

Rehabilitation Guidelines for Patellar Realignment

The knee consists of four bones that form three joints. The femur is the large bone in your thigh which attaches by ligaments and a capsule to your tibia, the large bone in your shin. Next to the tibia is the fibula, which runs parallel to the tibia. The patella, commonly called the knee cap, is embedded in the quadriceps and patellar tendon and articulates with the front of the femur. This is the patellofemoral joint. The patella acts as a pulley to increase the amount of force that the quadriceps muscle can generate and helps direct the force in the desired upward direction. The patella sits in a groove on the end of the femur called the trochlear groove. This groove varies in depth from person to person. While the knee flexes (bends), the patella travels down the groove and as the knee extends (straightens) it moves up the groove. As the patella travels up and down in the femoral groove it maintains a congruent boney alignment. This patellar movement in the femoral groove is often referred to as patellar tracking.

There are several structures that work together to keep the patella aligned and stabilized in the femoral groove properly, specifically to prevent the patella from excessive lateral movement. The lateral aspect of the trochlear groove is normally about 1 cm higher than the medial which helps to keep the patella in the trochlear groove by providing a buttress on the lateral side (Figure 1). This provides the main resistance to lateral patellar translation (which is the most common direction of

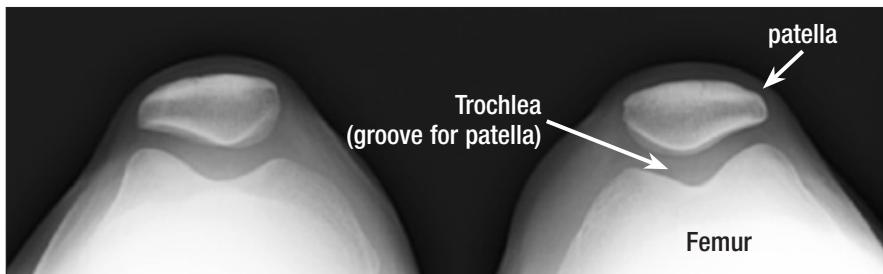


Figure 1 Radiograph of the patellofemoral joint in slight flexion. The lateral aspect of the trochlear groove is normally about 1 cm higher than the medial.

displacement), especially beyond 20° of knee flexion. People who have a shallow trochlea are more susceptible to patellar instability.

Proper stabilization of the patella is also affected by the soft tissue structures (ligaments and muscles) surrounding the knee. The medial patellofemoral ligament (MPFL) is a continuation of the deep retinaculum and vastus medialis oblique (VMO) muscle fibers (inner portion of the quadriceps muscle) on the inside of the knee. These structures provide a significant force (near 60% total) against lateral displacement of the patella, as their force is directed inward or medially. The MPFL is the primary restraint to lateral displacement of the patella during the first 20-30° of knee flexion. This ligament is a passive stabilizer and extends from the upper inner side of the patella to medial aspect of the femur. The patellomeniscal ligament and retinaculum also contribute over 20% of the restraining force. These ligaments can be injured and torn with an initial acute traumatic patellar dislocation (knee

cap quickly going out of place during a sport related movement). The most common mechanism for an initial dislocation is a forceful inward rotation of the knee on a planted foot. The radiograph below is that of a 12 year-old-boy in the emergency room after such an injury (Figure 2).

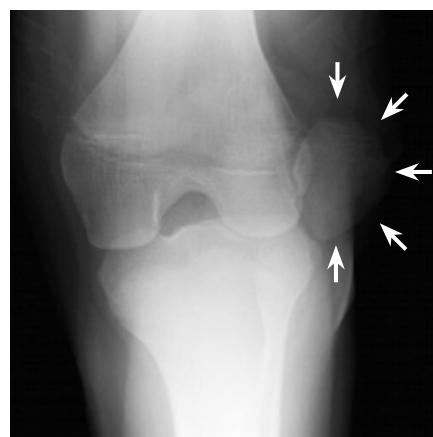


Figure 2 Radiograph of the knee, arrows show the laterally dislocated patella

Often times the patella will go back in to place (or relocate to the groove) as the knee is gently straightened. In this case the patient was unable to straighten his knee

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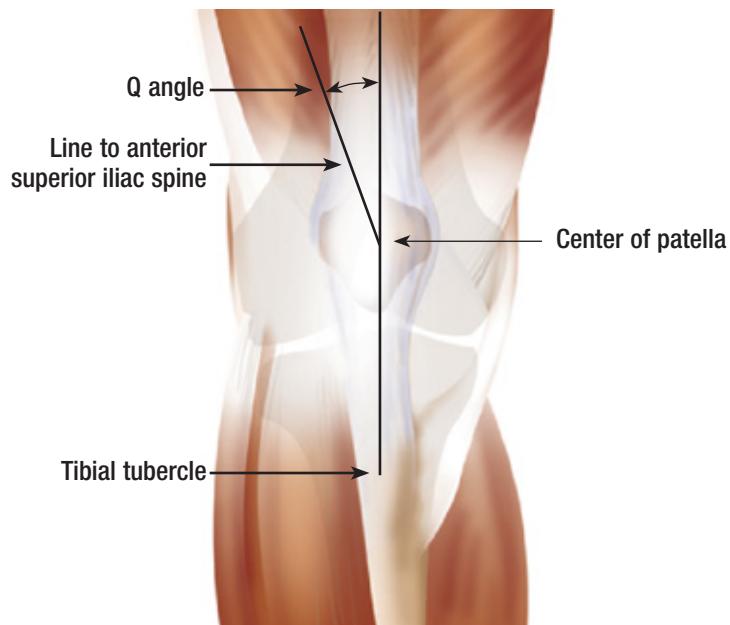


Figure 3 Diagram representing the “Q” angle of the knee

and his patella remained dislocated laterally. Note on the radiograph that there is no overlap of the femur and patella. An individual can also have atraumatic instability. In this situation the instability is more likely to be a partial dislocation or subluxation and not created by a large forceful one time injury. People with atraumatic instability usually have predisposing factors that alter their normal patellar tracking. The alignment of the pelvis and femur can affect patellar tracking. The alignment of the pelvis and femur can be structurally altered based on a particular individual's angle of the quadriceps muscle, also known as “Q angle”. The “Q angle” is formed by the superior line of the quadriceps pull (from the hip) and the patellar tendon (insertion onto the front of the tibia) as they intersect at the patella (Figure 3).

The alignment of the pelvis and femur can also be functionally altered in a weight bearing position due

to hip weakness or pronated (flat) feet. Patellofemoral stress syndrome (knee cap pain) and patellar instability result from a deviation in the normal tracking of the patella. Most often abnormal tracking results in lateral positioning of the patella (toward the outside of the knee). Lateral displacement can occur from the femur rotating inward or the patella being pulled outward. This can happen as a result of injury or repetitive stress. Instability can occur as a mild subluxation (slight loss of joint alignment), or as a complete dislocation (Figure 2). Patellar dislocation typically involves a strong quadriceps contraction combined with a flexed and valgus knee position and an internally rotated femur relative to the tibia. In sports this often occurs when an athlete plants his/her foot to pivot and the knee turns inward while the upper body and hips are turning outward. Annual incidence of patellar dislocations in people under

16 years-of-age was found to be 43 per 100,000. This incidence lowers to 31 per 100,000 in the second decade of life, followed by 11 per 100,000 in the third decade and even further to 1.5-2 per 100,000 in those between 30-59 years of age. People with recurrent dislocations of the patella often have anatomical variations or malalignment including patella alta or a higher quadriceps “Q angle” (Figure 3), which predispose them to instability. Patella alta describes a high-riding patella which engages the trochlea later in flexion than normal, giving the patella less boney stability. Many options exist for treating patellar instability. Rehabilitation is typically recommended following an initial dislocation; however, recurrent dislocation is reported to be as high as 48% with non-operative treatment. Operative treatment is typically performed on those with an underlying, predisposing anatomical variations/malalignment as noted above. Operative treatment is also performed on people who have had reoccurring dislocations, as these individuals typically have continued apprehension and progressive joint damage. Specific operative treatment is selected based on the particular needs of the individual including extent of malalignment, individual's age, level of activity, ligamentous injury (MPFL) and joint condition. Examples of procedures used include proximal realignment, MPFL repair or reconstruction, lateral release and distal realignment. Proximal realignment alters the medial-lateral position of the quadriceps muscle to the patella through appropriate manipulation of the tissues at or above the level of the patella. An incision is made over the knee and specific procedures include lateral

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Figure 4 Lateral radiograph of the knee showing a distal realignment to reduce the “Q” angle by moving the tibial tubercle medially.

retinacular release (lengthening the structures on the outside of the patella), VMO advancement and MPFL repair and reconstruction (shortening the muscle or ligaments on the inside of the patella). This procedure is sometimes done in combination with a distal realignment procedure.

Distal realignment is often done to reduce the “Q angle”. This is performed through an incision over the knee in which an instrument to cut the tibial tubercle (the boney prominence on the top of the tibia where the patellar tendon attaches) is used. This is called an osteotomy. The basic purpose of this type of osteotomy is to move the tibial tubercle medially (toward the inside). The type of osteotomy performed will determine how much of this bone will be cut. Because of this difference there will also be subsequent differences in when these patients can begin weight bearing. The patellar tendon and bone which was cut is then moved medially which alters the position of the patella. The bone is reattached in this new position to the tibia with screws (Figure 4).

A quality post-operative rehabilitation program is essential to having a successful outcome from a patellar stabilization procedure. The goals of rehabilitation will initially focus on protection for healing, mobility and range of motion. After this early

phase there will be a strong emphasis on strengthening throughout the entire leg and core. In the final stages of rehabilitation, the focus will be on control of sport specific movements, such as change of direction and rotational movements. The UW Health Sports Medicine rehabilitation guidelines below are presented in a criterion based progression. General time frames are given for reference to the average, but individual patients will progress at different rates depending on their age, associated injuries, pre-injury health status, rehabilitation compliance and injury severity. Modifications in the specific time frames, restrictions and precautions may also be made to protect healing tissues based on the specific surgical repair/reconstruction procedure performed.

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PHASE I (Surgery to 6 weeks after surgery)

Appointments	<ul style="list-style-type: none"> Physician appointment: 1 week and 4 weeks after surgery Rehabilitation appointments begin 3-5 days after surgery, continuing 1 time every 10-14 days
Rehabilitation Goals	<ul style="list-style-type: none"> Protection of the post-surgical knee Restore normal knee range of motion (ROM) Normalize gait Eliminate effusion Restore leg control
Precautions	<ul style="list-style-type: none"> Brace locked in extension for gait and activities of daily living (ADL's). May unlock brace when sitting Drs. Scerpella and Spiker patients: Non-weight bearing or toe touch weight bearing for the first 6 weeks Drs. Baer and Walczak patients: Weight bearing as tolerated without pain for the first 6 weeks ROM limitations as stated below No driving
Range of Motion (ROM) Exercises	<ul style="list-style-type: none"> 0-90° with seated passive range of motion (PROM) or continuous passive motion or assisted wall slides in supine. Avoid active extension
Suggested Therapeutic Exercise	<ul style="list-style-type: none"> Assisted range of motion (seated knee flexion or supine wall slides) within above guidelines Knee extension ROM (avoid hyperextension past 5°) Ankle pumps progressing to resisted ankle ROM Patellar mobilizations Quad sets - 10 second sustained Straight leg raises in multiple directions Supine wall pushes Mini squats Weight shifting drills
Cardiovascular Exercise	<ul style="list-style-type: none"> Upper body circuit training or upper body ergometer (UBE)
Progression Criteria	<p>Patient may progress to Phase II if they have met the above stated goals and have</p> <ol style="list-style-type: none"> Safe gait with crutches and with brace unlocked No effusion 0-90° knee ROM

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PHASE II (begin after meeting Phase I criteria, usually 6 weeks after surgery)

Appointments	<ul style="list-style-type: none"> Physician appointment: 2 months after surgery Rehabilitation appointments are 1-2 times per week
Rehabilitation Goals	<ul style="list-style-type: none"> Single leg stand control Good control and no pain with short arc functional movements, including steps and partial squat Good quadriceps control
Precautions	<ul style="list-style-type: none"> Avoid over-stressing fixation by beginning close chain movements in a shallow arc of motion (starting 0-30, working up to 0-60) and using un-weighting techniques (pool) Avoid post-activity swelling Discontinue brace when patient has good single leg stand control and good quadriceps control
Suggested Therapeutic Exercise	<ul style="list-style-type: none"> Gait drills (begin with pool) Functional single plane closed chain movements (begin with pool) Continued gradual progression of ROM Balance and proprioception exercises
Cardiovascular Exercise	<ul style="list-style-type: none"> Upper body circuit training or UGE
Progression Criteria	<p>Patients may progress to Phase III if they have met the above stated goals and have</p> <ol style="list-style-type: none"> Normal gait on level surfaces Good leg control without extensor lag, pain or apprehension Single leg balance greater than 15 seconds

PHASE III (begin after meeting Phase II criteria, usually 10 weeks after surgery)

Appointments	<ul style="list-style-type: none"> Physician appointment: 3 months after surgery Rehabilitation appointments are 1-2 times per week
Rehabilitation Goals	<ul style="list-style-type: none"> Normal gait without crutches Full ROM No effusion Improve quadriceps strength Improve proximal hip and core strength Improve balance and proprioception
Precautions	<ul style="list-style-type: none"> Avoid closed chain exercises on land past 90° of knee flexion to avoid overstressing the repaired tissues and increased PF forces Avoid post-activity swelling

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Suggested Therapeutic Exercise	<ul style="list-style-type: none"> Continue ROM exercises and stationary bike Closed chain strengthening begin with single plane progress to multi-plane Single leg press Balance and proprioception exercises; single leg stand, balance board Hip and core strengthening. Stretching for patient specific muscle imbalances
Cardiovascular Exercise	<ul style="list-style-type: none"> Swimming with flutter kick (no breast stroke) or Stair master. No Running
Progression Criteria	<p>Patients may progress to Phase IV if they have met the above stated goals and have</p> <ol style="list-style-type: none"> Normal gait without crutches Full ROM No effusion No patellar apprehension Single leg balance with 30° knee flexion greater than 15 seconds Good control and no pain with squats and lunges

PHASE IV (begin after meeting Phase III criteria, usually 14-16 weeks after surgery)

Appointments	<ul style="list-style-type: none"> Physician appointment: 5 months after surgery Rehabilitation appointments are 1 time every 2 weeks
Rehabilitation Goals	<ul style="list-style-type: none"> Good eccentric and concentric multi-plane dynamic neuromuscular control (including impact) to allow for return to sport/work
Precautions	<ul style="list-style-type: none"> Post-activity soreness should resolve within 24 hours Avoid post-activity swelling
Suggested Therapeutic Exercise	<ul style="list-style-type: none"> Impact control exercises beginning 2 feet to 2 feet, progressing from 1 foot to other and then 1 foot to same foot Movement control exercise beginning with low velocity, single plane activities and progressing to higher velocity, multi-plane activities Sport/work specific balance and proprioceptive drills Hip and core strengthening Stretching for patient specific muscle imbalances
Cardiovascular Exercise	<ul style="list-style-type: none"> Replicate sport or work specific energy demands
Return to Sport/Work	<ul style="list-style-type: none"> Patient may return to sport after receiving clearance from the orthopedic surgeon and the physical therapist/athletic trainer. Progressive testing will be completed. The patient should have less than 15% difference in Biodex strength test, force plate jump and vertical hop tests, and functional horizontal hop tests

These rehabilitation guidelines were developed collaboratively by UW Health Sports Rehabilitation and the UW Health Sports Medicine physician group.

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