



CLINICAL GUIDELINES

CMM-312: Knee Surgery-Arthroscopic and Open Procedures

Version 1.0

Effective July 1, 2021



Definitions

- **The 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 as viewed by direct visualization intraoperatively, 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 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 as viewed on MRI, 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 tibial-femoral joint of the knee. When used, the radiographic findings on plain x-rays are typically reported within one of the following categories:
 - ◆ Grade 0 – No radiographic features of osteoarthritis are present
 - ◆ 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
- **Autologous Chondrocyte Implantation (ACI) or Autologous Chondrocyte Transplantation (ACT)** is a cell-based cartilage repair surgical technique which utilizes an individual's own cells in an effort to repair damage to articular cartilage with the goal of improving joint function and reducing pain. The procedure involves the collection and culture of articular cartilage cells (i.e., chondrocytes) that are then implanted into the cartilage defect with the intent that the cultured cells will contribute to the regeneration and repair of the articular surface.

- **MACI® Implant** (Vericel Corporation, Cambridge, MA [formerly Genzyme Biosurgery]): Until recently, Carticel® (Vericel Corporation, Cambridge, MA [formerly Genzyme Biosurgery]) was the only technology that received FDA approval for the culturing of chondrocytes. MACI® Implant received approval from the U.S. Food and Drug Administration December 2016 as an autologous cellularized scaffold indicated for repair of single or multiple symptomatic, full-thickness cartilage defects of the knee with or without bone involvement in adults. MACI® Implant is utilized as part of an ACI procedure in which cartilage cells are removed during arthroscopy, and shipped to a laboratory, where the cells are cultured over a period of several weeks. The cells are seeded on a porcine collagen membrane, and once the culturing process is complete, the cells seeded on the membrane are returned to the surgeon for implantation during the procedure. The membrane is placed into the defect, and over several months the cells create a matrix that is intended to cover the articular surface of the knee. The safety and effectiveness of MACI® Implant in joints other than the knee has not been established.
- **Kissing Lesion** is an articular cartilage defect on opposing joint surfaces of the knee and that are in contact either between the patella and distal femur or the distal femur and tibia (e.g., bipolar lesion).
- **Mosaicplasty** (or osteochondral cylinder transplantation) is a surgical technique which consists of harvesting cylindrical bone-cartilage grafts and transplanting them into focal chondral or osteochondral defects in the knee. After excision of the chondral lesion, an abrasion arthroplasty is performed to refresh the base of the defect. The grafting procedure involves collecting grafts from the posterior aspect of the distal femoral articular surfaces (medial condyle, lateral condyle or trochlea) and implanting the grafts in a mosaic-like pattern that will contribute to regeneration and repair the articular surface. A recipient tunnel is created and sized with a drill bit slightly larger than the length of the graft. The harvested graft is placed in the tunnel by a press-fit method. All subsequent grafts are inserted in a similar pattern.
- **The Osteochondral Allograft Transplantation (OATS) Procedure** is similar to mosaicplasty, involving the use of a larger, single plug that usually fills an entire defect. It is often performed to graft chondral defects that are also associated with anterior cruciate ligament (ACL) tears. This method allows arthroscopic access to both the ACL and the chondral defect for the performance of a repair and the grafting procedure.
- **Subchondral Drilling or Microfracturing** is a surgical procedure which is performed after the calcified cartilage is debrided and the surgeon creates tiny fractures in the adjacent bones (through the use of an awl). Blood and bone marrow (which contains stem cells) seep out of the fractures, creating a blood clot that releases cartilage-building cells. The microfractures are treated as an injury by the body, which is why the surgery results in new, replacement cartilage. Studies have shown that microfracturing techniques do not fill the chondral defect fully and the repair material that forms is fibrocartilage. Fibrocartilage is not as mechanically sound as the original hyaline cartilage; it is much denser and isn't able to withstand the demands of everyday activities as well as hyaline cartilage and is; therefore, at a higher risk of breaking down. The procedure is less effective in treating older

individuals, overweight individuals, or in larger cartilage lesions. Furthermore, chances are high that after only one or two years, symptoms start to return as the fibrocartilage wears away, forcing the individual to reengage in articular cartilage repair.

- **Arthrofibrosis** is a condition of the appendicular skeletal system that has resulted from disease, injury, or surgery, and results in pain and restricted range of motion due to internal scarring of the joint with consequent stiffness.
- **Non-surgical management**, with regard to the treatment of knee pain, 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. The types of treatment involved can include, but are not limited to: ice, relative rest/activity modification, acupuncture, weight loss, supervised physiotherapy modalities and therapeutic exercises, oral prescription and non-prescription medications, assistive devices (e.g., brace, cane, crutches, walker, wheelchair), and/or intra-articular injections (i.e., steroid, viscosupplementation).

General Guidelines

- The determination of medical necessity for the performance of knee surgery is always made on a case-by-case basis.
- Refer to **MS-25: Knee** for advanced imaging indications for conditions about the knee.

Indications and Non-Indications

Knee arthroscopic or open surgical procedures may be considered **medically necessary** for individuals when surgery is being performed for fracture, tumor, infection or foreign body that has led to, or will likely lead to, progressive destruction.

Diagnostic Arthroscopy

- Diagnostic arthroscopy is considered **medically necessary** as a stand-alone procedure when **ALL** of the following criteria have been met:
 - ◆ Function-limiting pain (e.g., loss of knee function which interferes with the ability to carry out age appropriate activities of daily living and/or demands of employment) for at least six (6) months in duration
 - ◆ Any **ONE** of the following physical examination findings:
 - Limited range of motion
 - Evidence of joint swelling/effusion
 - Joint line tenderness
 - ◆ Failure of provider-directed non-surgical management for at least three (3) months in duration
 - ◆ Absence of Kellgren-Lawrence Grade 2 or greater findings on plain radiographs
 - ◆ MRI or CT arthrogram is inconclusive for internal derangement/pathology
- Diagnostic Arthroscopy is considered **not medically necessary** for any other indication or condition.

Arthroscopic Debridement (Chondroplasty)/Loose Body/Foreign Body Removal

- Arthroscopic debridement (chondroplasty), loose body removal, and foreign body removal are considered **medically necessary** when **ALL** of the following criteria have been met:
 - ◆ Function-limiting pain (e.g., loss of knee function which interferes with the ability to carry out age appropriate activities of daily living and/or demands of employment)
 - ◆ Individual reports pain and any **ONE** of the following mechanical symptoms:
 - Knee range of motion is “blocked” due to pain
 - Giving way, subjective weakness, buckling of the knee
 - Painful locking, clicking, catching, or popping during weight-bearing activities
 - ◆ Failure of provider-directed non-surgical management for at least three (3) months in duration
 - **Please note:** In the presence of an acutely locked knee joint related to an intra-articular loose body or foreign body, three (3) months of provider-directed non-surgical management is not required.
 - ◆ MRI or CT arthrogram demonstrates articular cartilage degeneration and any **ONE** of the following conditions:
 - Loose body or foreign body within the joint
 - Unstable flaps of articular cartilage
 - Meniscal tear that extends to the articular surface (not simply degenerative changes, i.e., fraying) in conjunction with articular cartilage degeneration
 - Impinging osteophytes, which would be reasonably expected to result in mechanical symptoms and loss of knee joint function
- Arthroscopic debridement (chondroplasty) and loose body removal is considered not medically necessary in the presence of Kellgren-Lawrence Grade 2 or greater findings on plain radiographs except for loose body removal in the presence of an acutely locked knee on physical examination.
- Arthroscopic debridement (chondroplasty), loose body removal, and foreign body removal are considered **not medically necessary** for any other indication or condition.

Synovectomy

- Synovectomy (limited [e.g., plica or shelf resection], as a stand-alone procedure, or a major procedure with 2 or more compartments [e.g., medial or lateral]) is considered **medically necessary** when **ALL** of the following criteria have been met:
 - ◆ Function-limiting pain (e.g., loss of knee function which interferes with the ability to carry out age appropriate activities of daily living and/or demands of employment)
 - ◆ Any **ONE** of the following physical examination findings:
 - Limited range of motion
 - Evidence of joint swelling/effusion

- Joint line or plica tenderness
- ◆ Failure of provider-directed non-surgical management for at least three (3) months in duration
- ◆ MRI or CT arthrogram demonstrates evidence of synovitis or plica
- ◆ Presence of any **ONE** of the following:
 - Plica syndrome
 - Inflammatory arthritis (i.e., rheumatoid arthritis, gout, pseudogout, psoriatic arthritis)
 - Pigmented villonodular synovitis (PVNS)
 - Synovial chondromatosis
 - Lyme synovitis
 - Hemophilia
 - Hemochromatosis
 - Non-specific synovitis (including proliferative synovitis, post-operative synovitis as a sequela from a knee replacement, patellar clunk syndrome, cyclops lesion, etc.)
 - Recurrent hemarthrosis (i.e., secondary to sickle cell anemia, bleeding diathesis, etc.)
- Synovectomy is considered **not medically necessary** for any other indication or condition.

Meniscectomy or Meniscal Repair

- Meniscectomy (partial or total) or meniscal repair is considered **medically necessary** when **ALL** of the following criteria have been met:
 - ◆ Function-limiting pain (e.g., loss of knee function which interferes with the ability to carry out age appropriate activities of daily living and/or demands of employment)
 - ◆ Individual reports pain and any **ONE** of the following mechanical symptoms:
 - Knee range of motion is “blocked” due to pain
 - Giving way, subjective weakness, or buckling of the knee
 - Painful locking, clicking, catching, or popping during weight-bearing activities
 - ◆ **TWO OR MORE** of the following physical examination findings:
 - Limited range of motion
 - Evidence of joint swelling/effusion
 - Joint line tenderness
 - Positive McMurray’s Test, Thessaly Test, or Apley’s Compression Test
 - ◆ Failure of provider-directed non-surgical management for at least three (3) months in duration,
 - **Please note:** Acute meniscal tear with associated function-limiting pain or locked knee on physical examination does not require three (3) months of provider-directed non-surgical management.
 - ◆ MRI or CT arthrogram demonstrates a meniscal tear that extends to the articular surface (not simply degenerative changes, i.e., fraying) that correlates with the individual’s reported symptoms and physical exam findings

- Meniscectomy/debridement for degenerative meniscal tears is considered **medically necessary** when **ALL** of the above criteria have been met **AND** when **BOTH** of the following criteria have been met:
 - ◆ Acute or acute on chronic degenerative meniscal tear that produced a recent change in symptoms which includes new mechanical symptoms
 - ◆ Absence of Kellgren-Lawrence Grade 2 or greater findings on plain radiographs
 - **Please note:** Acute meniscal tear with associated function-limiting pain or locked knee on physical examination does not require absence of Kellgren-Lawrence Grade 2 or greater findings on plain radiographs
- Meniscectomy/saucerization for discoid lateral meniscus is considered **medically necessary** when MRI confirms the presence of a discoid meniscus and **ALL** of the above criteria are met (other than demonstration of a meniscal tear)
- Meniscectomy (partial or total) or meniscal repair is considered **not medically necessary** for any other indication or condition.

Meniscal Allograft Transplantation

- Meniscal allograft transplantation is considered **medically necessary** when **ALL** of the following criteria have been met:
 - ◆ Function-limiting pain (e.g., loss of knee function which interferes with the ability to carry out age appropriate activities of daily living and/or demands or employment)
 - ◆ Prior significant trauma resulting in an irreparable meniscal tear or has undergone a meniscectomy where at least 50% of the meniscus has been removed
 - ◆ Any **ONE** of the following physical examination findings:
 - Limited range of motion
 - Evidence of joint swelling/effusion
 - Joint line tenderness
 - ◆ Failure of provider-directed non-surgical management for at least three (3) months in duration
 - ◆ Body Mass Index (BMI) 35 or less
 - ◆ Age 49 years or younger
- Meniscal allograft transplantation is considered **not medically necessary** for any other indication or condition, including when **EITHER** of the following criteria is present:
 - ◆ Upon standing radiographs, individual demonstrates osteoarthritic change in the knee including joint space narrowing and osteophytes which is classified by the Kellgren-Lawrence Scale as Grade III or IV
 - ◆ Upon MRI, individual demonstrates articular degeneration in affected compartment which is classified by the Modified Outerbridge Classification as Grade III or IV

Anterior Cruciate Ligament (ACL) Reconstruction

- Anterior cruciate ligament (ACL) reconstruction with allograft or autograft is considered **medically necessary** when **ALL** of the following criteria have been met:
 - ◆ Function-limiting pain and/or a documented loss of knee function during the course of preoperative treatment which interferes with **ANY** of the following:
 - Ability to carry out age appropriate activities of daily living
 - Demands of employment
 - Need to return to activities that require cutting, pivoting, and/or agility in which ACL insufficiency may predispose to further instability episodes that may result in new articular or meniscal cartilage injuries
 - ◆ Individual reports knee instability which is noted as giving way, subjective weakness, or “buckling” during the course of preoperative treatment
 - ◆ Any **ONE** of the following physical examination findings:
 - Positive Lachman’s Test
 - Positive Anterior Drawer Test
 - Positive Pivot Shift Test
 - ◆ Failure of provider-directed non-surgical management for at least three (3) months in duration, except in an acute injury setting where hemarthrosis, effusion, and joint instability have been documented and **ANY** of the following are present:
 - Need to return to high-demand sports that require cutting, pivoting, and/or agility activities in which ACL insufficiency may predispose to further instability episodes that may result in new articular or meniscal cartilage injuries
 - A confirmed ACL tear and a repairable meniscus tear
 - Concomitant ligament injuries (i.e., multi-ligamentous knee injury) that require reconstruction to provide stability
 - ◆ MRI, CT arthrogram, or arthroscopy demonstrates a tear/disruption or significant laxity of the anterior cruciate ligament (ACL)
- Anterolateral ligament reconstruction is considered **medically necessary** when the above criteria are met for anterior cruciate ligament (ACL) reconstruction and when anterolateral ligament (ALL) reconstruction is required to augment the anterior cruciate ligament (ACL) reconstruction.
- Anterior cruciate ligament (ACL) reconstruction is considered **not medically necessary** for any other indication or condition.

Posterior Cruciate Ligament (PCL) Reconstruction

- Posterior cruciate ligament (PCL) reconstruction with allograft or autograft is considered **medically necessary** when **ALL** of the following criteria have been met:
 - ◆ Function-limiting pain and a documented loss of knee function which interferes with the ability to carry out the age appropriate activities of daily living and/or demands of employment
 - ◆ Any **ONE** of the following physical examination/radiographic imaging findings:
 - Positive Posterior Drawer Sign
 - Positive Posterior Sag Sign or Tibial Drop Back Test
 - Positive Quadriceps Active Test

- Eight (8) millimeters or more of increased posterior translation on stress radiographs
- ◆ Failure of provider-directed non-surgical management for at least three (3) months in duration, except in an acute injury setting where hemarthrosis, effusion and joint instability have been documented and **EITHER** of the following are present:
 - Need to return to high-demand sports that require cutting, pivoting, and/or agility activities in which PCL insufficiency may predispose to further instability episodes that may result in new articular or meniscal cartilage injuries
 - Concomitant ligament injuries (i.e., multi-ligamentous knee injury) that require reconstruction to provide stability
- ◆ MRI, CT arthrogram, or arthroscopy demonstrates a tear/disruption or significant laxity of the posterior cruciate ligament (PCL)
- Posterior cruciate ligament (PCL) reconstruction is considered **not medically necessary** for any other indication or condition.

Medial/Lateral Collateral Ligament (MCL/LCL) Repair/Reconstruction

- Medial/lateral collateral ligament (MCL/LCL) repair/reconstruction with allograft or autograft is considered **medically necessary** when **ALL** of the following criteria have been met:
 - ◆ Function-limiting pain and/or a loss of knee function which interferes with the ability to carry out age appropriate activities of daily living and/or demands of employment
 - ◆ Individual reports knee instability which is noted as giving way, subjective weakness, or buckling
 - ◆ **EITHER** of the following physical examination findings:
 - Positive Valgus Stress Test (Medial)
 - Positive Varus Stress Test (Lateral)
 - ◆ Failure of provider-directed non-surgical management for at least three (3) months in duration, except in an acute injury setting of the lateral collateral ligament (LCL) (including the posterolateral corner) when total disruption of the ligament is documented on MRI or CT arthrogram and effusion and joint instability have been documented on physical examination
 - ◆ MRI or CT arthrogram demonstrates a tear/disruption of the medial or lateral collateral ligament (MCL/LCL)
- Medial collateral ligament (MCL) repair/reconstruction is considered **not medically necessary** in an acute injury setting, including an isolated MCL repair.
- Medial/lateral collateral ligament (MCL/LCL) repair/reconstruction is considered **not medically necessary** for any other indication or condition.

Autologous Chondrocyte Implantation (ACI) or Autologous Chondrocyte Transplantation (ACT)

- Autologous chondrocyte implantation (ACI) or autologous chondrocyte transplantation (ACT) (using the MACI™ implant) is considered **medically**

necessary for the treatment of symptomatic single or multiple full-thickness cartilage defects of the distal femoral articular surface (i.e., medial condyle, lateral condyle, or trochlea) and/or patella caused by acute or repetitive trauma when **ALL** of the following criteria have been met:

- ◆ Function-limiting pain (e.g., loss of knee function which interferes with the ability to carry out age appropriate activities of daily living and/or demands of employment)
 - ◆ Presence of **BOTH** of the following findings:
 - A stable knee with intact or reconstructed ligaments (ACL or PCL) and menisci. A concurrent ligament stabilization or meniscal procedure at the time of ACI would be acceptable.
 - Normal tibial-femoral and/or patella-femoral alignment
 - ◆ Failure of provider-directed non-surgical management for at least three (3) months in duration
 - ◆ A full-thickness distal femoral articular surface (i.e., medial condyle, lateral condyle or trochlea) and/or patellar chondral defect of 1-10cm² in size that has been identified during an MRI or CT arthrogram, or during an arthroscopy and the Modified Outerbridge Classification or Outerbridge Classification is Grade III or Grade IV
 - ◆ Absence of an osteochondritis dissecans (OCD) lesion that requires bone grafting
 - ◆ Absence of inflammatory arthritis or other systemic disease affecting the joints
 - ◆ Minimal to absent osteoarthritic changes in the surrounding articular cartilage (e.g., Kellgren-Lawrence Grade 2 or less)
 - ◆ Normal articular cartilage at the lesion border (contained lesion)
 - ◆ For femoral and patellar chondral lesions, absence of a corresponding 'kissing lesion' with a Modified Outerbridge Classification of Grade III or IV of the distal femur (trochlea, condyles), patella or tibia
 - ◆ Body Mass Index (BMI) 35 or less
 - ◆ Age 15-55 years
- Autologous chondrocyte implantation is considered **not medically necessary** for any other indication or condition, including when **ANY** of the following criteria is present:
- ◆ Any knee joint surgery within six (6) months before screening excluding surgery to procure a biopsy or a concomitant procedure to prepare the knee for a MACI implant
 - ◆ Modified Outerbridge Classification Grade III or IV defect(s) on the tibia
 - ◆ Presence of Kellgren-Lawrence Grade 3 or 4 osteoarthritic changes in the surrounding articular cartilage
 - ◆ Total meniscectomy, meniscal allograft, or bucket-handle tear or displaced tear requiring > 50% removal of the meniscus in the target knee
 - ◆ Septic arthritis within one (1) year before screening
 - ◆ Known history of hypersensitivity to gentamicin, other aminoglycosides, or products of porcine or bovine origin
 - ◆ Uncorrected congenital blood coagulation disorders
 - ◆ Cruciate ligament instability

- Hybrid autologous chondrocyte implantation performed with osteochondral autograft transfer system (Hybrid ACI/OATS) technique for the treatment of osteochondral defects is considered **experimental, investigational, or unproven (EIU)**.

Osteochondral Allograft/Autograft Transplantation Systems (OATS)/Mosaicplasty

- Osteochondral allograft/autograft transplantation (OATS)/mosaicplasty is considered **medically necessary** when **ALL** of the following criteria have been met:
 - ◆ Function-limiting pain (e.g., loss of knee function which interferes with the ability to carry out age appropriate activities of daily living and/or demands of employment)
 - ◆ Presence of **BOTH** of the following findings:
 - A stable knee with intact or reconstructed ligaments (ACL or PCL) and menisci. A concurrent ligament stabilization or meniscal procedure at the time of OATS would be acceptable.
 - Normal tibial-femoral and/or patella-femoral alignment
 - ◆ Failure of provider-directed non-surgical management for at least three (3) months in duration
 - ◆ A full-thickness distal femoral articular surface (i.e., medial condyle, lateral condyle or trochlea) and/or patellar chondral defect that has been identified during an MRI or CT arthrogram, or during an arthroscopy and the Modified Outerbridge Classification or Outerbridge Classification is Grade III or Grade IV
 - ◆ **EITHER** of following:
 - Osteochondral autograft transplants and mosaicplasty:
 - Small (i.e., $\leq 2.5 \text{ cm}^2$ total) chondral defects with sharp, definite borders surrounded by normal-appearing hyaline cartilage
 - Osteochondral allograft transplants:
 - Larger (i.e., $\leq 10.0 \text{ cm}^2$ total) chondral defects with sharp definite borders surrounded by normal appearing hyaline cartilage
 - ◆ Absence of inflammatory arthritis or other systemic disease affecting the joints
 - ◆ Minimal to absent osteoarthritic changes in the surrounding articular cartilage (e.g., Kellgren-Lawrence Grade 2 or less)
 - ◆ Normal articular cartilage at the lesion border (contained lesion)
 - ◆ For femoral and patellar chondral lesions, absence of a corresponding 'kissing lesion' with a Modified Outerbridge Classification of Grade III or IV of the distal femur (trochlea, condyles), patella, or tibia
 - ◆ Individual is not a candidate for total knee arthroplasty
 - ◆ Body Mass Index (BMI) of less than 35
 - ◆ Age 49 years or younger
- Osteochondral allograft/autograft transplantation (OATS)/mosaicplasty of the distal femoral articular or patellar surface is considered **experimental, investigational, or unproven (EIU)** for any other indication or condition.
- Hybrid autologous chondrocyte implantation performed with osteochondral autograft transfer system (Hybrid ACI/OATS) technique for the treatment of osteochondral defects is considered **experimental, investigational, or unproven (EIU)**.

Abrasion Arthroplasty/Subchondral Drilling/Microfracturing

- Abrasion arthroplasty, subchondral drilling, or microfracturing is considered **medically necessary** when **ALL** of the following criteria have been met:
 - ◆ Function-limiting pain (e.g., loss of knee function interferes with the ability to carry out age appropriate activities of daily living and/or demands of employment)
 - ◆ Presence of **BOTH** of the following findings:
 - A stable knee with intact or reconstructed ligaments (ACL or PCL) and menisci. A concurrent ligament stabilization or meniscal procedure at the time of abrasion arthroplasty would be acceptable.
 - Normal tibial-femoral and/or patella-femoral alignment
 - ◆ Failure of provider-directed non-surgical management for at least three (3) months in duration
 - ◆ A full-thickness distal femoral articular surface (i.e., medial condyle, lateral condyle or trochlea) and/or patellar chondral defect of $\leq 2.5 \text{ cm}^2$ in size on the weight-bearing surface that has been identified during an MRI or CT arthrogram, or during an arthroscopy and the Modified Outerbridge Classification or Outerbridge Classification is Grade III or IV
- Abrasion arthroplasty, subchondral drilling, or microfracturing is considered **not medically necessary** for any other indication or condition.

Procedures for Patellofemoral Conditions

Procedures for anterior knee pain with or without recurrent patellar instability include both bony and/or soft tissue surgical procedures. Bony surgical procedures can include, but are not limited to, tibial tubercle osteotomy/tubercleplasty (e.g., Fulkerson, Maquet) and trochleoplasty. Soft tissue surgical procedures can include, but are not limited to, medial patellofemoral ligament (MPFL) reconstruction/repair, extensor realignment and/or muscle advancement or release (Campbell, Goldthwaite type procedure), and lateral retinacular release.

- Soft tissue and bony surgical procedures for anterior knee pain with or without recurrent patellar instability are considered **medically necessary** when **ALL** of the following criteria have been met:
 - ◆ Any **ONE** of the following:
 - Function-limiting anterior knee pain (e.g., loss of knee function which interferes with the ability to carry out age appropriate activities of daily living and/or demands of employment)
 - Recurrent patellar instability 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 in duration
 - ◆ Any **ONE** of the following physical examination findings:
 - Positive J sign
 - Positive moving patellar apprehension test
 - Lateral patellar translation $> \frac{1}{2}$ (one-half) of the patellar width

- Tenderness of the medial or lateral facets
- Patellar grind test (Clarke's sign)
- ◆ The following **procedure specific** radiographic or other findings:
 - Indications for **procedures other than** medial patellofemoral ligament (MPFL) reconstruction or trochleoplasty must include **ANY** of the following radiographic findings:
 - Radiographic evidence of patellar tilt > 20 degrees
 - Patella alta (e.g., Insall-Salvati, Blackburne-Peel, Caton-Deschamps ratios)
 - Sulcus angle > 145 degrees
 - Increased tibial tubercle-posterior cruciate distance of > 24 mm
 - Increased TT-TG (tibial tubercle-trochlear groove) distance of > 20 mm
 - Concordant osteochondral defect of the patellofemoral joint (MRI, CT scan, or previous arthroscopic procedure)
 - Acute patellar dislocation with associated intra-articular fracture
 - Indications for **medial patellofemoral ligament (MPFL) reconstruction/repair** must include:
 - Tear of the MPFL visualized on MRI/CT, identified by arthroscopy, or on physical examination
 - Indications for **trochleoplasty** must include **ANY** of the following radiographic findings:
 - Supratrochlear spur
 - Lateral trochlear inclination (LTI) > 11 degrees
 - Crossing sign
 - Double-contour sign
- Procedures for patellofemoral conditions are considered **not medically necessary** for any other indication or condition.

High Tibial Osteotomy

- High tibial osteotomy is considered **medically necessary** when **ALL** of the following criteria have been met:
 - ◆ Function-limiting pain (e.g., loss of knee function interferes with the ability to carry out age appropriate activities of daily living and/or demands of employment)
 - ◆ **ALL** of the following physical examination findings:
 - Less than 15 degrees of fixed varus deformity
 - The individual must be capable of at least 90 degrees of flexion
 - Joint stability in full extension
 - Intact anterior cruciate ligament (ACL)
 - ◆ Failure of provider-directed non-surgical management for at least three (3) months in duration
 - ◆ Unicompartamental osteoarthritis of the knee
 - ◆ Age 60 years or less
- High tibial osteotomy is considered **not medically necessary** for any other indication or condition, including when **ANY** of the following criteria is present:

- ◆ Inflammatory arthropathy (i.e., rheumatoid arthritis)
- ◆ Chondrocalcinosis
- ◆ Anterior cruciate ligament (ACL) tear
- ◆ Degenerative change affecting more than 1/3 of the femoral condylar surface
- ◆ Osteochondral defect more than five (5) mm in depth

Lysis of Adhesions/Manipulation Under Anesthesia (MUA)

- Lysis of Adhesions/Manipulation Under Anesthesia (MUA) is considered **medically necessary** for arthrofibrosis when **ALL** of the following criteria have been met:
 - ◆ Function-limiting pain (e.g., loss of knee function interferes with the ability to carry out age appropriate activities of daily living and/or demands of employment)
 - ◆ Patient demonstrates less than 90° of knee flexion by two (2) months after knee surgery or trauma
 - ◆ Failure of provider-directed non-surgical management for at least two (2) months in duration, including **BOTH** of the following:
 - Anti-inflammatory medication and/or cortisone injection unless contraindicated
 - At least two (2) months of physical therapy (i.e., active exercise and manual therapy designed to increase joint mobility and range of motion)
- Manipulation Under Anesthesia (MUA) should be performed in conjunction with an active rehabilitation/therapeutic exercise program. Manipulation performed in isolation without the individual participating in an active rehabilitation/therapeutic exercise program is considered **not medically necessary**.
- Lysis of adhesions, with or without manipulation, is considered **not medically necessary** for any other indication or condition.

Experimental, Investigational, or Unproven (EIU)

- Based on lack of scientific evidence of efficacy and safety, the following are considered **experimental, investigational, or unproven (EIU)**:
 - ◆ Subchondroplasty
 - ◆ Focal resurfacing of a single knee joint defect (e.g., Arthrosurface® femoral condyle implant)
 - ◆ In-office diagnostic arthroscopy (e.g., Mi-Eye™, VisionScope®)

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
27301	Incision and drainage, deep abscess, bursa, or hematoma, thigh or knee region
27303	Incision, deep, with opening of bone cortex, femur or knee (e.g., osteomyelitis or bone abscess)
27305	Fasciotomy, iliotibial (tenotomy), open
27306	Tenotomy, percutaneous, adductor or hamstring; single tendon (separate procedure)
27307	Tenotomy, percutaneous, adductor or hamstring; multiple tendons
27310	Arthrotomy, knee, with exploration, drainage, or removal of foreign body (e.g., infection)
27323	Biopsy, soft tissue of thigh or knee area; superficial
27324	Biopsy, soft tissue of thigh or knee area; deep (subfascial or intramuscular)
27325	Neurectomy, hamstring muscle
27326	Neurectomy, popliteal (gastrocnemius)
27327	Excision, tumor, soft tissue of thigh or knee area, subcutaneous; less than 3 cm
27328	Excision, tumor, soft tissue of thigh or knee area, subfascial (e.g. intramuscular); less than 5 cm
27329	Radical resection of tumor (e.g., sarcoma), soft tissue of thigh or knee area; less than 5 cm
27330	Arthrotomy, knee; with synovial biopsy only
27331	Arthrotomy, knee; including joint exploration, biopsy, or removal of loose or foreign bodies
27332	Arthrotomy, with excision of semilunar cartilage (meniscectomy) knee; medial OR lateral
27333	Arthrotomy, with excision of semilunar cartilage (meniscectomy) knee; medial AND lateral
27334	Arthrotomy, with synovectomy, knee; anterior OR posterior
27335	Arthrotomy, with synovectomy, knee; anterior AND posterior including popliteal area
27337	Excision, tumor, soft tissue of thigh or knee area, subcutaneous; 3 cm or greater
27339	Excision, tumor, soft tissue of thigh or knee area, subfascial (e.g., intramuscular); 5 cm or greater
27340	Excision, prepatellar bursa
27345	Excision of synovial cyst of popliteal space (e.g. Baker's cyst)
27347	Excision of lesion of meniscus or capsule (e.g. cyst, ganglion), knee
27350	Patellectomy or hemipatellectomy
27355	Excision or curettage of bone cyst or benign tumor of femur
27356	Excision or curettage of bone cyst or benign tumor of femur; with allograft
27357	Excision or curettage of bone cyst or benign tumor of femur; with autograft (includes obtaining graft)
27358	Excision or curettage of bone cyst or benign tumor of femur; with internal fixation (List in addition to code for primary procedure)
27360	Partial excision (craterization, saucerization, or diaphysectomy) bone, femur, proximal tibia and/or fibula (e.g., osteomyelitis or bone abscess)
27364	Radical resection of tumor (e.g. sarcoma), soft tissue of thigh or knee area; 5 cm or greater

27365	Radical resection of tumor, femur or knee
27372	Removal of foreign body, deep, thigh region or knee area
27380	Suture of infrapatellar tendon; primary
27381	Suture of infrapatellar tendon; secondary reconstruction, including fascial or tendon graft
27385	Suture of quadriceps or hamstring muscle rupture; primary
27386	Suture of quadriceps or hamstring muscle rupture; secondary reconstruction, including fascial or tendon graft
27390	Tenotomy, open, hamstring, knee to hip; single tendon
27391	Tenotomy, open, hamstring, knee to hip; multiple tendons, one leg
27392	Tenotomy, open, hamstring, knee to hip; multiple tendons, bilateral
27393	Lengthening of hamstring tendon; single tendon
27394	Lengthening of hamstring tendon; multiple tendons, one leg
27395	Lengthening of hamstring tendon; multiple tendons, bilateral
27396	Transplant, hamstring tendon to patella; single tendon
27397	Transplant, hamstring tendon to patella; multiple tendons
27400	Transfer, tendon or muscle, hamstrings to femur (e.g., Egger's type procedure)
27403	Arthrotomy with meniscus repair, knee
27405	Repair, primary, torn ligament and/or capsule, knee; collateral
27407	Repair, primary, torn ligament and/or capsule, knee; cruciate
27409	Repair, primary, torn ligament and/or capsule, knee; collateral and cruciate ligaments
27412	Autologous chondrocyte implantation, knee
27415	Osteochondral allograft, knee, open
27416	Osteochondral autograft(s), knee, open (e.g. mosaicplasty) (includes harvesting of autograft[s])
27418	Anterior tibial tubercleplasty (e.g. Maquet type procedure)
27420	Reconstruction of dislocating patella; (e.g. Hauser type procedure)
27422	Reconstruction of dislocating patella; with extensor realignment and/or muscle advancement or release (e.g. Campbell, Goldwaite type procedure)
27424	Reconstruction of dislocating patella; with patellectomy
27425	Lateral retinacular release, open
27427	Ligamentous reconstruction (augmentation), knee; extra-articular
27428	Ligamentous reconstruction (augmentation), knee; intra-articular (open)
27429	Ligamentous reconstruction (augmentation), knee; intra-articular (open) and extra-articular
27430	Quadricepsplasty (e.g., Bennett or Thompson type)
27435	Capsulotomy, posterior capsular release, knee
27442	Arthroplasty, femoral condyles or tibial plateau(s), knee
27448	Osteotomy, femur, shaft or supracondylar; without fixation
27450	Osteotomy, femur, shaft or supracondylar; with fixation
27454	Osteotomy, multiple, with realignment on intramedullary rod, femoral shaft (e.g., Sofield type procedure)
27455	Osteotomy, proximal tibia, including fibular excision or osteotomy (includes correction of genu varus [bowleg] or genu valgus [knock-knee]); before epiphyseal closure
27457	Osteotomy, proximal tibia, including fibular excision or osteotomy (includes correction of genu varus [bowleg] or genu valgus [knock-knee]); after epiphyseal closure
27465	Osteoplasty, femur; shortening (excluding 64876)

27466	Osteoplasty, femur; lengthening
27468	Osteoplasty, femur; combined, lengthening and shortening with femoral segment transfer
27470	Repair, nonunion or malunion, femur, distal to head and neck; without graft (e.g., compression technique)
27472	Repair, nonunion or malunion, femur, distal to head and neck; with iliac or other autogenous bone graft (includes obtaining graft)
27475	Arrest, epiphyseal, any method (e.g., epiphysiodesis); distal femur
27477	Arrest, epiphyseal, any method (e.g., epiphysiodesis); tibia and fibula, proximal
27479	Arrest, epiphyseal, any method (e.g., epiphysiodesis); combined distal femur, proximal tibia and fibula
27485	Arrest, hemiepiphyseal, distal femur or proximal tibia or fibula (e.g., genu varus or valgus)
27495	Prophylactic treatment (nailing, pinning, plating, or wiring) with or without methylmethacrylate, femur
27496	Decompression fasciotomy, thigh and/or knee, one compartment (flexor or extensor or adductor)
27497	Decompression fasciotomy, thigh and/or knee, one compartment (flexor or extensor or adductor); with debridement of nonviable muscle and/or nerve
27498	Decompression fasciotomy, thigh and/or knee, multiple compartments
27499	Decompression fasciotomy, thigh and/or knee, multiple compartments; with debridement of nonviable muscle and/or nerve
27570	Manipulation of knee joint under general anesthesia (includes application of traction or other fixation devices)
29850	Arthroscopically aided treatment of intercondylar spine(s) and/or tuberosity fracture(s) of the knee, with or without manipulation; without internal or external fixation (includes arthroscopy)
29851	Arthroscopically aided treatment of intercondylar spine(s) and/or tuberosity fracture(s) of the knee, with or without manipulation; with internal or external fixation (includes arthroscopy)
29855	Arthroscopically aided treatment of tibial fracture, proximal (plateau); unicondylar, includes internal fixation, when performed (includes arthroscopy)
29856	Arthroscopically aided treatment of tibial fracture, proximal (plateau); bicondylar, includes internal fixation, when performed (includes arthroscopy)
29866	Arthroscopy, knee, surgical; osteochondral autograft(s) (e.g. mosaicplasty) (includes harvesting of the autograft[s])
29867	Arthroscopy, knee, surgical; osteochondral allograft (e.g. mosaicplasty)
29868	Arthroscopy, knee, surgical; meniscal transplantation (includes arthrotomy for meniscal insertion), medial or lateral
29870	Arthroscopy, knee, diagnostic; with or without synovial biopsy (separate procedure)
29871	Arthroscopy, knee, surgical; for infection, lavage and drainage
29873	Arthroscopy, knee, surgical; with lateral release
29874	Arthroscopy, knee, surgical; for removal of loose body or foreign body (e.g. osteochondritis dissecans fragmentation, chondral fragmentation)
29875	Arthroscopy, knee, surgical; synovectomy, limited (e.g., plica or shelf resection) (separate procedure)
29876	Arthroscopy, knee, surgical; synovectomy, major, two or more compartments (e.g., medial or lateral)
29877	Arthroscopy, knee, surgical; debridement/shaving of articular cartilage (chondroplasty)

29879	Arthroscopy, knee, surgical; abrasion arthroplasty (includes chondroplasty where necessary) or multiple drilling or microfracture
29880	Arthroscopy, knee, surgical; with meniscectomy (medial AND lateral, including any meniscal shaving) including debridement/shaving of articular cartilage (chondroplasty), same or separate compartment(s), when performed
29881	Arthroscopy, knee, surgical; with meniscectomy (medial OR lateral, including any meniscal shaving) including debridement/shaving of articular cartilage (chondroplasty), same or separate compartment(s), when performed
29882	Arthroscopy, knee, surgical; with meniscus repair (medial OR lateral)
29883	Arthroscopy, knee, surgical; with meniscus repair (medial AND lateral)
29884	Arthroscopy, knee, surgical; with lysis of adhesions, with or without manipulation (separate procedure)
29885	Arthroscopy, knee, surgical; drilling for osteochondritis dissecans with bone grafting, with or without internal fixation (including debridement of base of lesion)
29886	Arthroscopy, knee, surgical; drilling for intact osteochondritis dissecans lesion
29887	Arthroscopy, knee, surgical; drilling for intact osteochondritis dissecans lesion with internal fixation
29888	Arthroscopically aided anterior cruciate ligament repair/augmentation or reconstruction
29889	Arthroscopically aided posterior cruciate ligament repair/augmentation or reconstruction

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.

Procedure (HCPCS) Codes

This guideline relates to the HCPCS 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.

J7330	Autologous cultured chondrocytes, implant
--------------	---

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

1. Aaron R, Skolnick A, Reinert S, Ciombor D. Arthroscopic debridement for osteoarthritis of the knee. *J Bone Joint Surg Am.* 2006;88(5):936-943.
2. Abrams G, Alentorn-Geli E, Harris J, Cole B. Treatment of a Lateral Tibial Plateau Osteochondritis Dissecans Lesion With Subchondral Injection of Calcium Phosphate. *Arthrosc Tech.* 2013;2(3):e271-e274. doi:10.1016/j.eats.2013.03.001.
3. Adler V, Pa L, Ko J, et al. Autologous chondrocyte transplantation for the treatment of articular defects of the knee. *Scr Med.* 2003;76(3):241-250.
4. Alleyne K, Galloway M. Management of osteochondral injuries of the knee. *Clin Sports Med.* 2001;20(2):343-364.
5. Altman R, Hochberg M, Moskowitz, R, et al.; Subcommittee on Osteoarthritis Guidelines. Recommendations for the medical management of osteoarthritis of the hip and knee. American College of Rheumatology Subcommittee on Osteoarthritis Guidelines. *Arthritis Rheum.* 2000;43(9):1905-1915.
6. Angadi D, Edwards D, Melton J. Calcium phosphate injection of symptomatic bone marrow lesions of the knee: what is the current clinical evidence?. *Knee Surg Relat Res.* 2020;32(1). doi:10.1186/s43019-019-0013-3.
7. Anley CM, Morris GV, Saithna A, et al. Defining the role of the tibial tubercle-trochlear groove and tibial tubercle-posterior cruciate ligament distances in the work-up of patients with patellofemoral disorders. *Am J Sports Med.* 2015;43(6): 1348-53. doi:10.1177/0363546515576128.
8. Askenberger M, Mostrom EB, Ekstrom W, et al. Operative repair of medial patellofemoral ligament injury versus knee brace in children with an acute first-time traumatic patellar dislocation. *Am J Sports Med.* 2018;46(10): 2328-40. doi: 10.1177/0363546518770616.
9. Bartha L, Vajda A, Duska Z, et al. Autologous osteochondral mosaicplasty grafting. *J Orthop Sports Phys Ther.* 2006;36(10):739-750.
10. Beard D, Davies L, Cook J et al. The clinical and cost-effectiveness of total versus partial knee replacement in patients with medial compartment osteoarthritis (TOPKAT): 5-year outcomes of a randomised controlled trial. *Lancet.* 2019;394(10200):746-756. doi:10.1016/s0140-6736(19)31281-4.
11. Bentley G, Biant L, Carrington R, et al. A prospective, randomised comparison of autologous chondrocyte implantation versus mosaicplasty for osteochondral defects in the knee. *J Bone Joint Surg Br.* 2003;85(2):223-230.
12. Berger Y, Ftaita S, Thienpont E. Does Medial Patellofemoral Osteoarthritis Influence Outcome Scores and Risk of Revision After Fixed-bearing Unicompartmental Knee Arthroplasty?. *Clin Orthop Relat Res.* 2019;477(9):2041-2047. doi:10.1097/corr.0000000000000738.
13. Bernstein J, Quach T. A perspective on the study of Moseley et al: Questioning the value of arthroscopic knee surgery for osteoarthritis. *Cleve Clin J Med.* 2003;70(5):401, 405-406, 408-410.
14. Biant LC, Bentley G, Vijayan S, et al. Long-term results of autologous chondrocyte implantation in the knee for chronic chondral and osteochondral defects. *Am J Sports Med.* 2014;42(9): 2178-83.
15. Biau D, Tournoux C, Katsahian S et al. Bone-patellar tendon-bone autografts versus hamstring autografts for reconstruction of anterior cruciate ligament: meta-analysis. *BMJ.* 2006;332(7548):995-1001.
16. Bradley J, Heilman D, Katz B, et al. Tidal irrigation as treatment for knee osteoarthritis: A sham-controlled, randomized, double-blinded evaluation. *Arthritis Rheum.* 2002;46(1):100-108.
17. Briggs T, Mahroof S, David L, et al. Histological evaluation of chondral defects after autologous chondrocyte implantation of the knee. *J Bone Joint Surg Br.* 2003;85(7):1077-1083.
18. Brignardello-Petersen R, Guyatt GH, Buchbinder R, et al. Knee arthroplasty versus conservative management in patients with degenerative knee disease: a systematic review. *BMJ Open.* 2017;7:e016114. doi:10.1136/bmjopen-2017-016114.
19. Brouwer, Reinoud W, Huizinga, Maarten R, Duivenvoorden, Tijs, van Raaij, Tom M, Verhagen, Arianne P, Bierma-Zeinstra, Sita MA, Verhaar, Jan AN. Osteotomy for treating knee osteoarthritis. *Cochrane Database of Systematic Reviews.* 2014, Issue 12. Art. No.: CD004019. doi: 10.1002/14651858.CD004019.pub4.

20. Burger J, Kleeblad L, Laas N, Pearle A. The Influence of Preoperative Radiographic Patellofemoral Degenerative Changes and Malalignment on Patellofemoral-Specific Outcome Scores Following Fixed-Bearing Medial Unicompartmental Knee Arthroplasty. *J Bone Joint Surg.* 2019;101(18):1662-1669. doi:10.2106/jbjs.18.01385.
21. Calvert G, Wright R. The use of arthroscopy in the athlete with knee osteoarthritis. *Clin Sports Med.* 2005;24(1):133-152.
22. Camathias C, Speth BM, Rutz E, Schlemmer T, Papp K, Vavken P, Studer K., Solitary Trochleoplasty for Treatment of Recurrent Patellar Dislocation, *JBJS Essent Surg Tech.* 2018 Apr 11;8(2):e11. doi: 10.2106/JBJS.ST.17.00039. eCollection 2018 Jun 27.
23. Campbell AB, Knopp MV, Kolovich GP, et al: Preoperative MRI underestimates articular cartilage defect size compared with findings at arthroscopic knee surgery. *Am J Sports Med.* 2013;41:590-5.
24. Cavendish P, Everhart J, Peters N, Sommerfeldt M, Flanigan D. Osteochondral Allograft Transplantation for Knee Cartilage and Osteochondral Defects. *JBJS Rev.* 2019;7(6):e7. doi:10.2106/jbjs.rvw.18.00123.
25. Chambers K, Schulzer M. Arthroscopic surgery for osteoarthritis of the knee. *N Engl J Med.* 2002;347:1718.
26. Chatain F, Adeleine P, Chambat P, Neyret P; Society Francaise d'Arthroscopie. A comparative study of medial versus lateral arthroscopic partial meniscectomy on stable knees: 10-year minimum follow-up. *Arthroscopy.* 2003; 19(8):842-849.
27. Cohen S, Sharkey B. Subchondroplasty for Treating Bone Marrow Lesions. *J Knee Surg.* 2015;29(07):555-563. doi:10.1055/s-0035-1568988.
28. Crawford DC, Safran MR. Osteochondritis Dissecans of the knee. *J Am Acad Orthop Surg.* 2006; 14: 90-100.
29. Dejour DH, Editorial Commentary: Trochleoplasty: Is It Really That Fearsome and Dangerous a Technique?, *Arthroscopy.* 2020 Aug;36(8):2246-2248. doi: 10.1016.
30. Deirmengian CA, Dines JS, Vernace JV, et al: Use of a small-bore needle arthroscope to diagnose intra-articular knee pathology: comparison with magnetic resonance imaging. *Am J Orthop.* 2018;47(2).
31. Dervin G, Stiell I, Rody K, Grabowski J. Effect of arthroscopic debridement for osteoarthritis of the knee on health-related quality of life. *J Bone Joint Surg Am.* 2003;85-A(1):10-19.
32. Diduch DR, Kandil A, Burrus MT. Lateral patellar instability in the skeletally mature patient: evaluation and surgical management. *J Am Acad Orthop Surg.* 2018;26:429-439. doi: 10.5435/JAAOS-D-16-00052.
33. Dixit S, DiFiori JP, Burton M, et al. Management of Patellofemoral Pain Syndrome. *Am Fam Physician.* 2007;75(2):194-202.
34. Dozin B, Malpeli M, Cancedda R, et al. Comparative evaluation of autologous chondrocyte implantation and mosaicplasty: A multicentered randomized clinical trial. *Clin J Sport Med.* 2005;15(4):220-226.
35. Duif C, Koutah MA, Ackermann O, et al. Combination of autologous chondrocyte implantation (ACI) and osteochondral autograft transfer system (OATS) for surgical repair of larger cartilage defects of the knee joint. A review illustrated by a case report. *Technol Health Care.* 2015;23(5):531-537. doi:10.3233/thc-151003.
36. Ebert JR, Fallon M, Smith A, et al. Prospective Clinical and Radiologic Evaluation of Patellofemoral Matrix-Induced Autologous Chondrocyte Implantation. *Am J Sports Med.* 2015;43(6):1362-1372.
37. Ebert JR, Schneider A, Fallon M, Wood DJ, Janes GC. A Comparison of 2-Year Outcomes in Patients Undergoing Tibiofemoral or Patellofemoral Matrix-Induced Autologous Chondrocyte Implantation. *Am J Sports Med.* 2017 Dec;45(14):3243-3253. doi: 10.1177/0363546517724761. Epub 2017 Sep 14.
38. Englund M, Guermazi A, Roemer FW, et al. Meniscal tear in knees without surgery and the development of radiographic osteoarthritis among middle-aged and elderly persons: The multicenter osteoarthritis study. *Arthritis Rheum.* 2009;60(3):831-9.
39. Englund M, Roos E, Lohmander L. Impact of type of meniscal tear on radiographic and symptomatic knee osteoarthritis: a sixteen-year follow-up of meniscectomy with matched controls. *Arthritis Rheum.* 2003;48(8):2178-87.

40. Erggelet C, Vavken P. Microfracture for the treatment of cartilage defects in the knee joint—A golden standard?. *J Clin Orthop Trauma*. 2016;7(3):145-152. doi:10.1016/j.jcot.2016.06.015.
41. Erickson BJ, Strickland SM, Gomoll AH. Indications, Techniques, Outcomes for Matrix-Induced Autologous Chondrocyte Implantation (MACI). *Oper Tech Sports Med*. 2018;26(3):175-182. doi:10.1053/j.otsm.2018.06.002.
42. Familiari F, Cinque ME, Chahla J, et al. Clinical outcomes and failure rates of osteochondral allograft transplantation in the knee. *Am J Sports Med*. 2018;46(14):3541-3549. doi:10.1177/0363546517732531.
43. Farr J. Autologous Chondrocyte Implantation Improves Patellofemoral Cartilage Treatment Outcomes. *CORR*. 2007;463:187-194.
44. Feeley BT, Lau BC. Biomechanics and Clinical Outcomes of Partial Meniscectomy. *J Am Acad Orthop Surg*. 2018;26(24):853-863. doi:10.5435/jaaos-d-17-00256.
45. Felson D, Buckwalter J. Debridement and lavage for osteoarthritis of the knee. *N Engl J Med*. 2002;347:132-3.
46. Felson D. Osteoarthritis of the knee. *N Engl J Med*. 2006;354:841-8.
47. Filardo G, Kon E, Andriolo L, et al. Treatment of “Patellofemoral” Cartilage Lesions With Matrix-Assisted Autologous Chondrocyte Transplantation: A Comparison of Patellar and Trochlear Lesions. *Am J Sports Med*. 2013;42(3):626-34.
48. Fond J, Rodin D, Ahmad S, Nirschl R. Arthroscopic debridement for the treatment of osteoarthritis of the knee: 2- and 5-year results. *Arthroscopy*. 2002;18(8):829-834.
49. Forster M, Straw R. A prospective randomised trial comparing intra-articular Hyalgan injection and arthroscopic washout for knee osteoarthritis. *Knee*. 2003;10(3):291-293.
50. Gigante A, Enea D, Greco F, et al. Distal realignment and patellar autologous chondrocyte implantation: mid-term results in a selected population. *Knee Surg Sports Traumatol Arthrosc*. 2009;17:2-10.
51. Gill TJ, Safran M, Mandelbaum B, et al. A prospective, blinded, multicenter clinical trial to compare the efficacy, accuracy, and safety of in-office diagnostic arthroscopy with magnetic resonance imaging and surgical diagnostic arthroscopy. *Arthroscopy*. 2018;34:2429-35.
52. Gillogly SD, Arnold RM. Autologous Chondrocyte Implantation and Anteromedialization for Isolated Patellar Articular Cartilage Lesions. *Am J Sports Med*. 2014;42(4):912-920.
53. Gobbi A, Kon E, Berruto M, et al. Patellofemoral Full-Thickness Chondral Defects Treated with Second-Generation Autologous Chondrocyte Implantation. *Am J Sports Med*. 2009;37(6):1083-1092.
54. Gomoll AH, Gillogly SD, Cole BJ, et al. Autologous Chondrocyte Implantation in the Patella: Multicenter Experience. *Am J Sports Med*. 2014;42(5):1074-1081.
55. Gomoll AH, Yoshioka H, Watanabe A, et al. Preoperative management of cartilage defects by MRI underestimates lesion size. *Cartilage*. 2011;2:389-93. doi:10.1177/1947603510397534.
56. Graf K, Sekiya J, Wojtyls E. Long-term results after combined medial meniscal allograft transplantation and anterior cruciate ligament reconstruction: Minimum 8.5-year follow-up study. *Arthroscopy*. 2004;20(2):129-140.
57. Guenther D, Irrarrazaval S, Bell KM, Rahnama-Azar AA, Fu FH, Debski RE, Musahl V. The role of extra-articular tenodesis in combined ACL and anterolateral capsular injury. *J Bone Joint Surg Am*. 2017 Oct 4; 99(19): 1654-60.
58. Haasper C, Zelle B, Knobloch K, et al. No mid-term difference in mosaicplasty in previously treated versus previously untreated individuals with osteochondral lesions of the talus. *Arch Orthop Trauma Surg*. 2008;128(5):499-504.
59. Halbrecht JL, Jackson DW. Office arthroscopy: a diagnostic alternative. *Arthroscopy*. 1992;8:320-6.
60. Hangody L, Vársárhelyi G, Hangody L, et al. Autologous osteochondral grafting-technique and long-term results. *Injury*. 2008;39 Suppl 1:S32-S39.
61. Harner C, Waltrip R, Bennett C, et al. Surgical management of knee dislocations. *J Bone Joint Surg Am*. 2004;86-A(2):262-73.
62. Harris JD, Siston RA, Pan X, et al. Autologous chondrocyte implantation: a systematic review. *J Bone Joint Surg Am*. 2010;92(12):2220-33. doi:10.2106/jbjs.j.00049.

63. Henderson I, Tuy B, Connell D, et al. Prospective clinical study of autologous chondrocyte implantation and correlation with MRI at three and 12 months. *J Bone Joint Surg Br.* 2003;85(7):1060-1066.
64. Hunt S, Jazrawi L, Sherman O, Arthroscopic management of osteoarthritis of the knee. *J Am Acad Orthop Surg.* 2002;10(5):356-63.
65. Jackson R, Dieterichs C. The results of arthroscopic lavage and debridement of osteoarthritic knees based on the severity of degeneration: A 4- to 6-year symptomatic follow-up. *Arthroscopy.* 2003;19(1):13-20.
66. Jakob R, Franz T, Gautier E, Mainil-Varlet P. Autologous osteochondral grafting in the knee: Indication, results, and reflections. *Clin Orthop.* 2002;(401):170-184.
67. Johnson LL. Arthroscopic abrasion arthroplasty: a review. *Clin Orthop Relat Res.* 2001 Oct;(391 Suppl):S306-17.
68. Kalson N, Borthwick L, Mann D et al. International consensus on the definition and classification of fibrosis of the knee joint. *Bone Joint J.* 2016;98-B(11):1479-1488. doi:10.1302/0301-620x.98b10.37957.
69. Karataglis D, Green M, Learmonth D. Autologous osteochondral transplantation for the treatment of chondral defects of the knee. *Knee.* 2006;13(1):32-35. doi:10.1016/j.knee.2005.05.006.
70. Karataglis D, Learmonth D. Management of big osteochondral defects of the knee using osteochondral allografts with the MEGA-OATS technique. *Knee.* 2005;12(5):389-393.
71. Katz JN, Wright J, Spindler KP et al.. Predictors and outcomes of crossover to surgery from physical therapy for meniscal tear and osteoarthritis: a randomized trial comparing physical therapy and surgery. *J Bone Joint Surgery Am.* 2016 Nov 16; 98(22):1890-1896.
72. Kelly M. Role of arthroscopic debridement in the arthritic knee. *J Arthroplasty.* 2006;21:Suppl 1:9- 10.
73. Kirkley A, Birmingham T, Litchfield R, et al. A Randomized Trial of Arthroscopic Surgery for Osteoarthritis of the Knee. *N Engl J Med.* 2008; 59:1097-1107, 1169-1170.
74. Kise NJ, Risberg MA, Stensrud S, et al. Exercise therapy versus arthroscopic partial meniscectomy for degenerative meniscal tear in middle aged patients: randomized control trial with two year follow-up. *BMJ.* 2016;354:i3740.
75. Kocher MS, Logan CA, Kramer DE. Discoid Lateral Meniscus in Children: Diagnosis, Management, and Outcomes. *J Am Acad Orthop Surg.* 2017;25:736-743.
76. Kohn M, Sassoon A, Fernando N. Classifications in Brief: Kellgren-Lawrence Classification of Osteoarthritis. *Clin Orthopaed and Rel Res®.* 2016;474(8):1886-1893. doi:10.1007/s11999-016-4732-4.
77. Kon E, Filardo G, Di Martino A, Marcacci M., ACI and MACI, *J Knee Surg.* 2012 Mar;25(1):17-22.
78. Kreuz P, Steinwachs M, Erggelet C, et al. Mosaicplasty with autogenous talar autograft for osteochondral lesions of the talus after failed primary arthroscopic management: A prospective study with a 4-year follow-up. *Am J Sports Med.* 2006;34(1):55-63.
79. Lahav A, Burks R, Greis P, et al. Clinical outcomes following osteochondral autologous transplantation (OATS). *J Knee Surg.* 2006;19(3):169-173.
80. Laupattarakasem W, Laopaiboon M, Laupattarakasem P, Sumananont C. Arthroscopic debridement for knee osteoarthritis. *Cochrane Database Syst Rev.* 2008;(1):CD005118.
81. Lee D, Park Y, Song S, Hwang S, Park J, Kang D. Which Technique Is Better for Treating Patellar Dislocation? A Systematic Review and Meta-analysis. *Arthroscopy.* 2018;34(11):3082-3093.e1. doi:10.1016/j.arthro.2018.06.052.
82. Linko E, Harilainen A, Malmivaara A, Seitsalo S. Surgical versus conservative interventions for anterior cruciate ligament ruptures in adults. *Cochrane Database Syst Rev.* 2005 Apr 18;(2):CD001356.
83. Ma H, Hung S, Wang S, et al. Osteochondral autografts transfer for post-traumatic osteochondral defect of the knee- 2 to 5 years follow-up. *Injury.* 2004;35(12):1286-1292.
84. MACI (autologous cultured chondrocytes on porcine collagen membrane) Product Insert revised 06/2017.
85. MACI prescribing information (December 2016). U.S. Food and Drug Administration.
86. Macmull S, Jaiswal PK, Bentley G, et al. The role of autologous chondrocyte implantation in the treatment of symptomatic chondromalacia patellae. *Int Orthop:SICOT.* 2012;36:1371-1377.

87. Marcacci M, Kon E, Zaffagnini S, et al. Multiple osteochondral arthroscopic grafting (mosaicplasty) for cartilage defects of the knee: Prospective study results at 2-year follow-up. *Arthroscopy*. 2005;21(4):462-470.
88. Marx R. Arthroscopic surgery for osteoarthritis of the knee? *N Engl J Med*. 2008;359(11):1169-1170.
89. McMillan S, Schwartz M, Jennings B, et al: In-office diagnostic needle arthroscopy: understanding the potential value for the US healthcare system. *Am J Orthop* 2017;46:252-6.
90. Minas T, Bryant T. The Role of Autologous Chondrocyte Implantation in the Patellofemoral Joint. *CORR*. 2005;436:30-39.
91. Mistovich RJ, Urwin JW, Fabricant PD, et. al. Patellar tendon-lateral trochlear ridge distance. A novel measurement of patellofemoral instability. *Am J Sports Med*. 2018;46(14):3400-3406. doi: 10.1177/0363546518809982.
92. Moseley J, O'Malley K, Petersen N, et al. A controlled trial of arthroscopic surgery for osteoarthritis of the knee. *N Engl J Med*. 2002;347:81-88.
93. Nawaz SZ, Bentley G, Briggs TW, et al. Autologous Chondrocyte Implantation in the Knee. *J Bone Joint Surg Am*. 2014;96:824-30.
94. Niemayer P, Steinwachs M, Erggelet C, et al. Autologous chondrocyte implantation for the treatment of retropatellar cartilage defects: clinical results referred to defect localization. *Arch Ortho Traum Surg*. 2008;128(11):1223-31.
95. Noyes F, Barber-Westin S, Rankin M. Meniscal transplantation in symptomatic individuals less than fifty years old. *J Bone Joint Surg Am*. 2005;87 Suppl 1(Pt.2):149-165.
96. Pareek A, Reardon PJ, Macalena JA, Levy BA, Stuart MJ, Williams RJ 3rd, Krych AJ. Osteochondral autograft transfer versus microfracture in the knee: a meta-analysis of prospective comparative studies at midterm. *Arthroscopy*. 2016 Oct; 32(10): 2118-30. doi:10.1016/j.arthro.2016.05.038.
97. Pagliazzi G, Napoli F, Previtali D, Filardo G, Zaffagnini S, Candrian C. A Meta-analysis of Surgical Versus Nonsurgical Treatment of Primary Patella Dislocation. *Arthroscopy*. 2019;35(8):2469-2481. doi:10.1016/j.arthro.2019.03.047.
98. Pascual-Garrido C, Slabaugh MA, L'Heureux DR, et al. Recommendations and treatment outcomes for patellofemoral articular cartilage defects with autologous chondrocyte implantation: prospective evaluation at average 4-year follow-up. *Am J Sports Med*. 2009;37 Suppl 1:33S-41S.
99. Patel KA, Hartigan DE, Makovicka JL, et al: Diagnostic evaluation of the knee in the office setting using small-bore needle arthroscopy. *Arthrosc Tech*. 2018;7:e17-e21.
100. Pearse E, Craig D. Partial meniscectomy in the presence of severe osteoarthritis does not hasten the symptomatic progression of osteoarthritis. *Arthroscopy*. 2003;19(9):963-968.
101. Peterson L, Minas T, Brittberg M, Lindahl A. Treatment of osteochondritis dissecans of the knee with autologous chondrocyte transplantation. *J Bone Joint Surg Am*. 2003;85(Suppl 2):17-24.
102. Peterson L, Vasiliadis HS, Brittberg M, Lindahl A. Autologous chondrocyte implantation: a long-term follow-up. *Am J Sports Med*. 2010 Jun;38(6):1117-24.
103. Peterson R, Shelton W, Bomboy A. Allograft versus autograft patellar tendon anterior cruciate ligament reconstruction: A 5-year follow-up. *Arthroscopy*. 2001;17(1):9-13.
104. Richter D, Schenck R, Wascher D, Treme G. Knee Articular Cartilage Repair and Restoration Techniques. *Sports Health: A Multidisciplinary Approach*. 2015;8(2):153-160. doi:10.1177/1941738115611350.
105. Roos E, Ostenberg A, Roos H, et al. Long-term outcome of meniscectomy: symptoms, function, and performance tests in individuals with or without radiographic osteoarthritis compared to matched controls. *Osteoarthritis Cartilage*. 2001;9(4):316-24.
106. Roos E, Roos H, Ryd L, Lohmander L. Substantial disability 3 months after arthroscopic partial meniscectomy: A prospective study of individual-relevant outcomes. *Arthroscopy*. 2000;16(6):619-26.
107. Rosenstiel N, Praz C, Ouanezar H, et al. Combined Anterior Cruciate and Anterolateral Ligament Reconstruction in the Professional Athlete: Clinical Outcomes From the Scientific Anterior Cruciate Ligament Network International Study Group in a Series of 70 Patients With a Minimum Follow-Up of 2 Years. *Arthroscopy*. 2019;35(3):885-892. doi:10.1016/j.arthro.2018.09.020.

108. Ruano-Ravina A, Jato Diaz M. Autologous chondrocyte implantation: a systematic review. *Osteoarthritis Cartilage*. 2006;14(1):47-51.
109. Ryu R, Dunbar V, Morse G, Meniscal allograft replacement: a 1-year to 6-year experience. *Arthroscopy*. 2002;18(9):989-994.
110. Saris D, Price A, Widuchowski W, et al. on behalf of the SUMMIT Study Group. Matrix-Applied Characterized Autologous Cultured Chondrocytes Versus Microfracture: Two-Year Follow-up of a Prospective Randomized Trial. *Am J of Sports Med*. 2014;42(6):1384-1394. doi:10.1177/0363546514528093.
111. 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.
112. Seitzinger G, Scheurecker G, Hogler R, et al. Tibial tubercle-posterior cruciate ligament distance: A new measurement to define the position of the tibial tubercle in patients with patellar dislocation. *Am J Sports Med*. 2012;40(5): 1119-25. doi: 10.1177/0363546512438762.
113. Sekiya J, Giffin J, Irrgang J, et al. Clinical outcomes after combined meniscal allograft transplantation and anterior cruciate ligament reconstruction. *Am J Sports Med*. 2003;31(6):896-906.
114. Sharpe J, Ahmed S, Fleetcroft J, Martin R. The treatment of osteochondral lesions using a combination of autologous chondrocyte implantation and autograft: Three-year follow-up. *J Bone Joint Surg Br*. 2005;87(5):730-735.
115. Sherman SL, Garrity J, Bauer K, Cook J et al. Fresh osteochondral allograft transplantation for the knee: current concepts. *J Am Acad Orthop Surg*. 2014;22(2):121-33.
116. Siemieniuk RA, Harris IA, Agoritsas T, et al. Arthroscopic surgery for generative knee arthritis and meniscal tears: a clinical practice guideline. *BMJ*. 2017;357:j1982.
117. Sihvonen R, Paavola M, Malmivaara A et al. FIDELITY (Finnish Degenerative Meniscal Lesion Study) Investigators. Arthroscopic partial meniscectomy versus placebo surgery of a degenerative meniscus tear: a 2-year follow-up of the randomized controlled trial. *Ann Rheum Dis*. 2018 Feb; 77(2): 188-95.
118. Solomon D, Avorn J, Warsi A et al. Which individuals with knee problems are likely to benefit from nonarthroplasty surgery? Development of a clinical prediction rule. *Arch Intern Med*. 2004;164(5):509-513.
119. Sonnery-Cottet B, Siatha A, Cavalier M, Kajetanek C, Temponi EF, Daggestt M, Helito CP, Thaumat M. Anterolateral ligament reconstruction is associated with significantly reduced ACL graft rupture rates at a minimum of follow-up of 2 years: a prospective comparative study of 502 patients from the SANTI study Group. *Am J Sports Med*. 2017 Jun; 45(7): 1547-57.
120. Stuart M, Lubowitz J. What, if any, are the indications for arthroscopic debridement of the osteoarthritic knee? *Arthroscopy*. 2006;22(3):238-239.
121. Szachnowski P, Wei N, Arnold WJ, et al: Complications of office-based arthroscopy of the knee. *J Rheumatol*. 1995;22:1722-5.
122. Thorlund JB, Juhl CB, Roos EM, et al. Arthroscopic surgery for degenerative knee: systematic review and meta-analysis of benefits and harms. *BMJ*. 2015;350:h2747. doi: 10.1136/bmj.h2747.
123. Tibbo M, Limberg A, Salib C et al. Acquired Idiopathic Stiffness After Total Knee Arthroplasty. *J Bone Joint Surg*. 2019;101(14):1320-1330. doi:10.2106/jbjs.18.01217.
124. Trinh TQ, Harris JD, Siston RA, Flanigan DC. Improved outcomes with combined autologous chondrocyte implantation and patellofemoral osteotomy versus isolated autologous chondrocyte implantation. *Arthroscopy*. 2013 Mar;29(3):566-74.
125. van de Graaf VA, Noorduyt JCA, Willigenburg NW, et al. Effect of early surgery vs physical therapy on knee function among patients with nonobstructive meniscal tears. *JAMA*. 2018;320(13):1328-1337. doi: 10.1001/jama.2018.13308.
126. Voigt JD, Mosier M, Huber B: Diagnostic needle arthroscopy and the economics of improved diagnostic accuracy: a cost analysis. *Appl Health Econ Health Policy*. 2014;12:523-35.
127. von Keudell A, Han R, Bryant T, Minas T. Autologous Chondrocyte Implantation to

- Isolated Patella Cartilage Defects. *Cartilage*. 2017 Apr;8(2):146-154.
128. Wang D, Jones KJ, Eliasberg CD, et al. Condyle-Specific Matching Does Not Improve Midterm Clinical Outcomes of Osteochondral Allograft Transplantation in the Knee. *J Bone Joint Surg Am*. 2017;99:1614-20.
129. Yeung M, Leblanc MC, Ayeni OR, et al. Indications for Medial Patellofemoral Ligament Reconstruction: A Systematic Review. *J Knee Surg*. 2015; 29(7):543-554.
130. Zhang W, Moskowitz R, Nuki Get 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.