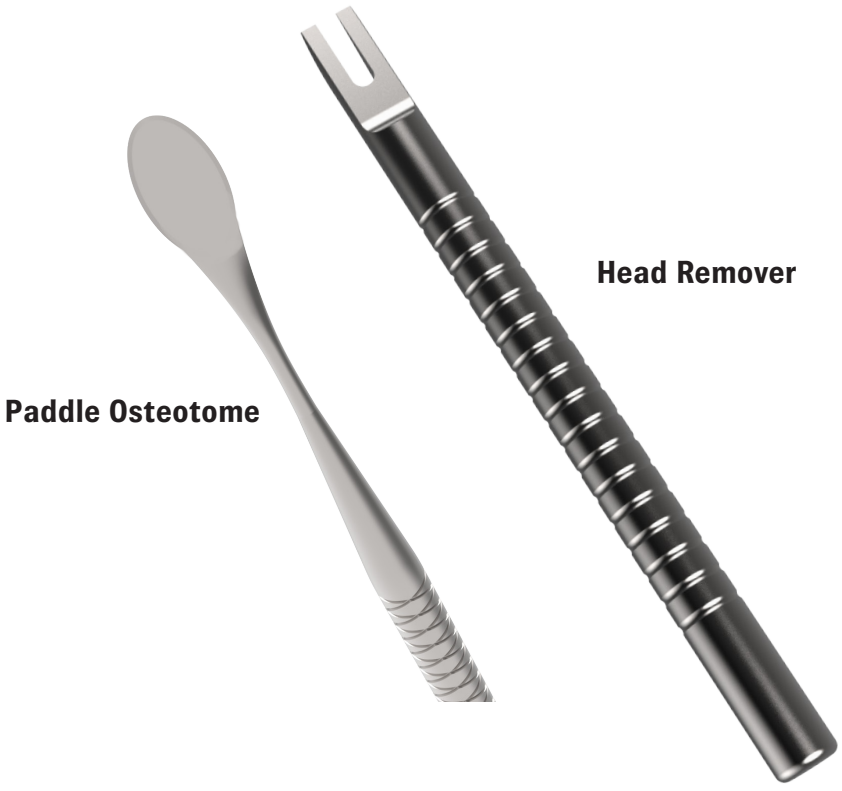
Required Instruments

The following instruments from the BioPro instrument set are referenced in this technique:

- Head Remover
- Paddle Osteotome (2 mm / 5 mm dual-sided)

Supplemental instruments (surgeon's preference):

- Small vise grips, pliers, or stout hemostats (for trunnion purchase)
- Single skin hook (for assisted dislocation if required)



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2929 Lapeer Road, Port Huron, MI 48060, USA
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www.bioproimplants.com

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