

Cigna Medical Coverage Policies – Musculoskeletal Hip Replacement/Arthroplasty

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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.

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CMM-313: Hip Replacement/Arthroplasty

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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 hip osteoarthritis): 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 hip pain from osteoarthritis. 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 sphericity of the femoral head

- **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 at least three (3) months of provider-directed non-surgical management
 - ◆ **Criteria exception:** Three (3) months of provider-directed non-surgical management 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).
 - ◆ **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 arthropathy affecting both the femoral head and acetabulum
 - ◆ Avascular necrosis of the femoral head involving more than 50% 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 arthropathy 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 at least three (3) months of provider-directed non-surgical management
 - ◆ **Criteria exception:** Three (3) months of provider-directed non-surgical management 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).
 - ◆ **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 involving more than 50% 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 at least three (3) months of provider-directed non-surgical management
 - ◆ **Criteria exception:** Three (3) months of provider-directed non-surgical management is **not required** when the medical record clearly documents 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 arthropathy affecting **BOTH** the femoral head and 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 Arthropathy

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

- Inflammatory arthropathy affecting both the femoral head and 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 at least three (3) months of provider-directed non-surgical management
 - ◆ **Criteria exception:** Three (3) months of provider-directed non-surgical management is **not required** when the medical record clearly documents 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 not responsive to a reasonable course of non-surgical care
- 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

- Unexplained 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 greater than six (6) months 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
 - ◆ Implants are well-fixed and in an acceptable position
- Acute post-operative periprosthetic joint infection (including hematogenous infection)
 - ◆ Implants are well-fixed
- Dislocation/instability:
 - ◆ Treatment 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 infection
- Individual with a pre-existing ambulatory dysfunction or that is non-ambulatory
- 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.

Procedure (CPT®) Codes (CMM-313)

This guideline relates to the CPT® code set below. Codes are displayed for informational purposes only. Any given code's inclusion on this list does not necessarily indicate prior authorization is required.

CPT®	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
This list may not be all-inclusive and is not intended to be used for coding/billing purposes. The final determination of reimbursement for services is the decision of the health plan and is based on the individual's policy or benefit entitlement structure as well as claims processing rules.	

References (CMM-313)

1. Adhikary SD, Liu W, Memtsoudis SG, et al. 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;31:749-753.
2. Adili A, Trousdale R. Femoral head resurfacing for the treatment of osteonecrosis in the young patient. *Clin Orthop Relat Res*. 2003;(417):93-101.
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*. Published online February 2023. 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, et al. The Effect of BMI on 30 Day Outcomes Following Total Joint Arthroplasty. *J Arthroplasty*. 2015;30:1113-1117.
6. American Academy of Orthopaedic Surgeons (AAOS). *Management of Osteoarthritis of the Hip Evidence-based Clinical Practice Guideline*. Rosemont, IL: American Academy of Orthopaedic Surgeons; 2017:1-850. https://www5.aaos.org/uploadedFiles/PreProduction/Quality/Guidelines_and_Reviews/OA%20Hip%20CPG_3.13.17.pdf.
7. Amstutz H, Ball S, Le Duff M, Dorey F. Resurfacing THA for Patients Younger Than 50 Years: Results of 2- to 9-year Follow-up. *Clin Orthop Relat Res*. 2007;460:159-164.
8. Amstutz H, Su E, Le Duff M. Surface arthroplasty in young patients with hip arthritis secondary to childhood disorders. *Orthop Clin North Am*. 2005;36(2):223-230.
9. Andrew J, Palan J, Kurup H, et al. Obesity in total hip replacement. *J Bone Joint Surg Br*. 2008; 90(4):424-429.
10. Back D, 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.
11. Bartels S, Kristensen T, Gjertsen J, 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.
12. Basu I, Howes M, Jowett C, et al. Girdlestones excision arthroplasty: Current update. *Int J Surg*. 2011;9(4):310-313.
13. Beaulé P, Antoniadou J. Patient selection and surgical technique for surface arthroplasty of the hip. *Orthop Clin North Am*. 2005;36(2):177-185, viii-ix.
14. Beaulé PE, Matta JM, Mast JW. Hip arthrodesis: current indications and techniques. *J Am Acad Orthop Surg*. 2002;10(4):249-258.
15. Beaulé P, Schmalzried T, Campbell P, et al. Duration of symptoms and outcome of hemiresurfacing for hip osteonecrosis. *Clin Orthop Relat Res*. 2001;(385):104-117.
16. 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.
17. Biring G, Masri B, Greidanus N, et al. Predictors of quality of life outcomes after revision total hip replacement. *J Bone Joint Surg Br*. 2007;89(11):1446-1451.
18. Boraiah S, Ragsdale M, Achor T, et al. Open reduction internal fixation and primary total hip arthroplasty of selected acetabular fractures. *J Orthop Trauma*. 2009;23(4):243-248.
19. Boyd H, Ulrich S, Seyler T, et al. Resurfacing for Perthes disease: an alternative to standard hip arthroplasty. *Clin Orthop Relat Res*. 2007;465:80-85.
20. Brooks PJ. Dislocation following total hip replacement. *Bone Joint J*. 2013;95-B(10):67-69. doi: 10.1302/0301-620X.95B11.
21. Browne J, Casp A, Cancienne J, Werner B. 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.
22. Busato A, Roder C, Herren S, Eggli S. Influence of high BMI on functional outcome after total hip arthroplasty. *Obesity Surgery*. 2008; 18(5):595-600.
23. California Technology Assessment Forum (CTAF). *Metal-on-metal total hip resurfacing as an alternative to total hip arthroplasty. A Technology Assessment*. San Francisco, CA: CTAF; October 17, 2007.
24. Center for Disease Control and Prevention (CDC). *Defining adult overweight and obesity*. Updated June 16, 2016. <https://www.cdc.gov/obesity/adult/defining.html>.
25. 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.
26. Chen W, Klemm C, Padmanabha A, Tirumala V, Xiong L, Kwon Y. 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.
27. 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.

28. Chughtai M, Piuzzi NS, Khlopas A, et al. 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.
29. Cohen JS, Gu A, Lopez NS, et al. 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.
30. 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.
31. Dumbleton J, Manley M. Metal-on-Metal total hip replacement: What does the literature say? *J Arthroplasty*. 2005;20(2):174-188.
32. Ferrara P, Rabini A, Aprile I, et al. Effect of pre-operative physiotherapy in patients with end-stage osteoarthritis undergoing hip arthroplasty. *Clin Rehabil*. 2008;22(10-11):977-986.
33. Fillingham Y, Della Valle C, Bohl D, 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.
34. Friedman RJ, Hess S, Berkowitz SD, et al. Complication Rates After Hip or Knee Arthroplasty in Morbidly Obese Patients. *Clin Orthop Relat Res*. 2013;471:3358-3366.
35. 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.
36. Girard J, Lavigne M, Vendittoli P, Roy A. 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.
37. Gjertsen J, Lie S, Fevang J, et al. Total hip replacement after femoral neck fractures in elderly patients: results of 8,577 fractures reported to the Norwegian Arthroplasty Register. *Acta Orthopaedica*. 2007;78(4):491-497.
38. Grecula M. Resurfacing arthroplasty in osteonecrosis of the hip. *Orthop Clin North Am*. 2005;36(2):231-242.
39. Grigoris P, Roberts P, Panousis K, Bosch H. The evolution of hip resurfacing arthroplasty. *Orthop Clin North Am*. 2005;36(2):125-134, vii.
40. Gwynne-Jones J, Wilson R, Wong J, Abbott J, Gwynne-Jones D. 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.
41. Hamel M, Toth M, Legedza A, Rosen M. 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.
42. Inoue D, Yazdi H, Goswami K, Tan T, 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.
43. Jurgensmeier K, Jurgensmeier D, Kunz D, Fuerst P, Warth L, Daines S. 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.
44. Keeney B, Austin D, Jevsevar D. 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.
45. 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.
46. Le Duff M, Amstutz H, Dorey F. Metal-on-metal hip resurfacing for obese patients. *J Bone Joint Surg Am*. 2007;89(12):2705-2711.
47. Li M, Glassman A. What's New in Hip Replacement. *J Bone Joint Surg*. 2020;102(18):1572-1580. doi: 10.2106/jbjs.20.00927.
48. Lubbeke A, Katz J, Perneger T, Hoffmeyer P. Primary and revision hip arthroplasty: 5-year outcomes and influence of age and comorbidity. *J Rheumatol*. 2007;34(2):394-400.
49. Lubbeke A, Moons K, Garavaglia G, Hoffmeyer P. Outcomes of obese and nonobese patients undergoing revision total hip arthroplasty. *Arthritis Rheumatol*. 2008;59(5):738-745.
50. Malhotra R, Kannan A, Kumar V, et al. Hip Resurfacing Arthroplasty in Inflammatory Arthritis: A 3- to 5-Year Follow-up Study. *J Arthroplasty*. 2012;27(1):15-20.
51. Marker D, Seyler T, Jinnah H, et al. Femoral neck fractures after metal-on-metal total hip resurfacing: a prospective cohort study. *J Arthroplasty*. 2007;22(7 Suppl 3):66-71.
52. McLaughlin J, Lee K. 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.
53. Mont M, Rajadhyaksha A, Hungerford D. 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.
54. Mont M, Seyler T, Marker D, et al. 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.
55. Moroni A, Cadossi M, Bellenghi C, et al. Resurrection of hip resurfacing: what is the evidence? *Expert Rev Med Devices*. 2006;3(6):755-762.

56. Morse KW, Su EP. Hip resurfacing arthroplasty for patients with inflammatory arthritis: a systematic review. *Hip Int*. 2017. doi: 10.5301/hipint.5000558.
57. Mouchti S, Whitehouse M, Sayers A, Hunt L, MacGregor A, Blom A. 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.
58. Naal F, Schmied M, Munzinger U, et al. Outcome of hip resurfacing arthroplasty in patients with developmental hip dysplasia. *Clin Orthop Relat Res*. 2009;467(6):1516-1521.
59. 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.
60. 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.
61. Parker M, Gurusamy K, 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.
62. Parker M, Gurusamy K. Internal fixation versus arthroplasty for intracapsular proximal femoral fractures in adults. *Cochrane Database Syst Rev*. 2006;(4):CD001708.
63. Parvizi J, Pour A, Keshavarzi N, et al. Revision total hip arthroplasty in octogenarians. A case- control study. *J Bone Joint Surg Am*. 2007;89(12):2612-2618.
64. Peters R, van Steenbergen L, Stewart R 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.
65. Petis SM, Kubista B, Hartzler RU, et al. Polyethylene liner and femoral head exchange in total hip arthroplasty. *J Bone Joint Surg Am*. 2019;101:421-428.
66. Quintana J, Azkarate J, Goenaga J, et al. Evaluation of the appropriateness of the hip joint replacement techniques. *Intl J Tech Assess Health Care*. 2000;16(1):165-177.
67. Revell M, McBryde C, Bhatnagar S, et al. Metal-on-metal hip resurfacing in osteonecrosis of the femoral head. *J Bone Joint Surg Am*. 2006;88(Suppl 3):98-103.
68. Santaguida P, Hawker G, Hudak P, 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.
69. Scheerlinck T, Dezillie M, Monsaert A, et al. 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.
70. 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.
71. Sharma H, Dreghorn CR, Gardner ER. Girdlestone resection arthroplasty of the hip: Current perspectives. *Curr Orthop*. 2005;19(5):385-392.
72. Shimmin A, Bare J, Back L. Complications associated with hip resurfacing arthroplasty. *Orthop Clin North Am*. 2005;36(2):187-193, ix.
73. Shimmin A, Beaulé PE, Campbell P. Metal-on-metal hip resurfacing arthroplasty. *J Bone Joint Surg Am*. 2008;90(3):637-654.
74. 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/s11999.00000000000000141.
75. Steinberg M, Steinberg D. Classification systems for osteonecrosis: an overview. *Orthop Clin North Am*. 2004;35(3):273-283, vii-viii.
76. Stevenson C, Ogonda L, Blaney J, et al. Minimal Incision Total Hip Arthroplasty. *J Bone Joint Surg Am*. 2017;99:1715-1720.
77. Treacy R, McBryde C, Pynsent P. Birmingham hip resurfacing arthroplasty. A minimum follow-up of five years. *J Bone Joint Surg Br*. 2005;87(2):167-170.
78. Walmsley DW, Waddell JP, Schemitsch EH. Isolated Head and Liner Exchange in Revision Hip Arthroplasty. *J Am Acad Orthop Surg*. 2017;25:288-296.
79. 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. Epub 2015 Jun 3.
80. Warren J, George J, Anis H 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.
81. Watson D, Bostrom M, Salvati E, et al. Primary total hip arthroplasty for displaced femoral neck fracture. *Orthopedics*. 2008;31(10).
82. Wylde V, Blom A, Whitehouse S, et al. Patient-reported outcomes after total hip and knee arthroplasty: comparison of midterm results. *J Arthroplasty*. 2009;24(2):210-216.

83. 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;11:347-56. doi: 10.1007/s12178-018-9497-9.
84. Zusmanovich M, Kester BS, Schwarzkopf R. Postoperative Complications of Total Joint Arthroplasty in Obese Patients Stratified by BMI. *J Arthroplasty.* 2018;33:856-864.