

Indexing Metadata/Description

- › **Title/condition:** Recurrent Patella Dislocation
- › **Synonyms:** Patella dislocation, recurrent; dislocation, recurrent patella; chronic patella dislocation; dislocation, chronic patella; patella dislocation, chronic; chronic patellar instability; patellar instability, chronic; instability, chronic patellar; chronic patella subluxation; subluxation, chronic patella; patella subluxation, chronic
- › **Anatomical location/body parts affected:** Knee/patella, femoral trochlea, quadriceps muscle group, medial collateral ligament, medial patellofemoral ligament, lateral retinaculum
- › **Area(s) of specialty:** Orthopedic Rehabilitation, Sports Rehabilitation
- › **Description**
 - Recurrent patellar dislocation (RPD) is an episodic condition characterized by patellofemoral joint instability that allows the patella to dislocate (laterally in most cases) from the trochlea. RPD is usually caused by direct or indirect trauma that stretches patellar attachments (chronic sprain), rather than habitual activity. However, anatomical factors such as severe trochlear dysplasia, hypermobility, patella alta, patellar tilt, and increased tibial tuberosity to trochlear groove distance may contribute to patellar dislocations^(11,20)
 - Trochlear dysplasia refers to a shallow trochlear groove or intercondylar sulcus⁽²⁹⁾
 - Painful episodes of the knee “giving-way” lead to patient apprehension and disability in ADLs

Patellar hypermobility may be corrected surgically by repairing injured structures that restrain the patella medially (e.g., medial patellofemoral ligament [MPFL]), releasing tight structures that pull the patella laterally (e.g., lateral retinaculum),^(1,2) and autologous chondrocyte implantation for chondral defects that often occur concurrently with patellar dislocations⁽¹³⁾

- Functional rehabilitation includes lower extremity ROM exercises and strengthening, with emphasis on medial quadriceps (vastusmedialis obliquus [VMO]) training to help offset lateral tracking^(1,2)
- This Clinical Review does not specifically address differences in treatment of RPD in the pediatric knee versus the skeletally mature knee
- › **Reimbursement:** Depends on insurance contract coverage; no specific issues or information is identified regarding reimbursement for this condition
- › **Presentation/signs and symptoms**
 - Primary patellar dislocation is seen most commonly in the second and third decades⁽¹⁴⁾
 - More often in females than males
 - Anterior knee pain (chronic retropatellar aching with moments of sharp pain)
 - Rarely bilateral
 - Activity-related episodes of “my kneecap slips out of place” (daily dislocation indicates the condition is “habitual”)
 - Restricted in certain ADLs (e.g., climbing stairs, squatting, jumping, running)
 - Instability when walking on uneven terrain or side of a hill
 - The apprehension that pivoting movements will cause dislocation

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- Decreased stable knee ROM in flexion with reduced dynamic balance
- Reduced quadriceps, hip extension, abduction, and external rotation strength
- Nonspecific signs and symptoms
 - Edema
 - Crepitation
 - Locking

Causes, Pathogenesis, & Risk Factors

› Causes

- Injury
 - Significant direct trauma to the knee that injures soft tissues of the knee⁽¹⁴⁾ leads to hypermobility and maltracking.
 - Activity-related microtrauma from chronic intrinsic maltracking

- Intrinsic and anatomic factors (see *Pathogenesis*, below)

› Pathogenesis

- Chronic instability often follows a first-time traumatic patella dislocation. The MPFL may be damaged during the injury
- Biomechanical factors that predispose to patellar dislocation are likely to occur in early knee flexion with external rotation of the tibia and contraction of the quadriceps⁽²¹⁾
- Intrinsic factors that contribute to lateral patellar tracking on weight-bearing⁽²⁹⁾
 - Tight lateral retinacular attachments to the patella
 - Insufficient restraint from medial tracking structures (e.g., MPFL, medial collateral ligament [MCL], VMO) compared to lateral forces (e.g., lateral retinaculum, iliotibial band)
- Anatomic predispositions for patellar maltracking^(22,29)
 - Patella alta
 - Increased tibial tuberosity (TT) to trochlear groove (TG) distance
 - Trochlear dysplasia
 - Ligamentous laxity
 - Large quadriceps angle (Q-angle)
 - Pes planus
- A case-control study (N = 180) in the United States found that patients with RPD (n = 60) had higher rates of patella alta (60.0% vs. 20.8%), increased TT-TG distance (42.0% vs. 3.2%), and trochlear dysplasia (68.3% vs. 5.8%) compared with patients without histories of patellar dislocation⁽¹¹⁾
- In a 2018 RCT, investigators found that trochlear dysplasia had the highest odds ratio for patellar redislocations⁽²³⁾
 - This study included 74 patients aged 9 to 14 with a first time traumatic lateral patellar dislocation.

› Risk factors ^(20,22,29,30)

- Adolescent athlete (higher risk in football and basketball)
- Females are more likely than males to develop patellofemoral pain⁽³⁰⁾
- Previous episodes
- Trochlear dysplasia
- MPFL insufficiency
- VMO hypoplasia/dysplasia
 - Whether RPD is associated with abnormal VMO morphology is unclear, although VMO strengthening is commonly a rehabilitation goal
 - Authors of a case-control study (N = 82) in Germany found no significant differences in VMO cross-sectional area, muscle-fiber angulation, or the craniocaudal extent of the VMO of the patella between patients with RPD (n = 30) and controls (n = 22)⁽¹²⁾
- Patellar maltracking (“J-sign” on knee flexion to extension)
- Increased distance of tibial tuberosity to trochlear groove⁽²²⁾
- Iliotibial band syndrome
- Lower extremity malalignment in standing
 - Foot overpronation, defined as a Foot Posture Index greater than 6, has a possible influence on patellar hypermobility⁽³⁰⁾

- Genu valgum
- Laterally deviated femoral groove
- Excessive internal femoral torsion
- Excessive external tibial torsion
- Excessive Q-angle (more than 15° in males and more than 20° in females)
- Excessive hip internal rotation
- Patella alta^(11,22)
- Patella tilt⁽³⁰⁾
- Tight lateral retinaculum
- Decreased flexibility of the hip flexors, vastuslateralis, or iliotibial band
- In a 2014 study, researchers found the MPFL to be longer in patients with patellar instability and previous patellar dislocation compared to controls⁽¹⁷⁾

Overall Contraindications/Precautions

- › Rule out patellar fracture and test neurovascular status in cases of recent knee trauma with visible skin injury and inability to bear weight
 - Osteochondral fractures of the patella are seen often after dislocations⁽¹⁶⁾
- › Significant neurological deficits are usually not associated with this condition. Consult with a physician if sensory or motor deficits are found in the involved limb
- › Confirm physician orders and evaluate for safety limitations on weight-bearing status, restrictions in ROM, and exercise therapy
- › Avoid use of ultrasound near growth plates in pediatric cases
- › In children, rule out referred pain to knee from serious back or hip disease
- › Notify referring physician immediately on discovery of evidence suggestive of undiagnosed deep vein thrombosis (DVT) or thrombophlebitis
 - Refer immediately to emergency care if evidence of ischemia or paralysis is present in the affected limb
 - See specific **Contraindications/precautions to examination** and **Contraindications/precautions** under **Assessment/Plan of Care**

Examination

- › Indications for evaluation in RPD include medical referral for anterior knee pain, history of activity-related signs and symptoms of patellar instability, postoperative knee rehabilitation, and exercise prescription
- › **Contraindications/precautions to examination**
 - In pediatric cases, obtain parental or guardian consent to perform the examination
 - Associated knee joint pathology (e.g., meniscal and ligament injuries) that contributes to altered knee/patella posture and gait mechanics
 - Patient unable to comprehend procedure because of cognitive impairment
 - Unresolved knee injury, inflammation, or infection
- › **History**
 - **History of present illness/injury**
 - Mechanism of injury or etiology of illness:** Patients will usually be able to describe the circumstances of their first-time patellar dislocation, as well as subsequent dislocating factors. The mechanism of dislocation is usually patellofemoral joint hypermobility combined with pivoting activities. What is the frequency of dislocations?
 - Course of treatment**
 - **Medical management:** Conservative treatment usually consists of physical therapy, activity modification, and patient education. What recent treatment has the patient received for this condition? Has a knee brace/sleeve, assistive device, or ambulatory aid been prescribed or used?
 - **Surgical management**
 - Operative procedures may involve repair of ligament tears (e.g., MPFL reconstruction),⁽¹⁸⁾ soft-tissue alignment/reconstruction (e.g., lateral release), osteotomy(femoral/tibial), and chondrocyte implantation;⁽¹³⁾ trochleoplasty⁽¹⁸⁾ and

distal patella realignment procedures.⁽¹⁴⁾ Fixation of osteochondral fractures of the patella may also be performed with MPFL reconstruction, as well as 4-in-1 patellar realignment surgery^(16,19)

- Tibial tubercle osteotomy (TTO) has been performed for patients with recurrent dislocations whose tibial tuberosity to trochlear groove distance is greater than 20mm⁽¹⁸⁾
- In a 2014 study, researchers found that MPFL reconstruction with simultaneous autologous chondrocyte implantation showed good clinical outcomes in patients with grade IV cartilage lesions⁽¹³⁾
 - In a 2-year follow-up no subsequent patellar dislocation occurred
 - Cartilage regeneration was successful in 80% of patients as measured by MRI
- Following an injury to the MPFL, MPFL reconstruction (MPFLR) appears satisfactory for adults with good patellofemoral joint congruity and knee function, whereas medial retinaculum plasty (MRP) might be indicated for patients without these⁽¹⁰⁾
 - In an RCT in China (N = 70 participants with RPD) researchers compared MRP surgery with MPFLR surgery
 - Outcome measures included presurgical vs. postsurgical measures for congruence angle, patellar tilt angle, and patellar lateral shift. Mean follow-up was 40 months (range, 24–55 months)
 - No significant differences in outcome measures were found between groups
 - In comparing use of a suture anchor to a double transpatellar tunnel fixation for MPFL reconstructions, there was no significant difference between the two. The suture fixation resulted in a higher level of patient-reported outcomes⁽²⁴⁾
- **Medications for current illness:** Pain and swelling are usually treated with common analgesic medications such as oral NSAIDs
- **Diagnostic tests completed:** Ask about results of X-rays or other imaging studies such as MRI⁽¹¹⁾
- **Home remedies/alternative therapies:** Has patient received acupuncture or tried taping/bracing knee or apply ice for pain?
- **Previous therapy:** Document whether the patient has had occupational or physical therapy for this or other orthopedic conditions and what specific treatments were helpful or not helpful
- **Aggravating/easing factors** (note length of time each factor is performed before the symptoms are aggravated or eased). Patients usually experience increased discomfort/apprehension with general physical activity
- **Body chart:** If areas other than anterior knee are involved, use body chart to document location and nature of symptoms
- **Nature of symptoms:** Note whether any of these symptoms are reported
 - Crepitation
 - Instability and giving-way
 - Locking (suggestive of loose bodies)
 - Stiffness
 - Other lower extremity pain
- **Rating of symptoms:** Use a visual analog scale (VAS), 0–10 scale, or Oucher scale for children, to assess symptoms at their best, at their worst, and at the moment. Specifically, address if the pain is a common symptom and whether it is present now and how much
- **Pattern of symptoms:** Document whether there are changes in symptoms throughout the day and night (i.e., a.m., mid-day, p.m., night)
- **Sleep disturbance:** Document number of wakings/night related to knee symptoms
- **Other symptoms:** Document other symptoms patient may be experiencing that might exacerbate the condition and/or symptoms that could indicate the need for physician consultation, such as falling because of knee pain on weight-bearing
- **Barriers to learning**
 - Does cognitive impairment limit the patient's ability to communicate or learn?
- **Medical history**
 - **Medical history**
 - **History of similar diagnoses:** Document medical and/or surgical history of orthopedic problems before this condition and especially involving the lower extremities
 - **Comorbid diagnoses:** Are there coexisting problems, such as diabetes, cancer, heart disease, dementia, psychiatric disorders, neuromuscular dysfunction?
 - **Medications prescribed:** Obtain a comprehensive list of medications prescribed and/or being taken (including OTC drugs)
 - **Other symptoms:** Ask the patient whether there are symptoms other than knee pain (low back, groin, or hip)

- **Social/occupational history**

- **Patient’s goals:** Document the specific and general goals the patient hopes to accomplish with therapy (these are usually related to the frequency and severity of activity-related knee pain/patella dislocation during work or recreation)
- **Vocation/avocation and associated repetitive behaviors, if any:** Does knee pain occur during participation in occupational or recreational activities? Does patient participate in high-risk activities that involve knee extension and pivoting (e.g., agility running, breaststroke “whip-kick”)? What activities does work require?
- **Functional limitations:** Does knee pain interfere with ADLs or use of adaptive equipment?
- **Living environment:** Are there barriers in the home that restrict access, such as stairs; any modifications necessary?

- › **Relevant tests and measures: (While tests and measures are listed in alphabetical order, sequencing should be appropriate to patient medical condition, functional status, and setting)**

- **Anthropometric characteristics:** Document height, weight, and BMI
- **Assistive and adaptive devices:** Evaluate the need for an assistive ambulatory device (cane, crutches, rarely a walker) and modify prescription, as appropriate. Assess fit and safe operation of assistive devices. If applicable, assess ability to correctly don/doff knee brace
- **Balance:** Assess stability and for nonsymmetrical weight-bearing in standing. If the patient’s status is not full weight-bearing, assess stability in standing using an assistive device. Before discharge, assess balance in the single-leg stand with perturbations
- **Circulation:** Dorsalis pedis and posterior tibial pulses should be intact
- **Edema/atrophy:** Assess for knee swelling and thigh atrophy with circumference measurements⁽³⁾
- **Functional mobility** (including transfers, etc.): Assess using Timed Up and Go (TUG) test and FIM, as indicated. Although designed for patients with patellar tendinopathy, the Victorian Institute of Sport Assessment Scale for Patellar Tendinopathy (VISA-P) may be used for athletes with RPD
- **Gait/locomotion:** Inspect lower extremity movement for abnormalities while walking and/or running on a treadmill.⁽³⁾ Observe for visible lateral patellar tracking and rearfoot varus. Note whether knee remains fully extended during the stance phase. Compare sides. Assess with Dynamic Gait Index (DGI)
- **Joint integrity and mobility:** Assess passive mobility and dynamic tracking⁽³⁾ of the patella and tightness of lateral retinaculum in supine and standing positions (see *Special tests*, below). If not in the acute stage, assess for injury to knee ligaments and menisci. Compare to the unaffected knee. Assess multidirectional patellar mobility including medial/lateral tilt
- **Muscle strength:** Assess the strength of entire lower extremity, with emphasis on knee flexion and extension. Compare quadriceps-hamstrings strength ratio to the contralateral side. Assess ability to perform half-squat with the affected leg
- **Observation/inspection/palpation:** Assess:
 - Medial quadriceps/VMO for atrophy, tone, and activation at terminal knee extension⁽³⁾
 - Lateral and medial retinacula for tightness and tenderness
 - Patellofemoral joint for crepitation. Cartilage lesions of the patella are common⁽¹³⁾
- **Pain:** Assess for pain using VAS during strength tests. Does the patient’s maximal effort appear to be restricted by pain? Assess pain and compensatory postures with stairs, up and down
- **Posture:** Assess alignment and position of the patella in sitting and standing, as well as trunk, pelvis, and lower extremity alignment. Evaluate for leg-length discrepancy and large Q-angle. Inspect for rearfoot varus in subtalar neutral position and genu varum or valgus
- **Range of motion:** Scan lower extremity for functional ROM and flexibility. Assess active and passive ROM at the knee joint. Expect reduced active ROM in flexion
- **Reflexes:** Achilles and patellar tendon reflexes should be intact
- **Sensory testing:** Sensation should be intact except for localized deficits around surgical wounds, if applicable. Assess proprioception at the knee joint
- **Special tests specific to diagnosis** ⁽²⁾
 - “Circle sign” – patient circles patella with fingers
 - “J-sign” test – patient performs active knee extension in standing from 90° flexion, as in single-leg squat (test positive if patella deviates strongly medially at terminal extension)
 - Patella glide test – assess mobility in frontal plane by manually translating patella medially and laterally (test is positive if pain and apprehension are reproduced)

- Patella tilt test – with patient relaxed in supine position and hip joint neutral, assess for tightness of lateral attachments by lifting lateral border (test is positive if it cannot be raised to at least horizontal) and for laxity of medial attachments by lifting medial border (test is positive if it tilts more than contralateral side)
- Patella grind test – with patient relaxed in supine position and knee fully extended, displace patella inferiorly; ask the patient to contract quadriceps while gently resisting cephalad movement of the patella (test is positive for chondromalacia if pain and apprehension are reproduced)
- Q-angle – with the knee fully extended, the Q-angle is formed by the intersection of lines along the quadriceps vector (line from anterior superior iliac spine to the center of patella) and patellar tendon vector (line from the center of the patella to the tibial tubercle)
- Ober's test – for tightness of iliotibial band and hip abductors⁽⁴⁾
- Thomas test – for tightness of the hip flexors

Assessment/Plan of Care

› **Contraindications and precautions**

- **Only those contraindications/precautions applicable to this diagnosis are mentioned below, including with regard to modalities. Rehabilitation professionals should always use their professional judgment in their assessment and treatment decisions**
- **Patients with this diagnosis are at risk for falls; if inpatient, follow facility protocols for fall prevention and post fall-prevention instructions at the bedside. Ensure that patient and family/caregivers are aware of the potential for falls and educated about fall-prevention strategies**
- Use a sterile field and sterile techniques when treating open lesions; dressings that retain moisture are contraindicated in the presence of infection
- Allow for adequate wound healing before starting functional rehabilitation exercises
- **Cryotherapy** contraindications⁽⁵⁾
 - Raynaud's syndrome
 - Medical instability
 - Cryoglobulinemia
 - Cold urticaria
 - Paroxysmal cold hemoglobinuria
 - Avoid applying cold over superficial nerves, areas of diminished sensation, poor circulation, or slow-healing wounds
- **Cryotherapy** precautions⁽⁵⁾
 - Use caution with patients who are hypertensive, as cold can cause a transient increase in blood pressure; discontinue treatment if there is an elevation in blood pressure
 - Use caution with patients who are hypersensitive to cold
 - Avoid aggressive treatment with cold modalities over an acute wound
 - Use of cryotherapy with patients who have an aversion to cold may be counterproductive if being used to promote muscle relaxation and decrease pain
- **Superficial heat** contraindications⁽⁵⁾
 - Decreased circulation
 - Decreased sensation
 - Acute/subacute traumatic and inflammatory conditions
 - Skin infections
 - Impaired cognition or language barrier
 - Tumors
 - Tendency for hemorrhage or edema
 - Heat rubs
- **Electrotherapy** contraindications/precautions (in some cases, **when approved by the treating physician**, electrotherapy may be used under some of the circumstances listed below when benefits outweigh the perceived risk)⁽⁵⁾
 - Cardiac pacemakers
 - Implanted stimulators
 - Over carotid sinuses
 - Uncontrolled hypertension/hypotension

- Peripheral vascular disease
- Thrombophlebitis
- Pregnancy
- Diminished sensation
- Acute inflammation
- Seizure history
- Confused patients
- Immature patients
- Obesity
- Osteoporosis
- Used in close proximity to diathermy treatment
- **Therapeutic ultrasound** contraindications; do not use.⁽⁵⁾

- in area with infection or bleeding
- if a tumor is present in the area
- in the area of DVT or thrombophlebitis
- over epiphyseal plates of growing bones

- **Therapeutic ultrasound** precautions⁽⁵⁾

- Use caution in patients with sensory deficits and in patients who are unable to communicate sensory deficits
- Use caution if patient has circulatory impairments
- Use caution over plastic or metal implants

› **Diagnosis/need for treatment:** RPD/ knee pain, reduced knee ROM and strength; limitations in general and recreational ADLs. Trial of physical therapy to reduce RPD, alleviate knee pain, and restore functional capacity⁽⁶⁾

› **Rule out:** Other knee conditions: collateral ligament/cruciate ligament tear; meniscal injury (e.g., displacing lateral meniscus)⁽¹⁵⁾; osteoarthritis; chondromalacia patella; osteochondritis dissecans; popliteal cyst; pre-patellar bursitis; patellofemoral syndrome; soft-tissue hypermobility disorders (e.g., Ehlers-Danlos syndrome, Marfan syndrome)

› **Prognosis**

- Results of a 2015 systematic review suggested that there is not enough evidence to confirm a difference in outcomes between surgical and nonsurgical management of patients with a one-time dislocation⁽¹⁴⁾
- Authors of a meta-analysis compared surgical and nonsurgical treatment for primary patellar dislocations in patient younger than 18. The evidence appears to support surgical intervention for short-term prevention of redislocation, but the knee functional scores (Kujala and KOOS) were worse for the surgical intervention. The long term results beyond 5 years showed no difference in redislocation rates between surgical and nonsurgical treatment methods⁽²⁵⁾
- In a 2020 meta-analysis, investigators found that conservative treatment for primary patellar dislocations was more favorable with respect to Tegner score outcomes compared with MPFL reconstruction. The study urged caution in these findings given the small pool of 10 RCTs (569 patients total) and recommended further research⁽²⁶⁾
- Long-term prognosis in adolescents may be more favorable after open vastus medialisplasty (VMP) compared to arthroscopic MRP
 - Based on an RCT in China (N = 60)⁽⁷⁾
 - Although the surgically corrected position of the patella deteriorated in both groups over time, the patellar position remained better in the VMP group at 4-to 5-year follow-up
 - Functional results were also better in the VMP group
- In comparing MPFL repair to knee bracing in children with a first-time traumatic patellar dislocation, authors of a 2018 RCT found that both groups were satisfied with knee function. The surgical group had a significant reduction in redislocation rate, but subjective and objective measurements of knee function were no better compared with the bracing group⁽²³⁾
- Authors of a level II RCT and level III nonrandomized study found no difference in redislocation rate, pain, and function between operative and nonoperative management of acute patellar dislocation in adolescents. A third study (level II RCT) suggested that an operative approach was better⁽²⁷⁾

› **Referral to other disciplines:** Orthopedic physician for specific red flags and persisting inability to achieve full ROM; orthotist for shoe modifications; aquatic therapist for pool exercise; radiologist to image for soft-tissue injuries, to rule out patella fracture, or for laterally deviated femoral groove

› **Treatment summary**

- In nonoperative management, the desired long-term treatment outcomes are patellofemoral joint stability, normal knee ROM, and restored functional mobility (including a return to the sport in many cases)
 - Authors of a systematic review compared outcomes of four broad nonoperative RPD treatments based on immobilization, weight-bearing status, quadriceps exercise, and alternative therapies. Using the Kujala score, patient-reported outcomes consistently improved over all interventions; the pooled redislocation rate was 31%⁽²⁸⁾
 - There continues to be an overall lack of quality evidence to advocate for one treatment strategy over another
 - Quadriceps isometric strengthening exercises (“quad sets”), straight-leg raises, and gentle knee ROM exercises can begin soon after acute patella dislocation. The goal of treatment should be to restore neuromusculoskeletal control of the patellofemoral joint at the hip, ankle, knee, and foot⁽¹⁴⁾
 - Progressive VMO activation with neuromuscular electric stimulation and reeducation (biofeedback), as needed
 - Initial treatment may include bracing, immobilization, and manual therapy⁽¹⁴⁾
 - In athletes, sport-specific functional training may begin after bilateral symmetry in lower extremity strength and flexibility is restored
- In postoperative cases
 - Progressive VMO strengthening exercises can begin soon after MPFL reconstructive surgery, as prescribed

Problem	Goal	Intervention	Expected Progression	Home Program
Knee pain, edema	Decrease pain, edema	<p><u>Physical agents and mechanical modalities</u></p> <p>Rest, ice, compression, elevation, activity modification, and patient education</p>	Progress patient activity as appropriate	Follow PRICE at home
Quadriceps (especially VMO) weakness	Improve quadriceps strength	<p><u>Therapeutic exercise</u></p> <p>Open and closed kinetic-chain quadriceps strengthening exercises. Hip-targeted exercises in conjunction with knee-targeted exercises are optimal for short-, medium-, and long-term outcomes. Hip-targeted over knee-targeted exercises may be favored in early stages of care. VMO and vastus lateralis balance is integral for patellar tracking^(29,30)</p>	Progress the intensity and volume of exercises	Quad strengthening program

Patellar laxity	Stabilize patella	<p><u>Prescription, application of devices and equipment</u></p> <p>Patellar taping/ patellar bracing during the initial phase of exercise therapy⁽¹⁴⁾</p> <p>VMO training</p>	Patellar taping and bracing can be discharged when appropriate	Educate patient on the home use of the brace
Hip flexor and iliotibial band tightness	Improve hip flexor and iliotibial band flexibility	<p><u>Therapeutic exercise</u></p> <p>Exercises and stretches to improve hip flexor flexibility and iliotibial band mobility are effective in management of PFP⁽²⁹⁾</p>	Progress the intensity and volume of exercises	Hip flexor stretching program
Reduced tone and activation of VMO	Improved VMO tone/ strength and relative activations of the VMO and vastuslateralis ⁽⁸⁾	<p><u>Electrical stimulation</u></p> <p>Neuromuscular stimulation and/or EMG biofeedback for activation of the VMO⁽⁸⁾</p>	Increased awareness of VMO contraction	Home exercises
Deficits in knee proprioception and gait abnormalities	<p>Functional proprioception and balance reactions.</p> <p>Normal gait</p>	<p><u>Functional training</u></p> <p>To improve knee function in daily activities. To correct balance and proprioceptive deficits and/or faulty gait pattern</p>	Progress exercises until deficits are normalized	Recommend strategies for the home to assist in balance and gait training, as appropriate and indicated for each patient. Patient may benefit from shoe orthotics if over-pronation occurs with gait
<p>Decreased patient understanding and compliance with EMG biofeedback training</p> <p>At a risk of reinjury by returning to high-risk or aggravating activities before ready</p>	<p>Patient shows compliance with and understanding of the procedure</p> <p>Activity modification</p>	<p><u>Patient education</u></p> <p>Describe equipment (“gives information about your contraction”) and procedures used</p> <p>Specific verbal instructions to avoid anterior knee pain related to jumping, running, cycling, climbing, squatting, and kneeling</p>	<p>Gradual improvement in patient’s performance of desired contractions</p> <p>Trial of prior activity after pain-free movement is achieved during ADLs</p>	<p>Independent treatment with portable EMG unit is not recommended</p> <p>Restricted or modified exercise routines</p>

Patient lacks program for pain self-management	Patient will understand the reasons/ benefits of and complies with home Rx	<u>Patient education</u> Patient education on pain prevention and self-management	Patient reports benefits of self-treatment	Rest, ice, analgesics
Inability to participate in high-risk sports	Return to sport with physician's approval (within 6 to 12 months)	<u>Sport-specific drills</u> These involve high-speed cutting, turning, agility running, and/ or jumping such as in soccer, football, basketball, tennis, skiing	Progress until patient demonstrates fitness appropriate for the sport	Agility running, forward and lateral lunges, and jump-landing training

Desired Outcomes/Outcome Measures

- › Pain and swelling controlled
 - VAS
 - Circumferential limb measurements
- › Education of brace application/correct knee brace
- › Functional ROM (more than 120° flexion); full knee extension
 - Goniometry
- › Quadriceps strength comparable to unaffected side
 - Manual muscle testing
- › Symmetry in standing posture and during weight-bearing activities
 - Postural assessment
- › Good dynamic balance
 - Berg, Tinetti
- › Return to sport with physician's approval
 - Sport-specific testing
- › Improved flexibility
 - Muscle length testing
- › Improved knee mechanics/patellar tracking
 - Joint mobility assessment
 - X-ray or functional MRI for joint alignment
- › Decreased risk of recurrent patella dislocation
- › Improved functional mobility
 - TUG test
 - FIM
 - VISA-P
 - DGI
 - Patient subjective outcome using the International Knee Documentation Committee (IKDC) score⁽⁹⁾
 - Lower Extremity Functional Scale

Maintenance or Prevention

- › Continue quadriceps strengthening to restore symmetry
- › Continue VMO training to improve patellar control
- › Continue to strengthen hip for closed chain alignment of the lower extremity
- › Continue flexibility exercises
- › Patellar stabilization brace for athletics, as appropriate

Patient Education

Noyes Knee Institute, Unstable Kneecap

<http://noyeskneeinstitute.com/unstable-kneecap/>

Coding Matrix

References are rated using the following codes, listed in order of strength:

M Published meta-analysis	RV Published review of the literature	PP Policies, procedures, protocols
SR Published systematic or integrative literature review	RU Published research utilization report	X Practice exemplars, stories, opinions
RCT Published research (randomized controlled trial)	QI Published quality improvement report	GI General or background information/texts/reports
R Published research (not randomized controlled trial)	L Legislation	U Unpublished research, reviews, poster presentations or other such materials
C Case histories, case studies	PGR Published government report	CP Conference proceedings, abstracts, presentation
G Published guidelines	PFR Published funded report	

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