

Cigna Medical Coverage Policies – Musculoskeletal Hip Replacement/Arthroplasty

Effective July 1, 2025



Instructions for use

The following coverage policy applies to health benefit plans administered by Cigna. Coverage policies are intended to provide guidance in interpreting certain standard Cigna benefit plans and are used by medical directors and other health care professionals in making medical necessity and other coverage determinations. Please note the terms of a customer's particular benefit plan document may differ significantly from the standard benefit plans upon which these coverage policies are based. For example, a customer's benefit plan document may contain a specific exclusion related to a topic addressed in a coverage policy.

In the event of a conflict, a customer's benefit plan document always supersedes the information in the coverage policy. In the absence of federal or state coverage mandates, benefits are ultimately determined by the terms of the applicable benefit plan document. Coverage determinations in each specific instance require consideration of:

1. The terms of the applicable benefit plan document in effect on the date of service
2. Any applicable laws and regulations
3. Any relevant collateral source materials including coverage policies
4. The specific facts of the particular situation

Coverage policies relate exclusively to the administration of health benefit plans. Coverage policies are not recommendations for treatment and should never be used as treatment guidelines.

This evidence-based medical coverage policy has been developed by eviCore, Inc. Some information in this coverage policy may not apply to all benefit plans administered by Cigna.

CPT® (Current Procedural Terminology) is a registered trademark of the American Medical Association (AMA). CPT® five digit codes, nomenclature and other data are copyright 2025 American Medical Association. All Rights Reserved. No fee schedules, basic units, relative values or related listings are included in the CPT® book. AMA does not directly or indirectly practice medicine or dispense medical services. AMA assumes no liability for the data contained herein or not contained herein.

©Copyright 2025 eviCore healthcare

CMM-313: Hip Replacement/Arthroplasty

Definitions
General Guidelines
Hip Resurfacing Arthroplasty
Hip Replacement
Revision of Hip Replacement
Salvage Procedures
Codes (CMM-313)
References (CMM-313)

Definitions

- **Hip Arthroplasty:** an orthopaedic surgical procedure during which the articular surface of the hip joint is replaced, remodeled, or realigned.
- **Hip Replacement:** a form of arthroplasty that includes the surgical replacement of the hip joint with a prosthesis.
- **Hip Resurfacing Arthroplasty (HRA)** (also called metal-on-metal [MoM] hip resurfacing and hemi-resurfacing arthroplasty): a surgical technique that involves the removal of diseased cartilage and bone from the head of the femur, and the replacement of the surface of the femoral head with a metal hemisphere that fits into a metal acetabular cup or into the acetabulum respectively. The technique conserves femoral bone and maintains normal femoral loading and stresses. Because of bone conservation, it may not compromise future total hip replacements. Hip resurfacing arthroplasty has been promoted as an alternative to total hip replacement for younger individuals. Hip resurfacing arthroplasty may be either a partial HRA (i.e., hemi-hip resurfacing, hemi-resurfacing or femoral head resurfacing arthroplasty [FHRA]) or a total HRA.
- **Non-Surgical Management** (with regard to the treatment of lower extremity joint pain): any provider-directed non-surgical treatment, which has been demonstrated in the scientific literature as efficacious and/or is considered reasonable care in the treatment of lower extremity joint pain. The types of treatment involved can include, but are not limited to, the following: relative rest/activity modification; weight loss; supervised physiotherapy modalities and therapeutic exercises; prescription and non-prescription medications; assistive devices; and/or, intra-articular injections.
- **Partial Hip Replacement** (also called hip hemi-arthroplasty): a surgical technique where only the femoral head (the ball) of the damaged hip joint is replaced. The acetabulum (the socket) is not replaced.
- **Prosthesis:** an artificial device used to replace a structural element within a joint to improve and enhance function.
- **Revision of Hip Replacement (Partial or Total):** surgical reconstruction or replacement due to failure or complications of previous hip replacement.
- **Tönnis Classification System:** a system commonly used to describe the presence of osteoarthritis in the hips on plain X-rays with grading as follows:
 - ◆ **Grade 0:** No signs of osteoarthritis
 - ◆ **Grade 1:** Sclerosis of the joint with slight joint space narrowing and osteophyte formation, and no or slight loss of femoral head sphericity
 - ◆ **Grade 2:** Small cysts in the femoral head or acetabulum with moderate joint space narrowing and moderate loss of femoral head sphericity
 - ◆ **Grade 3:** Large cysts in the femoral head or acetabulum, severe joint space narrowing or obliteration of the joint space, and severe deformity and loss of femoral head sphericity

- **Total Hip Replacement:** a surgical technique that involves the removal of the damaged hip joint which is then replaced with an artificial prosthesis composed of two or three different components: 1) the head that replaces the original femoral head; 2) the femoral component (a metal stem placed into the femur); and, 3) the acetabular component that is implanted into the acetabulum. The stem may be secured using bone cement or press-fit for the bone to grow into it.

General Guidelines

Application of Guideline

- The determination of medical necessity for the performance of hip resurfacing and hip replacement (partial or total) is always made on a case-by-case basis.
- Until the scientific literature is more definitive, the type of bearing surface (e.g., metal-on-metal; ceramic-on-ceramic; metal-on-polyethylene) should be determined by the treating surgeon and the individual following a frank discussion explaining the pros and cons of each bearing surface.
- For individuals with significant medical conditions or co-morbidities, the risk/benefit of hip arthroplasty procedures should be clearly documented in the medical record.
- For non-resurfacing and non-replacement treatment of avascular necrosis of the femoral head refer to **CMM-314: Hip Surgery – Arthroscopic and Open Procedures**
- For the advanced imaging indications prior to hip resurfacing and hip replacement surgery refer to **MS-12: Osteoarthritis** and **MS-24: Hip**
- For advanced imaging indications following hip replacement surgery refer to **MS-16: Post-Operative Joint Replacement Surgery** and **MS-24: Hip**

Hip Resurfacing Arthroplasty

Partial Hip Resurfacing Arthroplasty Indications

Partial hip resurfacing arthroplasty is considered **medically necessary** when **ALL** of the following criteria have been met:

- Individual is age 64 years or younger
- Imaging shows **EITHER** of the following findings:
 - ◆ Osteoarthritis primarily affecting the femoral head with joint space narrowing on weight-bearing radiographs
 - ◆ Avascular necrosis of the femoral head **and** there is less than 50% involvement of the femoral head

- Symptoms include **BOTH** of the following:
 - ◆ Function-limiting pain at short distances (e.g., walking less than ¼ mile, limiting activity to two city blocks, the equivalent to walking the length of a shopping mall) for at least three (3) months duration
 - **Criteria exception:** Three (3) months of function-limiting pain is **not required** when the medical record clearly documents why provider-directed non-surgical management is inappropriate (e.g., collapse of the femoral head, inflammatory arthritis, advanced dysplasia).
 - ◆ Loss of hip function which interferes with the ability to carry out age-appropriate activities of daily living and/or demands of employment
- Failure of provider-directed non-surgical management for at least three (3) months duration
 - ◆ **Criteria exception:** Provider-directed non-surgical management may be inappropriate. The medical record must clearly document why provider-directed non-surgical management is inappropriate (e.g., collapse of the femoral head, inflammatory arthritis, advanced dysplasia).
 - ◆ **Note:** It is incumbent on the surgeon to preoperatively optimize reasonably modifiable medical and behavioral health comorbidities.

Partial Hip Resurfacing Arthroplasty Non-Indications

- Partial hip resurfacing arthroplasty is considered **not medically necessary** for **ANY** other indication, condition, or when **ANY** of the following are present:
 - ◆ Osteoarthritis affecting **BOTH** the femoral head and the acetabulum with joint space narrowing on weight-bearing radiographs
 - ◆ Inflammatory arthritis affecting **BOTH** the femoral head and acetabulum
 - ◆ Avascular necrosis of the femoral head with more than 50% involvement of the femoral head
 - ◆ Skeletal immaturity
 - ◆ Active local or systemic infection
 - ◆ Vascular insufficiency, significant muscular atrophy of the hip or leg musculature, or neuromuscular disease severe enough to compromise implant stability or post-operative recovery
 - ◆ Charcot joint

Total Hip Resurfacing Arthroplasty Indications

Total hip resurfacing arthroplasty is considered **medically necessary** when **ALL** of the following criteria have been met:

- Individual is age 64 years or younger
- Imaging shows **EITHER** of the following findings:
 - ◆ Osteoarthritis or an inflammatory arthritis affecting **BOTH** the femoral head and the acetabulum with joint space narrowing on weight-bearing radiographs
 - ◆ Avascular necrosis of the femoral head with possible acetabular surface involvement **and** there is less than 50% involvement of the femoral head

- Symptoms include **BOTH** of the following:
 - ◆ Function-limiting pain at short distances (e.g., walking less than ¼ mile, limiting activity to two city blocks, the equivalent to walking the length of a shopping mall) for at least three (3) months duration
 - **Criteria exception:** Three (3) months of function-limiting pain is **not required** when the medical record clearly documents why provider-directed non-surgical management is inappropriate (e.g., collapse of the femoral head, inflammatory arthritis, advanced dysplasia).
 - ◆ Loss of hip function which interferes with the ability to carry out age-appropriate activities of daily living and/or demands of employment
- Failure of provider-directed non-surgical management for at least three (3) months duration
 - ◆ **Criteria exception:** Provider-directed non-surgical management may be inappropriate. The medical record must clearly document why provider-directed non-surgical management is inappropriate (e.g., collapse of the femoral head, inflammatory arthritis, advanced dysplasia).
 - ◆ **Note:** It is incumbent on the surgeon to preoperatively optimize reasonably modifiable medical and behavioral health comorbidities.

Total Hip Resurfacing Arthroplasty Non-Indications

- Total hip resurfacing arthroplasty is considered **not medically necessary** for **ANY** other indication, condition, or when **ANY** of the following are present:
 - ◆ Avascular necrosis of the femoral head with more than 50% involvement of the femoral head
 - ◆ Skeletal immaturity
 - ◆ Active local or systemic infection
 - ◆ Vascular insufficiency, significant muscular atrophy of the hip or leg musculature, or neuromuscular disease severe enough to compromise implant stability or post-operative recovery
 - ◆ Charcot joint

Hip Replacement

Partial Hip Replacement Indications

Partial hip replacement is considered **medically necessary** for **ANY** of the following conditions when **ALL** of the associated criteria have been met:

Femoral Head/Neck Fracture

- Imaging shows a fracture of the femoral head or femoral neck
- Conservative management **or** surgical fixation is not considered a reasonable option

Avascular Necrosis (AVN)

- Imaging shows avascular necrosis with collapse of the femoral head
- Symptoms include **BOTH** of the following:
 - ◆ Function-limiting pain at short distances (e.g., walking less than ¼ mile, limiting activity to two city blocks, the equivalent to walking the length of a shopping mall) for at least three (3) months duration
 - **Criteria exception:** Three (3) months of function-limiting pain is **not required** when the medical record clearly documents why provider-directed non-surgical management is inappropriate.
 - ◆ Loss of hip function which interferes with the ability to carry out age-appropriate activities of daily living and/or their demands of employment
- Failure of provider-directed non-surgical management for at least three (3) months duration
 - ◆ **Criteria exception:** Provider-directed non-surgical management may be inappropriate. The medical record must clearly document why provider-directed non-surgical management is inappropriate
 - ◆ **Note:** It is incumbent on the surgeon to preoperatively optimize reasonably modifiable medical and behavioral health comorbidities.

Partial Hip Replacement Non-Indications

- **Partial hip replacement** is considered **not medically necessary** for **ANY** other indication, condition, or when **ANY** of the following are present:
 - ◆ Active local or systemic infection
 - ◆ Vascular insufficiency, significant muscular atrophy of the leg, or neuromuscular disease severe enough to compromise implant stability or post-operative recovery
 - ◆ Charcot joint
 - ◆ Inflammatory arthritis affecting **BOTH** the femoral head and the acetabulum

Total Hip Replacement Indications

Total hip replacement is considered **medically necessary** for **ANY** of the following conditions when **ALL** of the associated criteria have been met:

Femoral Head/Neck Fracture

- Imaging shows a fracture of the femoral head or femoral neck
- Conservative management **or** surgical fixation is not considered a reasonable option

Osteoarthritis, Avascular Necrosis (AVN), Inflammatory Arthritis

- Imaging shows **ANY** of the following findings:
 - ◆ Tönnis Grade 2-3 osteoarthritis
 - ◆ Avascular necrosis with collapse of the femoral head

- Inflammatory arthritis affecting **BOTH** the femoral head and the acetabulum with joint space narrowing
- Symptoms include **BOTH** of the following:
 - ◆ Function-limiting pain at short distances (e.g., walking less than ¼ mile, limiting activity to two city blocks, the equivalent to walking the length of a shopping mall) for at least three (3) months duration
 - **Criteria exception:** Three (3) months of function-limiting pain is **not required** when the medical record clearly documents why provider-directed non-surgical management is inappropriate.
 - ◆ Loss of hip function secondary to osteoarthritis which interferes with the ability to carry out age-appropriate activities of daily living and/or demands of employment
- Failure of provider-directed non-surgical management for at least three (3) months duration
 - ◆ **Criteria exception:** Provider-directed non-surgical management may be inappropriate. The medical record must clearly document why provider-directed non-surgical management is inappropriate.
 - ◆ **Note:** It is incumbent on the surgeon to preoperatively optimize reasonably modifiable medical and behavioral health comorbidities.

Total Hip Replacement Non-Indications

- **Total hip replacement** is considered **not medically necessary** for **ANY** other indication, condition, or when **ANY** of the following are present:
 - ◆ Active local or systemic infection
 - ◆ Vascular insufficiency, significant muscular atrophy of the leg, or neuromuscular disease severe enough to compromise implant stability or post-operative recovery

Revision of Hip Replacement

Revision of Hip Replacement (Partial or Total) Indications

Revision of hip replacement is considered **medically necessary** for an individual who has previously undergone a partial or total hip replacement when **ANY** of the following post-operative conditions are present:

- Recurrent prosthetic dislocation/subluxation that is unresponsive to provider-directed non-surgical management
- Aseptic loosening
- Periprosthetic infection
- Periprosthetic fracture
- Instability of the implant (e.g., disassembly, modular neck failure)
- Leg length discrepancy
- Osteolysis without eccentric wear (wear of elevated rim liner without wear superiorly)

- Elevated serum metal levels as diagnosis for adverse local tissue reaction (ALTR) secondary to corrosion
- Function-limiting pain at short distances (e.g., walking less than ¼ mile, limiting activity to two city blocks, the equivalent to walking the length of a shopping mall) that is unexplained, greater than six (6) months duration, and is unresponsive to provider-directed non-surgical management

Revision of Hip Replacement (Partial or Total) Non-Indications

- Revision of hip replacement is considered not medically necessary for **ANY** other indication or condition.

Isolated Head and Polyethylene Liner Exchange (IPE) Indications

Isolated head and polyethylene liner exchange (IPE) is considered **medically necessary** for **ANY** of the following post-operative conditions when **ALL** of the associated criteria have been met:

- Eccentric polyethylene wear (with or without osteolysis):
 - ◆ Individual is symptomatic
 - ◆ Well-fixed implants in an acceptable position
- Acute post-operative joint infection (periprosthetic or hematogenous) with well-fixed implants
- Dislocation/Instability:
 - ◆ Procedure includes **BOTH** of the following:
 - Conversion to a liner with higher offset, larger head size, dual-mobility, constrained liner
 - Conversion of failed metal-on-metal (MoM) or ceramic-on-ceramic (CoC) bearing surface to metal-on-polyethylene (MoP) or ceramic-on-polyethylene (CoP) bearing surface

Isolated Head and Polyethylene Liner Exchange (IPE) Non-Indications

- Isolated head and polyethylene liner exchange (IPE) is considered **not medically necessary** for **ANY** other indication or condition.

Salvage Procedures

Salvage Procedures Indications

Salvage procedures (e.g., Girdlestone acetabuloplasty, hip joint arthrodesis) are considered **medically necessary** when performed as a surgical alternative in certain individuals for whom primary hip replacement or revision of hip replacement is not a reasonable surgical option due to **ANY** of the following conditions:

- Chronic infection, osteomyelitis, or persistent periprosthetic joint infection
- Individual is non-ambulatory or has a pre-existing ambulatory dysfunction

- Presence of co-morbidities or diseases which would preclude the performance of a successful hip replacement
- Inadequate bone stock (e.g., severe osteoporosis or following tumor resection when there is insufficient bone remaining to support a joint replacement)
- Recurrent instability/dislocation of the replaced hip
- Aseptic loosening of the replaced hip with no other practical surgical options
- Inability to pursue a successful reimplantation

Salvage Procedures Non-Indications

- **Salvage procedures** are considered **not medically necessary** for **ANY** other indication or condition.

Codes (CMM-313)

The inclusion of any code in this table does not imply that the code is under management or requires prior authorization. Refer to the applicable health plan for management details. Prior authorization of a code listed in this table is not a guarantee of payment. The Certificate of Coverage or Evidence of Coverage policy outlines the terms and conditions of the member's health insurance policy.

Code	Code Description/Definition
27122	Acetabuloplasty; resection, femoral head (e.g., Girdlestone procedure)
27125	Hemiarthroplasty, hip, partial (e.g., femoral stem prosthesis, bipolar arthroplasty)
27130	Arthroplasty, acetabular and proximal femoral prosthetic replacement (total hip arthroplasty), with or without autograft or allograft
27132	Conversion of previous hip surgery to total hip arthroplasty, with or without autograft or allograft
27134	Revision of total hip arthroplasty; both components, with or without autograft or allograft
27137	Revision of total hip arthroplasty; acetabular component only, with or without autograft or allograft
27138	Revision of total hip arthroplasty; femoral component only, with or without allograft

Evidence Discussion (CMM-313)

Hip Replacement/Arthroplasty

Hip replacement surgery is an effective treatment when non-surgical means do not provide adequate relief of osteoarthritic pain. However, there are risks to hip replacement surgery which include, but are not limited to the following: infection; neurovascular injury; fracture; instability; prosthetic failure; deep vein thrombosis; pulmonary embolus; and, death. Because of the risk of these significant complications, proper patient selection is critical to minimize the risk benefit ratio.

Hip osteoarthritis can be treated with a variety of methods to manage pain and improve function. The American Academy of Orthopaedic Surgeons (AAOS) has developed clinical practice guidelines and appropriate use criteria (AUC) for the management of hip osteoarthritis to guide both nonsurgical and surgical treatment and provide risk assessment tools to help ensure patients receive treatment that is appropriate, safe and effective. Conservative treatment is recommended for multiple clinical scenarios by the AAOS in *Appropriate Use Criteria: Osteoarthritis of the Hip*. The AAOS treatment recommendations in the AUC are based on multiple variables including, but not limited to, ambulatory capacity and radiographic severity of osteoarthritis. The duration of provider-directed non-surgical management allows for preoperative optimization of reasonably modifiable medical and behavioral health comorbidities.

Hip resurfacing arthroplasty conserves bone and may have better functional outcomes than total hip arthroplasty (THA), but THA is superior in terms of implant survival. Hip resurfacing is supported for individuals age 64 years or younger.

In certain patient groups wherein the risk of surgery far outweighs the benefit and surgery is contraindicated, hip replacement surgery has been shown to have unacceptably high rates of failure, increased morbidity, and increased mortality. The literature has documented higher complication rates in individuals with active local or systemic infection. Higher complications rates are also seen in individuals undergoing renal dialysis. It has been recommended that individuals undergoing dialysis who are also on a transplant list should await arthroplasty until transplant has taken place.

After the primary procedure, revision hip replacement surgery may be necessary for a variety of reasons both in the short term and long term. Revision surgery is associated with an increased risk of complications which can be minimized by proper patient selection and optimization prior to the primary procedure as well as the revision procedure. The *American Joint Replacement Registry (AJRR): 2023 Annual Report* indicated the most common diagnoses for all hip revisions were infection, mechanical complications, instability, aseptic loosening, pain, fracture, and osteolysis.

References (CMM-313)

1. Adhikary SD, Liu W, Memtsoudis SG, Davis CM 3rd, Liu J. Body Mass Index More Than 45 kg/m² as a Cutoff Point is Associated With Dramatically Increased Postoperative Complications in Total Knee Arthroplasty and Total Hip Arthroplasty. *J Arthroplasty*. 2016;31(4):749-753. doi:10.1016/j.arth.2015.10.042.
2. Adili A, Trousdale RT. Femoral head resurfacing for the treatment of osteonecrosis in the young patient. *Clin Orthop Relat Res*. 2003;(417):93-101. doi:10.1097/01.blo.0000096815.78689.3e.
3. Adrados M, Samuel LT, Locklear TM, Moskal JT. Institutional Adherence to the American Association of Hip and Knee Surgeons Body Mass Index Guidelines Lowers Perioperative Emergency Department Visits in Primary Total Knee Arthroplasty. *J Arthroplasty*. 2023;38(6S):S88-S93. doi:10.1016/j.arth.2023.02.034.
4. Allison C. Minimally invasive hip resurfacing. *Issues Emerg Health Technol*. 2005;(65):1-4.
5. Alvi HM, Mednick RE, Krishnan V, Kwasny MJ, Beal MD, Manning DW. The Effect of BMI on 30 Day Outcomes Following Total Joint Arthroplasty. *J Arthroplasty*. 2015;30:1113-1117. doi:10.1016/j.arth.2015.01.049.
6. American Academy of Orthopaedic Surgeons (AAOS). *Evidence-Based Clinical Practice Guideline: Management of Osteoarthritis of the Hip*. Dec 2023. Rosemont, IL. © American Academy of Orthopaedic Surgeons. Available at: <https://www.orthoguidelines.org/>.
7. American Academy of Orthopaedic Surgeons (AAOS). *Appropriate Use Criteria: Osteoarthritis of the Hip: Management*. Dec 2017. Rosemont, IL. © American Academy of Orthopaedic Surgeons. Available at: <https://www.orthoguidelines.org/go/auc/>.
8. American Academy of Orthopaedic Surgeons (AAOS). *American Joint Replacement Registry (AJRR): 2023 Annual Report*. Rosemont, IL. © American Academy of Orthopaedic Surgeons (AAOS). 2023. Available at: <https://www.aaos.org/registries/publications/ajrr-annual-report/>.
9. Amstutz HC, Ball ST, Le Duff MJ, Dorey FJ. Resurfacing THA for Patients Younger Than 50 Years: Results of 2- to 9-year Follow-up. *Clin Orthop Relat Res*. 2007;460:159-164. doi:10.1097/BLO.0b013e318041f0e7.
10. Amstutz HC, Su EP, Le Duff MJ. Surface arthroplasty in young patients with hip arthritis secondary to childhood disorders. *Orthop Clin North Am*. 2005;36(2):223-x. doi:10.1016/j.ocl.2005.01.005.
11. Andrew JG, Palan J, Kurup HV, Gibson P, Murray DW, Beard DJ. Obesity in total hip replacement. *J Bone Joint Surg Br*. 2008;90(4):424-429. doi:10.1302/0301-620X.90B4.20522.
12. Back DL, Dalziel R, Young D, Shimmin A. Early results of primary Birmingham hip resurfacings. An independent prospective study of the first 230 hips. *J Bone Joint Surg Br*. 2005;87(3):324-329. doi:10.1302/0301-620X.87b3.15556.
13. Bartels S, Kristensen TB, Gjertsen JE, et al. Total Hip Arthroplasty Leads to Better Results After Low-Energy Displaced Femoral Neck Fracture in Patients Aged 55 to 70 Years. *JBJS*. 2022;104(15):1341-1351. doi:10.2106/jbjs.21.01411.
14. Basu I, Howes M, Jowett C, Levack B. Girdlestones excision arthroplasty: Current update. *Int J Surg*. 2011;9(4):310-313. doi:10.1016/j.ijsu.2011.01.012.
15. Beaule PE, Antoniadou J. Patient selection and surgical technique for surface arthroplasty of the hip. *Orthop Clin North Am*. 2005;36(2):177-185, viii-ix. doi:10.1016/j.ocl.2005.01.001.
16. Beaule PE, Matta JM, Mast JW. Hip arthrodesis: current indications and techniques. *J Am Acad Orthop Surg*. 2002;10(4):249-258. doi:10.5435/00124635-200207000-00003.
17. Beaule P, Schmalzried TP, Campbell P, Dorey F, Amstutz HC. Duration of symptoms and outcome of hemiresurfacing for hip osteonecrosis. *Clin Orthop Relat Res*. 2001;(385):104-117. doi:10.1097/00003086-200104000-00018.
18. Bene N, Li X, Nandi S. Factors affecting failure of irrigation and debridement with liner exchange in total knee arthroplasty infection. *Knee*. 2018;25:932-938. doi:10.1016/j.knee.2018.07.003.
19. Biring GS, Masri BA, Greidanus NV, Duncan CP, Garbuz DS. Predictors of quality of life outcomes after revision total hip replacement. *J Bone Joint Surg Br*. 2007;89(11):1446-1451. doi:10.1302/0301-620X.89B11.19617.
20. Boraiah S, Ragsdale M, Achor T, Zelcof S, Asprinio DE. Open reduction internal fixation and primary total hip arthroplasty of selected acetabular fractures. *J Orthop Trauma*. 2009;23(4):243-248. doi:10.1097/BOT.0b013e3181923fb8.
21. Boyd HS, Ulrich SD, Seyler TM, Marulanda GA, Mont MA. Resurfacing for Perthes disease: an alternative to standard hip arthroplasty. *Clin Orthop Relat Res*. 2007;465:80-85. doi:10.1097/BLO.0b013e318156bf76.
22. Brooks PJ. Dislocation following total hip replacement. *Bone Joint J*. 2013;95-B(10):67-69. doi:10.1302/0301-620X.95B11.
23. Browne JA, Casp AJ, Cancienne JM, Werner BC. Peritoneal Dialysis Does Not Carry the Same Risk as Hemodialysis in Patients Undergoing Hip or Knee Arthroplasty. *J Bone Joint Surg*. 2019;101(14):1271-1277. doi:10.2106/jbjs.18.00936.
24. Busato A, Röder C, Herren S, Egli S. Influence of high BMI on functional outcome after total hip arthroplasty. *Obesity Surgery*. 2008;18(5):595-600. doi:10.1007/s11695-007-9412-8.
25. Center for Disease Control and Prevention (CDC). *Defining adult overweight and obesity*. Updated June 16, 2016. <https://www.cdc.gov/obesity/adult/defining.html>.

26. Chalmers BP, Tibbo ME, Trousdale RT, Lewallen DG, Berry DJ, Abdel MP. Primary Total Hip Arthroplasty for Charcot Arthropathy is Associated With High Complications but Improved Clinical Outcomes. *J Arthroplasty*. 2018;33(9):2912-2918. doi:10.1016/j.arth.2018.04.002.
27. Chen W, Klemm C, Padmanabha A, Tirumala V, Xiong L, Kwon YM. Outcome and Risk Factors Associated with Failures of Isolated Bearing Exchange for Osteolysis in Well-Fixed Cementless Total Hip Arthroplasty. *J Arthroplasty*. 2021;36(1):255-260. doi:10.1016/j.arth.2020.06.026.
28. Chotanaphuti T, Courtney PM, Fram B, et al. Hip and knee section, treatment, algorithm: proceedings of international consensus on orthopedic infection. *J Arthroplasty*. 2019;34: S393-397. doi:10.1016/j.arth.2018.09.024.
29. Chughtai M, Piuze NS, Khlopas A, Jones LC, Goodman SB, Mont MA. An evidence-based guide to the treatment of osteonecrosis of the femoral head. *Bone Joint J*. 2017;99-B(10):1267-1279. doi:10.1302/0301-620X.99B10.
30. Cohen JS, Gu A, Lopez NS, Park MS, Fehring KA, Sculco PK. Efficacy of revision surgery for the treatment of stiffness after total knee arthroplasty: a systematic review. *J Arthroplasty*. 2018;33:3049-3055. doi:10.1016/j.arth.2018.04.036.
31. Dowsey MM, Brown WA, Cochrane A, Burton PR, Liew D, Choong PF. Effect of Bariatric Surgery on Risk of Complications After Total Knee Arthroplasty. *JAMA Network Open*. 2022;5(4):e226722. doi:10.1001/jamanetworkopen.2022.6722.
32. Dumbleton JH, Manley MT. Metal-on-Metal total hip replacement: What does the literature say? *J Arthroplasty*. 2005;20(2):174-188. doi:10.1016/j.arth.2004.08.011.
33. Ferrara PE, Rabini A, Maggi L, et al. Effect of pre-operative physiotherapy in patients with end-stage osteoarthritis undergoing hip arthroplasty. *Clin Rehabil*. 2008;22(10-11):977-986. doi:10.1177/0269215508094714.
34. Fillingham YA, Della Valle CJ, Bohl DD, et al. Serum Metal Levels for Diagnosis of Adverse Local Tissue Reactions Secondary to Corrosion in Metal-on-Polyethylene Total Hip Arthroplasty. *J Arthroplasty*. 2017;32(9):S272-S277. doi:10.1016/j.arth.2017.04.016.
35. Forslund JM, Chan PH, Prentice HA, Purdy AC, Khatod M. Preoperative Patient Optimization: Outcomes from Elective Total Joint Arthroplasty in a Large US Healthcare System. *J Am Acad Orthop Surg*. 2023;31(14):746-753. doi:10.5435/JAAOS-D-23-00054.
36. Friedman RJ, Hess S, Berkowitz SD, Homering M. Complication Rates After Hip or Knee Arthroplasty in Morbidly Obese Patients. *Clin Orthop Relat Res*. 2013;471:3358-3366. doi:10.1007/s11999-013-3049-9.
37. Gaulton TG, Fleisher LA, Neuman MD. The association between obesity and disability in survivors of joint surgery: analysis of the health and retirement study. *Br J Anaesth*. 2018;120(1):109-116. doi:10.1016/j.bja.2017.11.011.
38. Girard J, Lavigne M, Vendittoli PA, Roy AG. Biomechanical reconstruction of the hip: a randomised study comparing total hip resurfacing and total hip arthroplasty. *J Bone Joint Surg Br*. 2006;88(6):721-726. doi:10.1302/0301-620X.88B6.17447.
39. Gjertsen JE, Lie SA, Fevang JM, et al. Total hip replacement after femoral neck fractures in elderly patients: results of 8,577 fractures reported to the Norwegian Arthroplasty Register. *Acta Orthop*. 2007;78(4):491-497. doi:10.1080/17453670710014130.
40. Grecula MJ. Resurfacing arthroplasty in osteonecrosis of the hip. *Orthop Clin North Am*. 2005;36(2):231-x. doi:10.1016/j.ocl.2005.02.005.
41. Grigoris P, Roberts P, Panousis K, Bosch H. The evolution of hip resurfacing arthroplasty. *Orthop Clin North Am*. 2005;36(2):125-134, vii. doi:10.1016/j.ocl.2005.01.006.
42. Gronbeck C, Cote MP, Lieberman JR, Halawi MJ. Risk stratification in primary total joint arthroplasty: the current state of knowledge. *Arthroplast Today*. 2019;5(1):126-131. doi:10.1016/j.artd.2018.10.002.
43. Günther KP, Deckert S, Lützner C, et al. Total Hip Replacement for Osteoarthritis-Evidence-Based and Patient-Oriented Indications. *Dtsch Arztebl Int*. 2021;118(43):730-736. doi:10.3238/arztebl.m2021.0323.
44. Gwynne-Jones JH, Wilson RA, Wong JMY, Abbott JH, Gwynne-Jones DP. The Outcomes of Nonoperative Management of Patients With Hip and Knee Osteoarthritis Triaged to a Physiotherapy-Led Clinic at Minimum 5-Year Follow-Up and Factors Associated With Progression to Surgery. *J Arthroplasty*. 2020;35(6):1497-1503. doi:10.1016/j.arth.2020.01.086.
45. Hamel MB, Toth M, Legedza A, Rosen MP. Joint replacement surgery in elderly patients with severe osteoarthritis of the hip or knee: decision making, postoperative recovery, and clinical outcomes. *Arch Intern Med*. 2008;168(13):1430-1440. doi:10.1001/archinte.168.13.1430.
46. Hannon CP, Delanois RE, Nandi S, et al. American Academy of Orthopaedic Surgeons Clinical Practice Guideline Summary Management of Osteoarthritis of the Hip. *J Am Acad Orthop Surg*. Published online June 6, 2024. doi:10.5435/JAAOS-D-24-00420.
47. Hinton ZW, Wu CJ, Ryan SP, Cunningham DJ, Green CL, Lachiewicz PF. Current Trends in Revision Hip Arthroplasty: Indications and Types of Components Revised. *J Arthroplasty*. 2022;37(7S):S611-S615.e7. doi:10.1016/j.arth.2022.03.008.

48. Inoue D, Yazdi H, Goswami K, Tan TL, Parvizi J. Comparison of Postoperative Complications and Survivorship of Total Hip and Knee Arthroplasty in Dialysis and Renal Transplantation Patients. *J Arthroplasty*. 2020;35(4):971-975. doi:10.1016/j.arth.2019.10.038.
49. Jurgensmeier K, Jurgensmeier D, Kunz DE, Fuerst PG, Warth LC, Daines SB. Intra-articular Injections of the Hip and Knee with Triamcinolone vs Ketorolac: A Randomized Controlled Trial. *J Arthroplasty*. 2021;36(2):416-422. doi:10.1016/j.arth.2020.08.036.
50. Keeney BJ, Austin DC, Jevsevar DS. Preoperative Weight Loss for Morbidly Obese Patients Undergoing Total Knee Arthroplasty. *J Bone Joint Surg Am*. 2019;101(16):1440-1450. doi:10.2106/jbjs.18.01136.
51. Kelmer G, Stone AH, Turcotte J, King PJ. Reasons for Revision: Primary Total Hip Arthroplasty Mechanisms of Failure. *J Am Acad Orthop Surg*. 2021;29(2):78-87. doi:10.5435/JAAOS-D-19-00860.
52. Kovalenko B, Bremjit P, Fernando N. Classifications in Brief. *Clin Orthop Relat Res*. 2018;476(8):1680-1684. doi:10.1097/01.blo.0000534679.75870.5f.
53. Le Duff MJ, Amstutz HC, Dorey FJ. Metal-on-metal hip resurfacing for obese patients. *J Bone Joint Surg Am*. 2007;89(12):2705-2711. doi:10.2106/JBJS.F.01563.
54. Li M, Glassman AH. What's New in Hip Replacement. *J Bone Joint Surg*. 2020;102(18):1572-1580. doi:10.2106/jbjs.20.00927.
55. Lübbeke A, Katz JN, Perneger TV, Hoffmeyer P. Primary and revision hip arthroplasty: 5-year outcomes and influence of age and comorbidity. *J Rheumatol*. 2007;34(2):394-400.
56. Lübbeke A, Moons KG, Garavaglia G, Hoffmeyer P. Outcomes of obese and nonobese patients undergoing revision total hip arthroplasty. *Arthritis Rheumatol*. 2008;59(5):738-745. doi:10.1002/art.23562.
57. Malhotra R, Kannan A, Kumar V, Nagaraj C, Marimuthu K, Khatri D. Hip Resurfacing Arthroplasty in Inflammatory Arthritis: A 3- to 5-Year Follow-up Study. *J Arthroplasty*. 2012;27(1):15-20. doi:10.1016/j.arth.2011.02.016.
58. Marker DR, Seyler TM, Jinnah RH, Delanois RE, Ulrich SD, Mont MA. Femoral neck fractures after metal-on-metal total hip resurfacing: a prospective cohort study. *J Arthroplasty*. 2007;22(7 Suppl 3):66-71. doi:10.1016/j.arth.2007.05.017.
59. McLaughlin JR, Lee KR. The outcome of total hip replacement in obese and non-obese patients at 10- to 18-years. *J Bone Joint Surg Br*. 2006;88(10):1286-1292. doi:10.1302/0301-620X.88B10.17660.
60. Mont MA, Ragland PS, Etienne G, Seyler TM, Schmalzried TP. Hip resurfacing arthroplasty. *J Am Acad Orthop Surg*. 2006;14(8):454-463. doi:10.5435/00124635-200608000-00003.
61. Mont MA, Rajadhyaksha AD, Hungerford DS. Outcomes of limited femoral resurfacing arthroplasty compared with total hip arthroplasty for osteonecrosis of the femoral head. *J Arthroplasty*. 2001;16(8 Suppl 1):134-139. doi:10.1054/arth.2001.28722.
62. Mont MA, Seyler TM, Marker DR, Marulanda GA, Delanois RE. Use of metal-on-metal total hip resurfacing for the treatment of osteonecrosis of the femoral head. *J Bone Joint Surg Am*. 2006;88(Suppl 3):90-97. doi:10.2106/JBJS.F.00543.
63. Moroni A, Cadossi M, Bellenghi C, Romagnoli M, Bevoni R, Giannini S. Resurrection of hip resurfacing: what is the evidence? *Expert Rev Med Devices*. 2006;3(6):755-762. doi:10.1586/17434440.3.6.755.
64. Morse KW, Su EP. Hip resurfacing arthroplasty for patients with inflammatory arthritis: a systematic review. *Hip Int*. 2017. doi: 10.5301/hipint.5000558
65. Mouchti S, Whitehouse MR, Sayers A, Hunt LP, MacGregor A, Blom AW. The Association of Body Mass Index with Risk of Long-Term Revision and 90-Day Mortality Following Primary Total Hip Replacement. *J Bone and Joint Surg Am*. 2018;100(24):2140-2152. doi:10.2106/jbjs.18.00120.
66. Naal FD, Schmied M, Munzinger U, Leunig M, Hersche O. Outcome of hip resurfacing arthroplasty in patients with developmental hip dysplasia. *Clin Orthop Relat Res*. 2009;467(6):1516-1521. doi:10.1007/s11999-008-0456-4.
67. O'Brien S, Bennett D, Doran E, Beverland D. Comparison of hip and knee arthroplasty outcomes at early and intermediate follow-up. *Orthopedics*. 2009;32(3):168.
68. Onggo J, Onggo J, de Steiger R, Hau R. Greater risks of complications, infections, and revisions in the obese versus non-obese total hip arthroplasty population of 2,190,824 patients: a meta-analysis and systematic review. *Osteoarthritis Cartilage*. 2020;28(1):31-44. doi:10.1016/j.joca.2019.10.005.
69. Parker MJ, Gurusamy KS, Azegami S. Arthroplasties (with and without bone cement) for proximal femoral fractures in adults. *Cochrane Database Syst Rev*. 2010;(6):CD001706. doi:10.1002/14651858.CD001706.pub4.
70. Parker MJ, Gurusamy K. Internal fixation versus arthroplasty for intracapsular proximal femoral fractures in adults. *Cochrane Database Syst Rev*. 2006;(4):CD001708. doi:10.1002/14651858.CD001708.pub2.
71. Parvizi J, Pour AE, Keshavarzi NR, D'Apuzzo M, Sharkey PF, Hozack WJ. Revision total hip arthroplasty in octogenarians. A case- control study. *J Bone Joint Sur Am*. 2007;89(12):2612-2618. doi:10.2106/JBJS.F.00881.
72. Peters RM, van Steenberg LN, Stewart RE, et al. Patient Characteristics Influence Revision Rate of Total Hip Arthroplasty: American Society of Anesthesiologists Score and Body Mass Index Were the Strongest Predictors for Short-Term Revision After Primary Total Hip Arthroplasty. *J Arthroplasty*. 2020;35(1):188-192.e2. doi:10.1016/j.arth.2019.08.024.

73. Petis SM, Kubista B, Hartzler RU, Abdel MP, Berry DJ. Polyethylene liner and femoral head exchange in total hip arthroplasty. *J Bone Joint Surg Am.* 2019;101:421-428. doi:10.2106/JBJS.18.00522.
74. Pugely AJ, Martin CT, Gao Y, Schweizer ML, Callaghan JJ. The incidence of and risk factors for 30-day surgical site infections following primary and revision total joint arthroplasty. *J Arthroplasty.* 2015;30:47–50.
75. Quinn RH, Murray J, Pezold R, Hall Q. Management of Osteoarthritis of the Hip. *J Am Acad Orthop Surg.* 2018;26(20):e434-e436. doi:10.5435/JAAOS-D-18-00351.
76. Quintana JM, Azkarate J, Goenaga JI, Aróstegui I, Beldarrain I, Villar JM. Evaluation of the appropriateness of the hip joint replacement techniques. *Intl J Tech Assess Health Care.* 2000;16(1):165-177. doi:10.1017/s0266462300161148.
77. Revell MP, McBryde CW, Bhatnagar S, Pynsent PB, Treacy RB. Metal-on-metal hip resurfacing in osteonecrosis of the femoral head. *J Bone Joint Surg Am.* 2006;88(Suppl 3):98-103. doi:10.2106/JBJS.F.01070.
78. Saleh KJ, Kassim R, Yoon P, Vorlicky LN. Complications of total hip arthroplasty. *Am J Orthop (Belle Mead NJ).* 2002;31(8):485-488.
79. Santaguida PL, Hawker GA, Hudak PL, et al. Patient characteristics affecting the prognosis of total hip and knee joint arthroplasty: a systematic review. *Can J Surg.* 2008;51(6):428-436.
80. Scheerlinck T, Dezillie M, Monsaert A, Opdecam P. Bipolar versus total hip arthroplasty in the treatment of avascular necrosis of the femoral head in young patients. *Hip Int.* 2002;12(2):142-149. doi:10.1177/112070000201200222.
81. Sermon A, Broos P, Vanderschot P. Total hip replacement for acetabular fractures. Results in 121 patients operated between 1983 and 2003. *Injury.* 2008;39(8):914-921. doi:10.1016/j.injury.2007.12.004.
82. Sharma H, Dregghorn CR, Gardner ER. Girdlestone resection arthroplasty of the hip: Current perspectives. *Curr Orthop.* 2005;19(5):385-392. doi:10.1016/j.cuor.2005.06.005.
83. Shimmin AJ, Bare J, Back DL. Complications associated with hip resurfacing arthroplasty. *Orthop Clin North Am.* 2005;36(2):187-193, ix. doi:10.1016/j.ocl.2005.01.002.
84. Shimmin A, Beaulé PE, Campbell P. Metal-on-metal hip resurfacing arthroplasty. *J Bone Joint Surg Am.* 2008;90(3):637-654. doi:10.2106/JBJS.G.01012.
85. Shohat N, Fleischman A, Tarabichi M, Tan T, Parvizi J. Weighing in on Body Mass Index and Infection After Total Joint Arthroplasty. *Clin Orthop Relat Res.* 2018;476(10):1964-1969. doi:10.1007/s11999-0000000000000141.
86. Smith TO, Nichols R, Donell ST, Hing CB. The clinical and radiological outcomes of hip resurfacing versus total hip arthroplasty: a meta-analysis and systematic review. *Acta Orthop.* 2010;81(6):684-695. doi:10.3109/17453674.2010.533933
87. Steinberg M, Steinberg D. Classification systems for osteonecrosis: an overview. *Orthop Clin North Am.* 2004;35(3):273-283, vii-viii. doi:10.1016/j.ocl.2004.02.005.
88. Stevenson C, Ogonda L, Blaney J, Dennison J, O'Brien S, Beverland D. Minimal Incision Total Hip Arthroplasty. *J Bone Joint Surg Am.* 2017;99:1715-1720. doi:10.2106/JBJS.16.00950.
89. Treacy RB, McBryde CW, Pynsent PB. Birmingham hip resurfacing arthroplasty. A minimum follow-up of five years. *J Bone Joint Surg Br.* 2005;87(2):167-170. doi:10.1302/0301-620x.87b2.15030.
90. Ulrich SD, Seyler TM, Bennett D, et al. Total hip arthroplasties: what are the reasons for revision?. *Int Orthop.* 2008;32(5):597-604. doi:10.1007/s00264-007-0364-3.
91. Walmsley DW, Waddell JP, Schemitsch EH. Isolated Head and Liner Exchange in Revision Hip Arthroplasty. *J Am Acad Orthop Surg.* 2017;25:288-296. doi:10.5435/JAAOS-D-15-00144.
92. Walsh J. *Metal on Metal Total Hip Resurfacing as an Alternative to Total Hip Arthroplasty: A Technology Assessment.* October 19, 2011. San Francisco, CA. California Technology Assessment Forum® (CATF). Available at: https://www.fdanews.com/ext/resources/files/archives/m/Metal_on_Metal_Hip_Resurfacing_100611.pdf.
93. Ward DT, Metz LN, Horst PK, Kim HT, Kuo AC. Complications of morbid obesity in total joint arthroplasty: risk stratification based on BMI. *J Arthroplasty.* 2015;30(9)(Suppl):42-46. doi:10.1016/j.arth.2015.03.045.
94. Warren JA, George J, Anis HK, et al. Effects of Estimated Glomerular Filtration Rate on 30-Day Mortality and Postoperative Complications After Total Hip Arthroplasty: A Risk Stratification Instrument. *J Arthroplasty.* 2020;35(3):786-793. doi:10.1016/j.arth.2019.10.001.
95. Watson D, Bostrom M, Salvati E, Walcott-Sapp S, Westrich G. Primary total hip arthroplasty for displaced femoral neck fracture. *Orthopedics.* 2008;31(10). doi:10.3928/01477447-20110525-15.
96. Wylde V, Blom A, Whitehouse SL, Taylor AH, Pattison GT, Bannister GC.. Patient-reported outcomes after total hip and knee arthroplasty: comparison of midterm results. *J Arthroplasty.* 2009;24(2):210-216. doi:10.1016/j.arth.2007.12.001.
97. Zaruta DA, Qiu B, Liu AY, et al. Indications and guidelines for debridement and implant retention for periprosthetic hip and knee infection. *Curr Rev Musculoskelet Med.* 2018;11:347-356. doi:10.1007/s12178-018-9497-9.
98. Zusmanovich M, Kester BS, Schwarzkopf R. Postoperative Complications of Total Joint Arthroplasty in Obese Patients Stratified by BMI. *J Arthroplasty.* 2018;33:856-864. doi:10.1016/j.arth.2017.09.067.