Clients with Knee Problems …
By Ruth Sova with help from Beth Scalone

Working with the knee begins with understanding how it is designed to work; what common conditions limit its function; and which strategies can help correct those conditions.

The knee joint does not have the inherent structural stability of a ball-and-socket joint. Rather, it is mainly stabilized by soft-tissue structures (tendons, ligaments, and menisci). The kneecap (patella) lies on the front of the knee and glides in a groove on the lower end of the femur.

The Bones

The knee is a hinge joint comprising three bones: the femur, the tibia and the patella. The primary movements of the knee are flexion and extension, along with slight medial and lateral rotation of the tibia on the femur. The knee joint lacks intrinsic stability and has no muscles running over it, so it relies on ligaments and muscles for support.

The Ligaments

The ligaments of the knee keep the femur and the tibia attached. The ligaments provide stability in the anterior-posterior plane and in the lateral plane, but they are vulnerable to damage when the knee is twisted or when it is hit from any angle. The knee has four (sometimes five) primary ligaments:

- The anterior cruciate ligament (ACL) keeps the tibia from sliding forward on the femur.
- The posterior cruciate ligament (PCL) keeps the tibia from sliding backward on the femur.
- The medial collateral ligament (MCL) keeps the tibia and the femur from separating along the medial joint line.
- The lateral collateral ligament (LCL) keeps the tibia and the femur from separating along the lateral joint line.
- Sometimes the anterolateral ligament (ALL) is recognized. It links the femur to the tibia.

The Muscles

The muscles around the knee create movement and support the joint. Balance in the musculature is essential for smooth functioning of the knee and for preventing overuse injuries. Several muscle groups affect the knee:

- The primary knee extensor, and one of the strongest muscle groups in the body, is the quadriceps. It consists of the vastus medialis, intermedius and lateralis, plus the rectus femoris. Balanced development of this muscle group helps protect the patella from wear and tear, which can lead to patellofemoral dysfunction or chondromalacia patella.
- The knee flexors are the hamstrings—both lateral (biceps femoris) and medial (semimembranosus and semitendinosus)—and the gastrocnemius, popliteus, sartorius and gracilis. The hamstrings support the back of the knee and align the femur on the tibia. The medial hamstrings medially rotate the tibia, and the lateral hamstrings laterally rotate the tibia. The quadriceps and the hamstrings work together to provide power for jumping, running, biking and getting out of a chair.
- The hip muscles, including the hip abductors, adductors and external rotators, assist in creating femur alignment and in tracking the knee in a straight line during walking, running and biking.
- The lower-leg muscles, including the gastrocnemius, soleus, peroneals, anterior and posterior tibialis and toe flexors and extensors, work to align the foot so that ground forces move up to the knee in a balanced way.

When all of these muscles work together in harmony, our knees can keep us moving for a lifetime without trouble.

Knee Checklist

Before exercising in water, clients should be 6 weeks postsurgery (depending on wound healing and physician recommendation). This is not accepted by all surgeons since some have their clients in the water within three days and others wait 12 weeks.

* Compare non-weightbearing (seated in a chair) ROM for both sides. Full pain-free ROM compared with the other knee is a goal.

* Record pain levels.

* Be aware of the signs and symptoms of edema that are not normal. Swelling, edema, or effusion of the knee can occur after exercise. Watch for edema or pain that will not resolve. With intra-articular or ligamentous problems, your clients may have immediate pain that worsens when they try to walk or bend their knees, experience a popping sound at the knee, are unable to bear weight on the injured knee, or have a feeling that the knee might buckle or give way (Madiagan Army Medical Center Practice Guidelines).

Exercises to Try

I have taken most of these exercises from Ideas for Knees video download (on sale now for $9 for those of you who read this far 😊) https://ruth-sova-103927.square.site/product/10-in-10-knees-/388?cs=true&cst=custom.

Squats
Shallow squats in shallow water
Squat combo (possible wall use for balance, alignment or knee ROM)
- 2 feet – shoulder width stance
- 1 foot – R / L (feet still shoulder width, non-weight-bearing foot touching pool bottom)
- 2 feet – feet together
- 1 foot – R / L (as above)

Squat combo with 'heavy' concept
Squat combo with 'reverse heavy' concept
Shallow squats on single leg
- Move non-weight-bearing leg to various positions

Variable squats (as in Loaded Movement Training)
- Vary stance (toes out, toes in, staggered, narrow, tandem, etc)
- Vary truck movement (lean, turn, weigh shift, bend, etc)
- Vary arm movement (reach bilaterally, unilaterally, ipsilaterally in any direction back, diagonals, forward, up, down, etc)

- Squat on a noodle in shallow water for stability with alignment and knee strength
- Deeper squats
- Single squats
- Deeper water
- Modify with head/eyes, arm positioning, weight shifting, internal/external hip rotation

ADLs
Walk forward and backwards
- BackHab forward and backward strides and side steps
- BackHab progressions

Go up and down steps
Open Chain Exercises
- Sit on a noodle, seat, wonderboard
- Flex / extend knees forward and diagonal
- Circumduct

Stretches
- Quadricep stretch
- Hip flexor stretch
- Hamstring stretch
- Gastroc stretch

General Suggestions

- Exercises strengthening the vastus medialus or quadriceps should be used; they would involve knee extensions in both an open chain and closed chain position.
- Pain-free stretching of the tensor fascia latae, quadriceps, gastocnemius, hamstrings, gluteals, and soleus (basically the quadriceps, hamstrings, and calves) is important to keep participants injury free. This will lengthen the contracted muscles and tissues and increase the blood supply.
- Include balance, coordination, and proprioception training that mimic ADLs.
- Gradually increase the size and/or speed of movement to adjust overload. Add adjustable resistive equipment for progression when appropriate.
- Use gradual progressions for squats and step work, beginning with mini squats in water that off-loads the body comfortably and progressing to shallower water gradually.
- Include walking forward and backward for general muscular and cardio conditioning.

Aim to strengthen the appropriate muscles in order to compensate for the loss of ligamentous support.

- For anterior cruciate ligament sprains and tears, focus on hamstring strength.
- For posterior cruciate ligament sprains and tears, focus on quadriceps strength.
- For medial collateral ligament sprains and tears, focus on medial chain strength, including the vastus medialis, gracilis, sartorius and medial hamstrings.

Precautions

- Some practitioners say that knee flexion should be limited to no more than a 90-degree angle. Any greater angle that can occur when doing deep squats or high kneelifts, may aggravate the patella. The 90-degree limit is very safe but in rehab it is not always functional. Personal trainers and group trainers should stay with 90-degrees while therapists go further as the client tolerates.
- Determine which movements cause pain and offer clients alternatives to them.
- Stair climbing, cycling, and step stairs can be beneficial or can compromise the knee. Water cycling is the safest exercise. Note with ACL reconstruction descending stairs puts a lot of stress on the ACL so when using stairs to get into the pool stepping sideways or leading with the involved leg with descent controlled by the non-surgical leg should be utilized early on after ACLR.
- Weight-bearing activities that require full flexion and extension can aggravate the knee.
- Any twisting moves with the feet planted should also be eliminated. The knee and foot should always be in the same longitudinal alignment, with the knee directly above the foot. This means that the knee and toes of the same foot should always be pointed in the same direction. This will eliminate torque, twisting, or compromising the knee joint.

- Knee braces can be worn in the pool for exercise if necessary. Some braces are very expensive and will be ruined if used in the water so the person should be aware. It is best to have two: a dry one used on land and one used exclusively in the pool.
- Minimize quick changes in direction for 6 to 8 months.
- Clients with knee problems should be in water as deep as possible to take advantage of the buoyancy.
- Change water depth for comfort to adjust impact and lower-body load. Progress walking from deep to shallow water depth (waist height or shallower) to optimize gait crossover training to land. Walking in water immersed to the xiphoid process reduces weight bearing between 71% and 80% compared with dry land. Clients with a need to decrease weight bearing at the lower extremity, secondary to pain or weakness, could benefit from working out in the water.
- When a client has significant ligamentous loss in the knee (not repaired) deeper water/ open chain is often uncomfortable because they do not have passive stability. They need the closed chain co-contraction for stability. Shallow water is recommended for those clients.
- For ACL clients, 6 to 10 weeks postsurgery is the weakest point in the reconstructed ACL ligament, and the most strain is measured from about 15 to 30 degrees ROM. Brindle et al. suggested that after wound healing, an aquatic environment may be ideal during all phases of ACL rehabilitation postsurgery, especially given the concerns about providing an ideal weight-bearing load. By varying the depth of the water and using flotation and resistive devices, patients can safely progress through knee ROM and neuromuscular recovery activities. The training program also can incorporate a sports-specific functional movement pattern (e.g., hopping and jumping). Therefore, the reduced weight-bearing environment of water also can provide a safe environment for your client's long-term training when aggressive ROM, strengthening, and sports-specific activities on dry-land activity are not recommended.
- Eliminate any ballistic exercises.
- Retrain movement patterns. By using water as a surrounding liquid resistance medium, overload to the muscles can be applied through normal patterns of play or by using functional activities of daily living that can lead to improvements in neuromuscular adaptations.

Equipment

- Shoes are suggested for slip resistance.
- Participants with knee pain should not exercise with equipment until muscular structure has strengthened sufficiently.

Resistant, buoyant and weighted equipment can be used to increase water's natural resistance for muscular overload. Equipment broadens the progression in the pool.

Adjustable resistive devices attached to the leg seem to be safe and effective for knee extension exercise by clients after ACL surgery. Biscarini and Cerulli found that underwater knee extension exercises performed with light resistance resulted in no ACL stress (with no shear joint forces) over the entire ROM.

The Water Helps

The properties of buoyancy and resistance provide a unique training environment that enhances comfort and promotes a balanced approach to improving range of motion (ROM) and cardiovascular, muscular, and functional conditioning.

Roi et al. (22) reported that a 35-year-old world-class soccer player who sustained a complete tear of his ACL during the competitive season was able to return to play within 90 days of surgery. Starting 8 days after surgery, he completed two rehabilitation sessions per day, 5 days per week, plus one session on Saturday. Sessions included a combination of aquatic therapy and land-based flexibility, strength, and field work. The water- and land-based progressive rehabilitation program allowed the patient to play for 20 minutes during a game and a full game 77 days after surgery. No follow-up treatment was needed after 3 months. This case report indicates that personalized progression of water- and land-based training is consistent with an optimal and early return to play.

Through understanding how the knees work and developing balanced strength, flexibility and correct alignment, you can keep your clients moving well for decades.

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