



CLINICAL GUIDELINES

CMM-311: Knee Replacement/Arthroplasty

Version 2.0.2019

Effective August 1, 2019



CMM-311: Knee Replacement/Arthroplasty	
CMM-311.1: Definition	3
CMM-311.2: General Guidelines	4
CMM-311.3: Indications and Non-Indications	4
CMM-311.4: Experimental, Investigational, or Unproven	8
CMM-311.5: Procedure (CPT®) Codes	9
CMM-311.6: References	10

CMM-311.1: Definition

- **Knee arthroplasty** is an orthopaedic surgical procedure during which the articular surface of the knee joint is replaced, remodeled or realigned.
- **Knee replacement** is a form of arthroplasty that includes the surgical replacement of the knee joint with a prosthesis.
- **Prosthesis** refers to an artificial device used to replace a structural element within a joint to improve and enhance function.
- **Total knee replacement** involves surgical reconstruction or replacement of the entire knee joint as a result of unicompartmental, bicompartmental, or tricompartmental involvement.
- **Partial knee replacement** involves surgical reconstruction or replacement of one joint surface of the knee joint as a result of unicompartmental (e.g., medial, lateral, or patellofemoral) involvement.
- **Revision of knee replacement (partial or total)** involves surgical reconstruction or replacement due to failure or complications of previous knee replacement.
- **The Modified Outerbridge Classification** is a system that has been developed for judging articular cartilage injury to the knee. This system allows delineation of varying areas of chondral pathology, based on the qualitative appearance of the cartilage surface, and can assist in identifying those injuries that are suitable for repair techniques. The characterization of cartilage in this system is as follows:
 - ◆ Grade I - Softening with swelling
 - ◆ Grade II - Fragmentation and fissuring less than one square centimeter (1 cm²)
 - ◆ Grade III - Fragmentation and fissuring greater than one square centimeter (1 cm²)
 - ◆ Grade IV - Subchondral bone exposed
- **The Kellgren-Lawrence Grading System** is a radiographic grading system that has been developed for describing osteoarthritic changes to the knee. When used, the radiographic findings are typically reported within one of the following categories:
 - ◆ Grade I – Doubtful narrowing of joint space and possible osteophytic lipping
 - ◆ Grade II – Definite osteophytes and possible narrowing of joint space
 - ◆ Grade III – Moderate multiple osteophytes, definite narrowing of joint space, some sclerosis, and possible deformity of bone contour
 - ◆ Grade IV – Large osteophytes, marked narrowing of joint space, severe sclerosis, and definite deformity of bone contour

- **Non-surgical management**, with regard to the treatment of knee osteoarthritis, is defined as 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 knee pain from osteoarthritis. The types of treatment involved can include, but are not limited to: relative rest/activity modification, weight loss, supervised physiotherapy modalities and therapeutic exercises, oral prescription and non-prescription medications, bracing and other assistive devices (e.g., cane, crutches, walker, wheelchair), and/or intra-articular injections (i.e., steroid and/or viscosupplementation).

CMM-311.2: General Guidelines

The determination of medical necessity for the performance of knee replacement (partial or total) is always made on a case-by-case basis.

CMM-311.3: Indications and Non-Indications

Partial Knee Replacement

- **Partial knee replacement** (medial, lateral, or patellofemoral unicompartmental) is considered **medically necessary** when **ALL** of the following criteria have been met:
 - ◆ 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
 - ◆ Loss of knee function which interferes with the ability to carry out age appropriate activities of daily living and/or demands of employment
 - ◆ Severe unicompartmental (medial, lateral, or patellofemoral) degenerative arthritis evidenced by **EITHER** of the following:
 - Large osteophytes, marked narrowing of joint space, severe sclerosis, and definite deformity of bone contour (i.e., Kellgren-Lawrence Grade IV radiographic findings)
 - Exposed subchondral bone (i.e., Modified Outerbridge Classification Grade IV arthroscopy findings)
 - ◆ Intact, stable ligaments, in particular the anterior cruciate ligament
 - ◆ Knee arc of motion (full extension to full flexion) greater than 90°
 - ◆ Failure of at least three (3) months of provider-directed non-surgical management
 - For patients with BMI > 40, there must be failure of at least six (6) months of provider-directed non-surgical management
 - Provider-directed non-surgical management may be inappropriate. The medical record must clearly document why provider-directed non-surgical management is not appropriate.

- **Patellofemoral unicompartmental replacement** to manage protracted anterior knee pain and/or mechanical symptoms attributed to the patellofemoral joint following a total knee replacement, during which patellar replacement was not performed at the time of the index knee replacement, is considered **medically necessary** when the above criteria are met for the performance of patellofemoral unicompartmental replacement, with the exception of radiographic criteria.
- **Partial knee replacement** (medial, lateral, or patellofemoral unicompartmental) is considered **not medically necessary** for any other indication or condition, when **ANY** of the following criteria is present:
 - ◆ Grade III or IV patellofemoral joint arthritis (when unicompartmental replacement is to be performed of the medial or lateral compartment) and Grade IV medial or lateral compartment degenerative changes (when unicompartmental replacement is to be performed of the patellofemoral compartment), evidenced by **ANY** of the following:
 - Large osteophytes, marked narrowing of joint space, severe sclerosis, and definite deformity of bone contour (i.e., Kellgren-Lawrence Grade IV radiographic findings)
 - Moderate multiple osteophytes, definite narrowing of joint space, some sclerosis, and possible deformity of bone contour (i.e., Kellgren-Lawrence Grade III radiographic findings)
 - Exposed subchondral bone (i.e., Modified Outerbridge Classification Grade IV arthroscopy findings)
 - ◆ Tibial or femoral shaft deformity
 - ◆ Radiographic evidence of medial or lateral subluxation
 - ◆ Flexion contracture greater than 15°
 - ◆ Varus deformity greater than 15°
 - ◆ Valgus deformity greater than 20°
 - ◆ Inflammatory arthropathy
 - ◆ Active local or systemic infection
 - ◆ Osseous abnormalities that cannot be optimally managed prior to surgery which would increase the likelihood of a poor surgical outcome (i.e., inadequate bone stock to support the implant)
 - ◆ Severe lack of collateral ligament integrity leading to joint instability
 - ◆ Charcot joint
 - ◆ One or more uncontrolled or unstable medical conditions that would significantly increase the risk of morbidity (e.g., cardiac, pulmonary, liver, genitourinary, or metabolic disease; hypertension; abnormal serum electrolyte levels)
 - ◆ Vascular insufficiency, significant muscular atrophy of the leg, or neuromuscular disease severe enough to compromise implant stability or post-operative recovery
 - ◆ Severe immunocompromised state

Total Knee Replacement

- **Total Knee Replacement** is considered **medically necessary** when **ALL** of the following criteria have been met:
 - ◆ 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
 - ◆ Loss of knee function which interferes with the ability to carry out age appropriate activities of daily living and/or demands of employment
 - ◆ Severe unicompartmental (medial, lateral, or patellofemoral), bicompartamental, or tricompartmental degenerative arthritis evidenced by **EITHER** of the following:
 - Large osteophytes, marked narrowing of joint space, severe sclerosis, and definite deformity of bone contour (i.e., Kellgren-Lawrence Grade IV radiographic findings)
 - Exposed subchondral bone (i.e., Modified Outerbridge Classification Grade IV arthroscopy findings)
 - ◆ Failure of at least three (3) months of provider-directed non-surgical management
 - For patients with BMI > 40, there must be failure of at least six (6) months of provider-directed non-surgical management
 - Provider-directed non-surgical management may be inappropriate. The medical record must clearly document why provider-directed non-surgical management is not appropriate.
- **Total Knee Replacement** is considered **medically necessary** for a fracture of the distal femur when conservative management or surgical fixation is not considered a reasonable option.
- **Total Knee Replacement** is considered **not medically necessary** for any other indication or condition, including when **ANY** of the following criteria is present:
 - ◆ Active local or systemic infection
 - ◆ Osseous abnormalities that cannot be optimally managed and which would increase the likelihood of a poor surgical outcome (i.e., inadequate bone stock to support the implant)
 - ◆ Joint instability due to a lack of collateral ligament integrity not amenable to surgical correction (e.g., specialized implant, constrained implant, or a hinge implant)
 - ◆ Greater than 30 degrees of fixed varus or valgus deformity not amenable to surgical correction.
 - ◆ One or more uncontrolled or unstable medical conditions that would significantly increase the risk of morbidity (e.g., cardiac, pulmonary, liver, genitourinary, or metabolic disease; hypertension; abnormal serum electrolyte levels)
 - ◆ Vascular insufficiency, significant muscular atrophy of the leg, or neuromuscular disease severe enough to compromise implant stability or post-operative recovery
 - ◆ Severe immunocompromised state

- Refer to **MS-12: Osteoarthritis** and **MS-25: Knee** for the advanced imaging indications prior to knee replacement surgery.

Revision of Knee Replacement – Partial or Total

- **Revision of Knee Replacement** (including revision of a total knee replacement, revision of a medial, lateral, or patellofemoral unicompartmental replacement to another medial, lateral, or patellofemoral unicompartmental replacement, or revision of a medial, lateral, or patellofemoral unicompartmental replacement to a total knee replacement) is considered **medically necessary** for an individual who has previously undergone a partial or total knee replacement when **ANY** of the following criteria have been met:
 - ◆ Presence of **ANY** of the following:
 - Fracture or dislocation of the patella
 - Aseptic loosening
 - Periprosthetic infection
 - Periprosthetic fracture
 - Implant fracture or component failure
 - Stiffness more than 12 weeks post-operatively when manipulation is deemed unsafe by provider with well positioned, well fixed, appropriately sized components
 - Stiffness due to component sizing or positioning
 - Instability of the knee
 - Clinically significant, symptomatic limb malalignment due to existing component position
 - ◆ 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
 - ◆ Kellgren-Lawrence Grade IV radiographic findings in the non-replaced medial, lateral, or patellofemoral compartments if revising from a partial (unicompartmental) knee replacement to a total joint replacement
- **Revision of knee replacement** is considered **not medically necessary** for any other indication or condition.
- **Isolated polyethylene liner exchange (IPE)** is considered **medically necessary** when **ANY** of the following criteria have been met:
 - ◆ Wear and Osteolysis:
 - Symptomatic individual with progressive osteolysis noted on imaging studies which also confirm well-fixed implants in acceptable position
 - ◆ Periprosthetic joint infection:
 - Individual is less than four (4) weeks from the index replacement procedure with well-fixed implants
 - ◆ Stiffness following total knee replacement (flexion contracture of > 15 degrees or flexion limited to < 90 degrees):

- Individual presents later than three (3) months from the index replacement procedure, after failure of physical therapy and manipulation under anesthesia with persistent restricted range-of-motion
- ◆ Instability:
 - Individual with flexion or mid-flexion instability without component malrotation or malalignment
- **Isolated polyethylene liner exchange (IPE)** is considered **not medically necessary** for any other indication or condition.
- Refer to **MS-16: Post-Operative Joint Replacement Surgery** and **MS-25: Knee** for advanced imaging indications following knee replacement surgery.

Knee Arthroplasty

- Refer to **CMM-312.3: Procedures for Patellofemoral Conditions** for the indications and non-indications of trochleoplasty using CPT® 27442 for a hypoplastic trochlea in patients with recurrent patellar instability.

Lysis of Adhesions/Manipulation Under Anesthesia (MUA)

- Refer to **CMM-312.3: Lysis of Adhesion/Manipulation Under Anesthesia (MUA)** for indications and non-indications of lysis of adhesions/manipulation under anesthesia (MUA).

CMM-311.4: Experimental, Investigational, or Unproven

- Based on lack of scientific evidence of efficacy and safety, the following are considered **experimental, investigational, or unproven**:
 - ◆ Bicompartamental knee arthroplasty
 - ◆ Bi-unicompartamental knee arthroplasty
 - ◆ Focal resurfacing of a single knee joint defect (e.g., Arthrosurface® femoral condyle implant)
 - ◆ Unicompartamental free-floating (un-fixed) interpositional device (e.g., UniSpacer®)
- The following CPT codes for arthroplasty of the patella, distal femur, or tibia are considered **experimental, investigational or unproven**:
 - ◆ CPT® 27437 - Arthroplasty, patella; without prosthesis
 - ◆ CPT® 27440 - Arthroplasty, knee, tibial plateau
 - ◆ CPT® 27441 - Arthroplasty, knee, tibial plateau; with debridement and partial synovectomy
 - ◆ CPT® 27443 - Arthroplasty, femoral condyles or tibial plateau(s), knee; with debridement and partial synovectomy

CMM-311.5: Procedure (CPT®) Codes

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
27438	Arthroplasty, patella; with prosthesis
27442	Arthroplasty, femoral condyles or tibial plateau(s), knee
27445	Arthroplasty, knee, hinge prosthesis (e.g. Walldius type)
27446	Arthroplasty, knee, condyle and plateau; medial OR lateral compartment
27447	Arthroplasty, knee, condyle and plateau; medial AND lateral compartments with or without patella resurfacing (total knee Arthroplasty)
27486	Revision of total knee Arthroplasty, with or without allograft; 1 component
27487	Revision of total knee Arthroplasty, with or without allograft; femoral and entire tibial component
27488	Removal of prosthesis, including total knee prosthesis, methylmethacrylate with or without insertion of spacer, knee
+0055	Computer-assisted musculoskeletal surgical navigational orthopedic procedure, with image-guidance based on CT/MRI images (List separately in addition to code for primary procedure)
HCPCS Level II	
S2900	Surgical techniques requiring use of robotic surgical system (list separately in addition to code for primary procedure)
The use of the following CPT® codes are considered experimental, investigational, and unproven.	
27437	Arthroplasty, patella; without prosthesis
27440	Arthroplasty, knee, tibial plateau
27441	Arthroplasty, knee, tibial plateau; with debridement and partial synovectomy
27443	Arthroplasty, femoral condyles or tibial plateau(s), knee; with debridement and partial synovectomy
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.	

CMM-311.6: References

1. Abdel MP, Bonadurer III GF, Jennings MT, et al. Increased Aseptic Tibial Failures in Patients with a BMI ≥ 35 and Well-Aligned Total Knee Arthroplasties. *J Arthroplasty*. 2015;30:2181-2184.
2. Abdel MP, Ast MP, Lee Y, et al. All-Cause In-Hospital Complications and Urinary Tract Infections Increased in Obese Patients Undergoing Total Knee Arthroplasty. *J Arthroplasty*. 2014; 29:1430-1434.
3. Ackroyd CE, Newman JH, Evans R, et al. The Avon patellofemoral arthroplasty: Five-year survivorship and functional results. *J Bone Joint Surg Br*. 2007;89(3):310-315.
4. 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.
5. Al-Hadithy N, Patel R, Navadgi B, et al. Mid-term results of the FPV patellofemoral joint replacement. *Knee*. 2014;21(1):138-141.
6. Altman, R, et al. American College of Rheumatology Subcommittee on Osteoarthritis Guidelines. Recommendations for the medical management of osteoarthritis of the hip and knee: 2000 update. *Arthritis Rheum*. 2000;43(9):1905-1915.
7. Altman R, Lim S, Steen RG, Dasa V. Hyaluronic Acid Injections Are Associated with Delay of Total Knee Replacement Surgery in Patients with Knee Osteoarthritis: Evidence from a Large U.S. Health Claims Database. *PLoS ONE*, 2015;10(12): e0145776. doi:10.1371/journal.pone.0145776
8. Altman R, Fredericson M, Bhattacharyya S, et al. Association between Hyaluronic Acid Injections and Time-to-Total Knee Replacement Surgery. *J Knee Surg*. 2016;29:564-570.
9. 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.
10. American Academy of Orthopaedic Surgeons (AAOS). AAOS clinical guideline on osteoarthritis of the knee, 2nd edition 2013. Available at: <http://www.aaos.org/Research/guidelines/TreatmentofOsteoarthritisoftheKneeGuideline.pdf>
11. Bailie A, Lewis P, Brumby SA et al. The Unispacer knee implant: Early clinical results. *J Bone Joint Surg Br*. 2008;90(4):446-450.
12. Baker RP, Masri BA, Greidanus NV, et al. Outcome After Isolated Polyethylene Tibial Insert Exchange in Revision Total Knee Arthroplasty. *J Arthroplasty*. 2013;28(1):1-6.
13. Berend KR, Berend ME, Dalury DF, et al. Consensus statement on indications and contraindications for medial unicompartmental knee arthroplasty. *Journal of Surgical Orthopaedic Advances*. 2015; 24(4):252-256. doi: 10.3113/JSOA.2015.0252.
14. Berend KR, Lombardi AV Jr, Adams JB. Obesity, young age, patellofemoral disease, and anterior knee pain: identifying the unicompartmental arthroplasty patient in the United States. *Orthopedics*, 2007; 30(5, suppl); 19-23.
15. Bing MR, Di Cesar's PE. Stiffness after total knee arthroplasty. *J Am Acad Orthop Surg* 2004; 12: 164-71.
16. Borus T, Thornhill T. Unicompartmental knee arthroplasty. *J Am Acad Orthop Surg*. 2008;16(1):9- 18.
17. Bradbury T, Fehring TK, Taunton M, et al. The fate of acute methicillin resistant *Staphylococcus aureus* periprosthetic knee infections treated by open debridement and retention of components. *J Arthroplasty* 2009;24:101-104.
18. Chewy VA, Foran JRH, Paxton RH RT al. Arthrofibrosis associated with total knee arthroplasty. *J Arthroplasty* 2017; 32: 2604-11.
19. Confalonieri N, Manzotti A, Cerveri P, De Momi E. Bi-unicompartmental versus total knee arthroplasty: A matched paired study with early clinical results. *Arch Orthop Trauma Surg*. 2008 Aug 12.
20. Davies AP. High early revision rate with the FPV patella-femoral unicompartmental arthroplasty. *Knee*. 2013;20(6):482-484.
21. Deyle GD, Allison SC, Matekel RL, et al. Physical Therapy Treatment Effectiveness for Osteoarthritis of the Knee: A Randomized Comparison of Supervised Clinical Exercise and Manual Therapy Procedures Versus a Home Exercise Program. *Physical Therapy*. 2005;85(12):1301-1317.
22. Dy CJ, Franco N, Ma Y, et al. Complications after patella-femoral versus total knee replacement in the treatment of isolated patella-femoral osteoarthritis. A meta-analysis. *Knee Surg Sports Traumatol Arthrosc*. 2012;20:2174-2190.

23. Deshmukh R, Hayes J, Pinder I. Does body weight influence outcome after total knee arthroplasty? A 1-year analysis. *J Arthroplasty* 2002 Apr;17(3):315-9.
24. Dewan A, Bertolusso R, Karastinos A, et al. Implant Durability and Knee Function After Total Knee Arthroplasty in the Morbidly Obese Patient. 2009 Sep; 24 (6)(Suppl 1):89-94:94.e1-3. Epub 2009 Jul 2.
25. Dowsey MM, Liew D, Stoney JD, et al. The impact of pre-operative obesity on weight change and outcome in total knee replacement. *J Bone Joint Surg Br.* 2010;92-B:513-20.
26. Escobar A, Quintana J, Bilbao A, et al. Effect of patient characteristics on reported outcomes after total knee replacement. *Rheumatology.* 46(1):112-9, 2007 Jan.
27. Ethgen O, Bruyère O, Richy F, et al. Health-related quality of life in total hip and total knee arthroplasty. A qualitative and systematic review of the literature. *J Bone Joint Surg Am.* 2004 May;86-A(5):963-74
28. Fitzsimmons SE, Vazquez EA, Bronson MJ. How to Treat the Stiff Total Knee Arthroplasty? A Systematic Review. *Clin Orthop Relat Res.* 2010;468:1096-1106.
29. Franklin PD, Rosal MC. Can Knee Arthroplasty Play a Role in Weight Management in Knee Osteoarthritis? *Arthritis Care Res.* 2013;65(5):667-668.
30. 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.
31. Gaulton TG, Fleisher LA, Neuman MD. The association between obesity and disability in survivors of joint surgery: analysis of the health and retirement study. *British Journal of Anaesthesia.* 2018;120(1):109-116.
32. George J, Piuze NS, Ng M, et al. Association Between Body Mass Index and Thirty-Day Complications After Total Knee Arthroplasty. *J Arthroplasty.* 2018;33:865-871.
33. Glassman, Andrew, Lachiewicz, et al. Chapter 9 Unicompartmental, Patellofemoral and Bicompartmental Arthroplasty. *Orthopaedic Knowledge Update: Hip and Knee Reconstruction* 4th ed. 2011. 107 & 109.
34. Griffen T, Maddern G, Rowden N, et al. Unicompartmental knee arthroplasty for unicompartmental osteoarthritis: A systematic review. *ASERNIP-S Report; 44.* North Adelaide, SA: Royal Australasian College of Surgeons, Australian Safety and Efficacy Register of New Interventional Procedures (ASERNIP) - Surgical; 2005.
35. Griffin T, Rowden N, Morgan D, et al. Unicompartmental knee arthroplasty for the treatment of unicompartmental osteoarthritis: A systematic study. *ANZ J Surg.* 2007;77(4):214-221.
36. Hawker G, Guan J, Croxford R, et al. A prospective population-based study of the predictors of undergoing total joint arthroplasty. *Arthritis Rheum.* 2006 Oct;54(10):3212-20.
37. Jacofsky DJ, Della Valle CJ, Meneghini, et al. Revision Total Knee Arthroplasty: What the Practicing Orthopaedic Surgeon Needs to Know. *J Bone Joint Surg Am.* 2010;92:1282-92.
38. Jamali AA, Scott RD, Rubash HE, et al. *AM J Orthop.* 2009;38(1):17-23.
39. Jones C, Beaupre L, Johnston D, Suarez-Almazor ME. Total joint arthroplasties: current concepts of patient outcomes after surgery. *Rheum Dis Clin North Am.* 2007 Feb;33(1):71-86.
40. Jones C, Voaklander D, Johnston D, et al. The effect of age on pain, function, and quality of life after total hip and knee arthroplasty. *Arch Intern Med* 2001 Feb;161(3):454-60.
41. Khanna G, Levy B. Oxford unicompartmental knee replacement: Literature review. *Orthopedics.* 2007;30(5 Suppl):11-14.
42. King AH, Engasser WM, Sousa PL, et al. Patellar fracture following patellofemoral arthroplasty. *J Arthroplasty.* 2015;30(7):1203-1236.
43. Konan S, Haddad FS. Midterm Outcome of Avon Patellofemoral Arthroplasty for Posttraumatic Unicompartmental Osteoarthritis. *J Arthroplasty.* 2016;31:2657-2659.
44. König A, Walther M, Kirschner S, et al. Balance sheets of knee and functional scores 5 years after total knee arthroplasty for osteoarthritis: a source for patient information. *J Arthroplasty* 2000;15(3):289-94.
45. Kulshrestha V, Datta B, Kumar S, et al. Outcome of Unicompartmental Knee Arthroplasty vs Total Knee Arthroplasty for Early Medial Compartment Arthritis: A Randomized Study. *J Arthroplasty.* 2017; 32:1460-1469.
46. Lachiewicz PF, Soileau ES. Liner Exchange in Total Knee Arthroplasty. *J of Surgical Orthopaedic Advances.* 2013;22(2):152-156.
47. Lonner JH. Patellofemoral arthroplasty. *J Am Acad Orthop Surg.* 2007;15(8):495-506.

48. Luring C, Tingart M, Drescher W, et al. Therapy of isolated arthritis in the patellofemoral joint: Are there evidence-based options? *Orthopade*. 2011;40(10):902-906.
49. Lustig S. Patellofemoral arthroplasty. *Orthop Traumatol Surg Res*. 2014;100(1 Suppl):S35-S43.
50. Matzkin EG, Curry EJ, Kong Q, et al. Efficacy and Treatment Response of Intra-articular Corticosteroid Injections in Patients with Symptomatic Knee Osteoarthritis. *J Am Acad Orthop Surg*. 2017;25:703-714.
51. Martin JR, Jennings JM, Dennis DA. Morbid Obesity and Total Knee Arthroplasty: A Growing Problem. *JAAOS*. 2017;25(3):188-194.
52. McElroy MJ, Pivec R, Issa K, et al. The effects of obesity and morbid obesity on outcomes in TKA. *J Knee Surg*. 2013;26:83-8.
53. Meding J, Ritter M, Faris P, et al. Does the preoperative radiographic degree of osteoarthritis correlate to results in primary total knee arthroplasty? *J Arthroplasty* 2001 Jan;16(1):13-6.
54. Meneghini M. Revision Total Knee Arthroplasty. In Glassman AH, Lachiewicz PF, Tanzer M. eds. *Orthopaedic Knowledge Update: Hip and Knee Reconstruction* 4th edition, 2011, American Academy of Orthopaedic Surgeons, Rosemont, IL.
55. Mohammed R, Syed S, Ahmed N. Manipulation under anaesthesia for stiffness following knee arthroplasty. *Ann R Coll Surg Engl*. 2009;91:220-223.
56. Newman MT, Lonner JH, Ries M. Unicompartmental, patellofemoral, and bicompartmental arthroplasty. In Glassman AH, Lachiewicz PF, Tanzer M. eds. *Orthopaedic Knowledge Update: Hip and Knee Reconstruction* 4th edition, 2011, American Academy of Orthopaedic Surgeons, Rosemont, IL.
57. Ontario Ministry of Health and Long-Term Care, Medical Advisory Secretariat (MAS). Total knee replacement. *Health Technology Literature Review*. Toronto, ON: MAS; June 2005.
58. Pandit H, Beard D, Jenkins C, et al. Combined anterior cruciate reconstruction and Oxford unicompartmental knee arthroplasty. *J Bone Joint Surg Br*. 2006;88(7):887-892.
59. Pang H, Razak HR, Petis S, et al. The role of isolated polyethylene exchange in total knee arthroplasty. *EFFORT Open Rev*. 2017;2:66-71.
60. Parvizi J, Seel M, Hanssen A, et al. Patellar component resection arthroplasty for the severely compromised patella. *Clin Orthop* 2002 Apr;(397):356-61.
61. Pennington D, Swienckowski J, Lutes W, Drake G. Lateral unicompartmental knee arthroplasty: Survivorship and technical considerations at an average follow-up of 12.4 years. *J Arthroplasty*. 2006;21(1):13-17.
62. Pisanu G, Rosso F, Bertolo C, et al. Patellofemoral arthroplasty: current concepts and review of the literature. *Joints*. 2017;5:237-245.
63. Rajgopal V, Bourne RB, Chesworth BM, et al. The Impact of Morbid Obesity on Patient Outcomes After Total Knee Arthroplasty. *J Arthroplasty*. 2008;23(6):795-800.
64. Riddle DL, Perera RA, Jiranek WA, et al. Using Surgical Appropriateness Criteria to Examine Outcomes of Total Knee Arthroplasty in a United States Sample. *Arthritis Care Res*. 2015;67(3):349-357.
65. Saldanha K, Keys G, Svard U, et al. Revision of Oxford medial unicompartmental knee arthroplasty to total knee arthroplasty - results of a multicentre study. *Knee*. 2007;14(4):275-279.
66. Saleh K, Dykes D, Tweedie R, et al. Functional outcome after total knee arthroplasty revision: a metaanalysis. *J Arthroplasty* 2002 Dec;17(8):967-77.
67. Samson AL, Mercer GE, Campbell DG. Total knee replacement in the morbidly obese: a literature review. *ANZ J Surg*. 2010;80:595-599.
68. Sanders TL, Pareek A, Johnson NR, Stuart MJ, Dahm DL, Krych AJ. Patellofemoral arthritis after lateral patellar dislocation: a matched population-based analysis. *Am J Sports Med*. 2017 Apr; 45(5): 1012-7.
69. 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 Dec;51(6):428-36.
70. Scott R. UniSpacer: Insufficient data to support its widespread use. *Clin Orthop*. 2003;(416):164- 166.
71. Sisto D, Mitchell I. UniSpacer arthroplasty of the knee. *J Bone Joint Surg Am*. 2005;87(8):1706- 1711.
72. Skou ST, Roos EM, Laursen MB, Rathleff MS et al. A randomized, controlled trial of total knee replacement. *New England Journal of Medicine*, 2015; 373(17): 1597-1606.
73. Stickles B, Phillips L, Brox W, et al. Defining the relationship between obesity and total joint arthroplasty. *Obes Res* 2001 Mar;9(3):219-23.

74. Valenzuela GA, Jacobson NA, Buzas D, et al. Unicompartmental knee replacement after high tibial osteotomy. *Bone Joint J.* 2013;95-B:1348-53.
75. van der List JP, Chawla H, Zulderbaan HA, et al. Survivorship and functional outcomes of patellofemoral arthroplasty: a systematic review. *Knee Surg Sports Traumatol Arthrosc.* 2017;25:2622-31. doi 10.1007/s00167-015-3878-z.
76. 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 Sep;30(9)(Suppl):42-6. Epub 2015 Jun 3.
77. Zhang W, Moskowitz R, Nuki G, et al. OARSI recommendations for the management of hip and knee osteoarthritis, Part II: OARSI evidence-based, expert consensus guidelines. *Osteoarthritis Cartilage.* 2008;16(2):137-162.
78. Zusmanovich M, Kester BS, Schwarzkopf R. Postoperative Complications of Total Joint Arthroplasty in Obese Patients Stratified by BMI. *J Arthroplasty.* 2018;33:856-864.