

9.1C Passive knee extension in prone (prone knee hang)

See Fig. 9.1C

Purpose

- Increase knee extension range of motion

Position

- Prone, thigh relaxed on table
- Lower leg suspended off edge of table
- Ensure that the patella is off the edge of the table or place a folded towel under distal thigh to avoid compressing the patella.
- Placing a pillow under the abdomen while a patient is in a prone position will help the patient maintain lumbar spine in a neutral position.

Action

- Passive knee extension using the weight of leg and gravity to provide the stretch

Advantages

- Allows low-load, long-duration stretch to improve mobility

Teaching tips

- Instruct the patient to crawl forward onto the table rather than bending the knee when finishing the stretch. Immediately

reversing the stretch does not allow the tissues to accommodate and will be very uncomfortable.

- The patient can place weighted objects in a purse or tote bag and hang it on his or her ankle over the edge of the bed to replicate the exercise at home. Bags of dried goods such as rice or beans are packaged by weight, often in 1-pound increments and can be added to the bag for increased challenge.

Specific parameters

- Prolonged hold can be started at 30 seconds and built up to 3 minutes, as tolerated.
- Short holds followed by releasing the position should be repeated to reach a total of 3–5 minutes.

Alternatives

- Supine passive extension stretch (Exercise 9.1A)
- Hold/relax in prone (Exercise 9.2)

Progression

- Add cuff weight to ankle to increase stretch.
- Increase duration.
- Progress to active extension exercises.



Fig. 9.1C

9.2 Hold/relax prone for knee extension

See Fig. 9.2.

Purpose

- Increase knee extension ROM

Position

- Prone, pillow under abdomen
- Thigh relaxed on table
- Towel roll under the distal quadriceps above the patella

Action

1. The therapist stabilizes the patient's thigh above the knee with one hand (Fig. 9.2A).
2. The patient is instructed to engage his or her hamstrings to flex the knee against submaximal resistance provided by the therapist on the distal tibia and hold for 8–10 seconds.
3. The patient relaxes while the therapist presses the knee into maximal extension and then holds the stretch for 20–30 seconds (Fig. 9.2B).

Teaching tip

- Instruction example:
 - “Try to bend your knee against my resistance and hold it. Completely relax, then let me try to straighten your knee again.”

Advantages

- Manual contact allows the therapist to detect muscle guarding and to modify the amount of force delivered for resisting the hamstrings or providing the stretch.

Specific parameters

- The emphasis is reaching the available range and increasing the stretch toward the maximum elastic end feel.
- As the range increases, and if no swelling is present, the amount of time held at full extension is slowly increased.
- Resistance can be adjusted to allow knee flexion (contract/relax) if the full extension range is painful.

Alternatives

- Active isometric knee extension in sitting (Exercise 9.1B)
- Prone knee hangs (Exercise 9.1C)
- Hamstring stretching (Exercise 9.9)

Progression

- Increase duration of stretch.
- Increase range.
- Increase amount of resistance or length of time of contraction.
- Active or active assistive knee extension in supine or sitting to access the newly available range and train neuromuscular activation patterns.

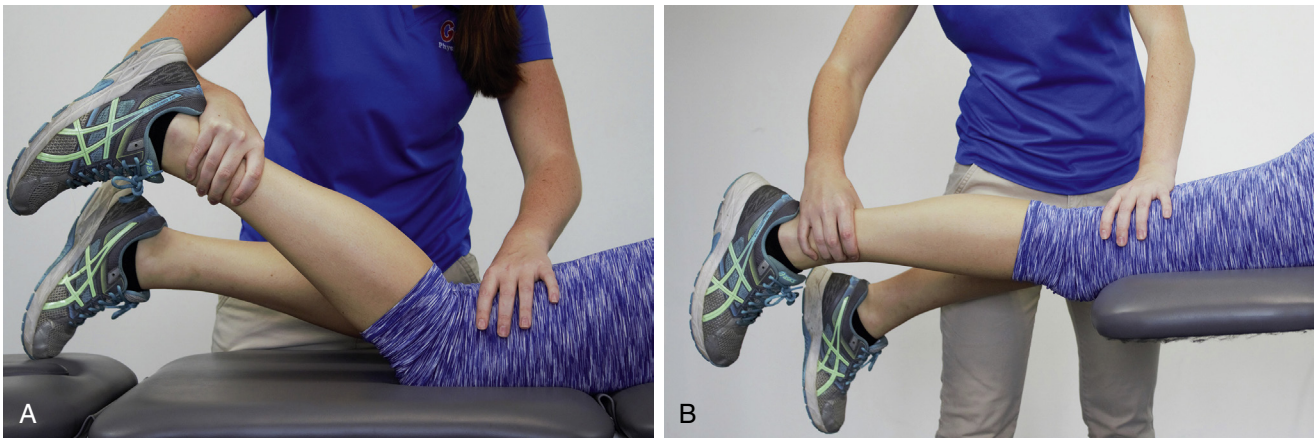


Fig. 9.2

9.3 Active supine heel slides with slider (extension and flexion mobility)

See Fig. 9.3.

Purpose

- Increase or maintain hip or knee range of motion with minimal stress on knee joint
- Decrease knee joint effusion by low-load repetitive range of motion creating a muscle pumping action
- Decrease pain
- Initiate proprioceptive input and stability/control of knee and hip. Isolation of the movement to sagittal plane will help the patient maintain proper lower extremity alignment during functional exercises.

Position

- Supine with head supported or long sitting, depending on patient comfort
- Hip and knee flexed (on both sides if possible)
- Pelvis level and neutral spine
- Ankle and foot are placed on a surface with limited friction (such as tile or hardwood floor) using a sock or material to assist sliding (Fig. 9.3A). A furniture slider (Fig. 9.3B) or a roller board (Fig. 9.3C) will decrease friction between the foot and supporting surface, or the exercise can be performed on a sliding board.

Action

1. Slide the heel toward the body to flex the hip and knee, keeping the heel in contact with the supporting surface.
2. After reaching end range of knee flexion, reverse the motion by sliding the heel away until the hip and knee are fully extended.

Teaching tips

- Common errors to correct:
 - Allowing the leg to move in and out of the sagittal plane (no abduction/adduction)
- Methods to address or prevent compensations:
 - Teach the patient to maintain the plane of movement in the sagittal plane using the hip internal and external rotators to prevent the knee drifting inward or outward. If the patient is having difficulty, using a strap or band is useful in the early stages of rehabilitation (Exercise 9.4A).

Advantages

- Low load and stress on joints and tissues
- Requires minimal muscle activation
- Decreasing friction reduces the amount of muscle activation needed while allowing the primary goal of mobility to be addressed.

Alternatives

- Use a strap around the ball of the foot to assist knee flexion or under the distal thigh to assist with hip flexion.
- Sit with the foot on the floor (tile or wooden floor) using a sock or sheet to assist the motion.

Progression

- Increase the range of motion as swelling and pain decrease.
- Hold the end range 8–10 seconds for increased stretch.
- Perform motion with heels on an exercise ball, which increases feedback to stabilize the leg in the sagittal plane and is more challenging to control (Exercise 9.4.B).
- Progress from an exercise ball to a smaller ball (e.g., basketball or inflatable ball), which offers less support.
- Perform active knee flexion in standing or prone.

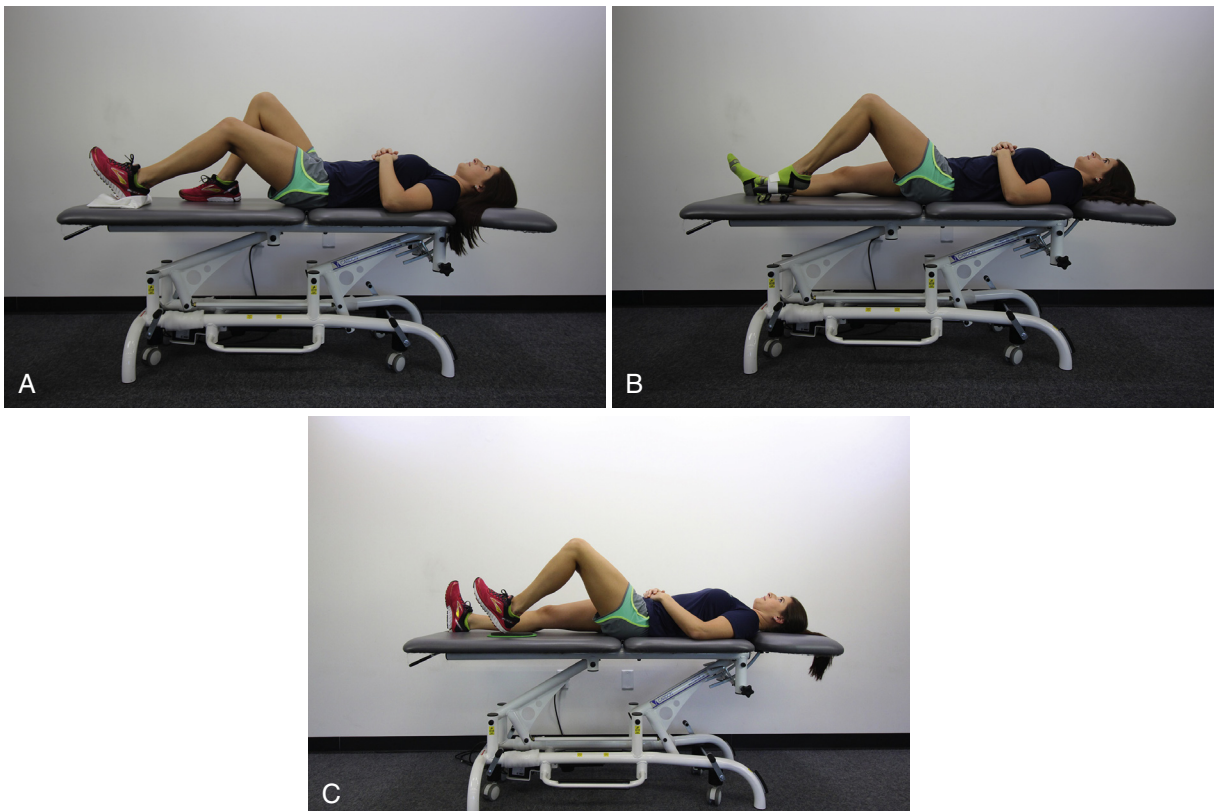


Fig. 9.3

9.4 Active-assisted knee extension or hip and knee flexion

9.4A Active-assisted knee extension using a strap

See Fig. 9.4.

Purpose

- Increase or maintain knee extension, knee flexion, or hip flexion range of motion
- Increase quadriceps activation through terminal extension
- Pumping action to assist with edema resolution

Position

- Supine or long-sitting on a treatment plinth, with towel roll, pillow, or bolster under knee (Fig. 9.4A)
- The patient's foot is placed in the strap while holding on to the other end (Fig. 9.4A).
- A dog leash, belt, sheet, or towel can be used as a substitute for a strap to continue this exercise at home.

Action

1. The patient activates the quadriceps to straighten the knee and lift the heel off table.
2. The patient uses the strap to assist lifting the foot until the knee is fully extended.
3. Slowly lower the foot while controlling the movement with an eccentric contraction of the quadriceps.

Advantages

- Assistance for knee extension prevents compensation of psoas major, iliacus, or gluteus maximus

Teaching tips

- Instruction example:
 - “Concentrate on the muscle contraction and watch as your quadriceps extend your knee.” (Seeing the muscle contract provides instant feedback and increases the visual input to strengthen the neuromuscular connection.)

Alternatives

- The therapist can assist the movement until the patient understands the purpose of the exercise.
- Electrical stimulation or biofeedback can be used at the same time to facilitate activation (see Exercise 9.39).
- Pulley-assisted knee extension in sitting: A strap is attached behind the patient's lower leg with the pulley assisting the extension movement. The patient first initiates flexion, then relaxes into extension (contract-relax) (Fig. 9.4B).

Progression

- Decrease rest periods between contractions.
- Increase repetitions.
- Reduce assistance.
- Increase the range by positioning the knee over a bolster, foam roller, or foam cushion.
- Progress to active small-range extension assisted through the movement and then slowly lower the leg, reducing the amount of support.
- Increase range of extension against gravity by having patient sit on edge of table or in a standard chair with the leg starting from the ground.

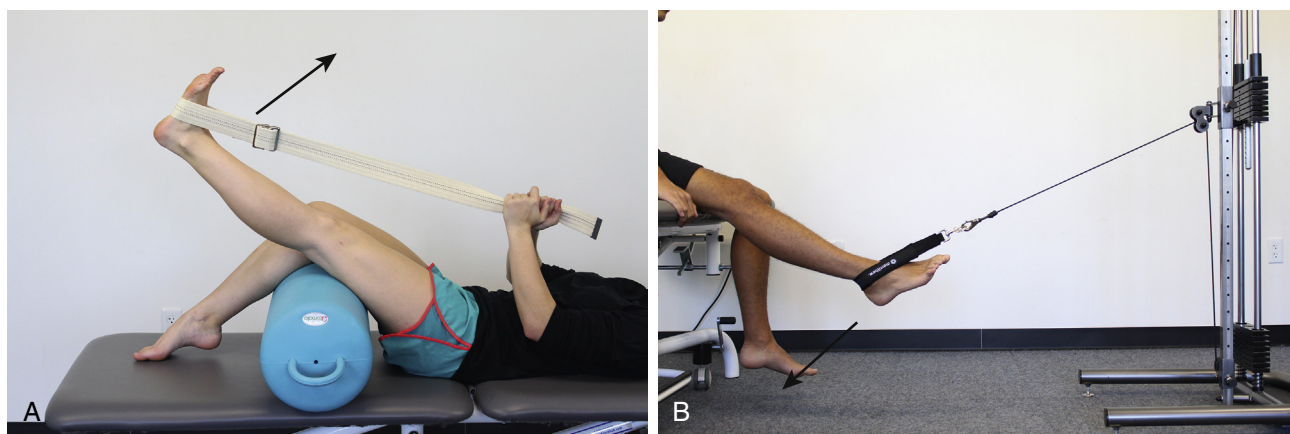


Fig. 9.4

9.4B Active hip and knee flexion on an exercise ball or knee flexion using a strap

See Fig. 9.4C–E.

Purpose

- Increase knee and hip flexion
- Challenge proprioceptive ability while performing sagittal plane motion

Position

- Active hip and knee flexion with the leg supported on an exercise ball
 - Supine, with lower half of lower leg resting on an exercise ball (55 or 65 cm depending on the patient's leg length) (Fig. 9.4C, D)
 - Neutral spine, level pelvis
 - Ankle in neutral position
- Using a strap for self-assisted hip flexion or knee flexion
 - Strap placed behind the back of the thigh to increase hip flexion (supine; Fig. 9.4E)
 - Strap placed around the ankle to increase knee flexion (in prone or standing) (Fig. 9.4F and G)

Action

- Active hip and knee flexion with the leg supported on an exercise ball
 1. Activate the hamstrings to roll the ball toward the hips (Fig. 9.4D; Video 1.8).
 2. Maintain a neutral position of ankle by co-contracting the ankle dorsiflexors and plantarflexors (isometric contraction).
 3. Control the position of the ball (in the sagittal plane) throughout the movement.
 4. Reverse the movement to extend the hip and the knee.
- Using a strap for self-assisted hip flexion or knee flexion
 1. Use upper extremities to pull the leg toward the body using the strap to assist with motion as needed (Fig. 9.4E–G).

Advantages

- Low load/stress on the knee and hip

- Visual and tactile input for flexion range
- The exercise ball decreases friction and supports the weight of the leg.
- The strap can be used to assist mobility for a full passive stretch.

Teaching tips

- Instruction example:
 - “Keep the ball moving in a straight line without crossing an imaginary line between your legs.”
- Common errors to correct:
 - Losing the sagittal alignment or creating excess rotation or valgus stress once the end range is reached
- Methods to address or prevent compensations:
 - Ask the patient to maintain the ball moving in line with the hip (sagittal plane) to challenge proprioception and maintain lower extremity alignment.
 - Placing the heel on the ball and pushing down gently encourages active knee flexion using the hamstrings and the gastrocnemius.

Alternatives

- Heel slides with the feet on wall, or rolling a ball on the wall, encourages flexion with gravity assistance.
- The size of the ball can be selected to encourage hip flexion (larger ball with the lower leg supported) or to encourage controlled knee extension (smaller ball).
- A fully inflated ball will provide more support for the weight of the leg.
- Small motion toward full flexion range can be used to increase knee flexion.
- Prone or standing with the strap placed around the ankle to increase knee flexion (Fig. 9.4G)

Progression

- Increase range by adjusting the starting position of the ball with respect to the body: move the ball closer to the body to increase hip and knee flexion or further away to increase extension.

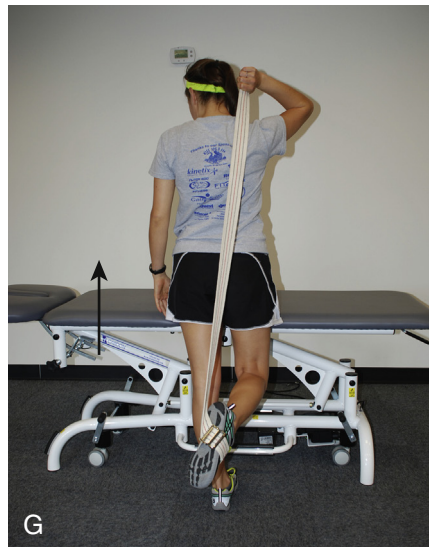
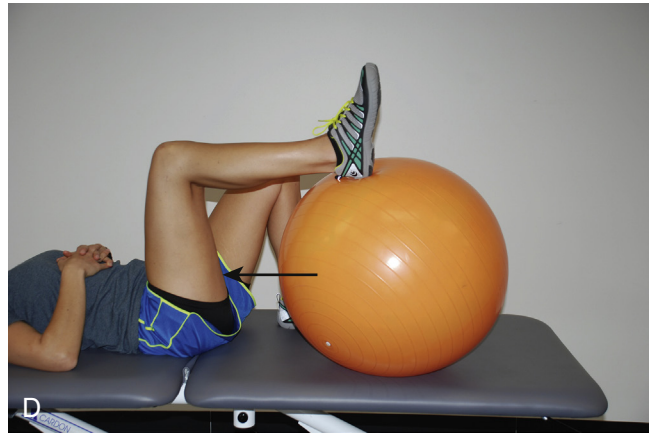


Fig. 9.4, Cont'd

9.5 Active hip internal and external rotation on a swivel stool

See Fig. 9.5.

Purpose

- Restore or maintain hip rotation range of motion

Position

- Standing, with the knee of the involved leg flexed to 90 degrees and positioned in the center of a swivel stool (Fig. 9.5A)
- The hip is in a neutral flexion/extension.
- Involved leg (femur) is lined up with the central axis of the stool.
- If the patient has knee pain, the patella can be positioned over the edge of the stool.

Action

1. Activate the trunk stabilizers to keep the pelvis level and avoid placing excessive vertical forces through the leg on the stool. (Do not let the patient rest too much body weight through the stool.)
2. Activate the hip rotators to spin the stool clockwise or counterclockwise while keeping the trunk still (Fig. 9.5B, C).

Advantages

- Low weight-bearing load on the hip while performing isolated rotation
- Rotation mobility is restored in neutral, functional position of hip.

Teaching tips

- Instruction example:
 - “Keep your pelvis facing forward while turning your leg inward and outward.”
- Common errors to correct:
 - Watch for generalized trunk motion rather than hip rotation or pelvic rotation rather than hip rotation
 - Watch for Trendelenburg position
- Methods to address or prevent compensations:
 - The height of the stool should be adjusted to keep the pelvis level, with limited body weight supported on the knee.
 - The supporting leg can be flexed to keep the pelvis level.

Alternatives

- Supine, legs extended, active internal and external rotation of the hip
- Gravity-assisted rotation in prone with the knee flexed to 90 degrees

Progression

- Increase range.
- Increase repetitions.
- Increase hold at the end range.
- Clam shells to increase activation, endurance, or strength through external rotation range against gravity (Exercise 9.26A)

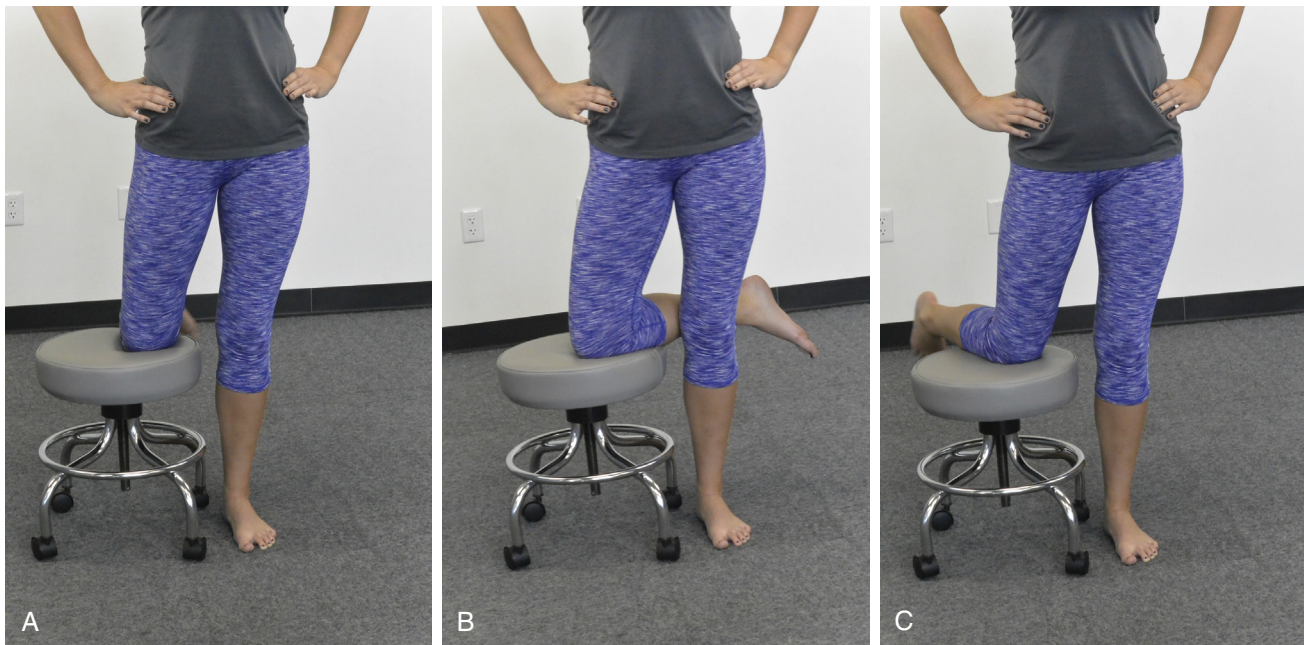


Fig. 9.5

9.6 Active hip abduction in supine on a sliding board

See Fig. 9.6.

Purpose

- Restore or maintain hip abduction in a gravity-eliminated position

Position

- Supine, lower leg and/or foot on sliding board or heel on friction-minimizing fabric/surface or foot resting on a sheet to reduce friction
- Knee extended

Action

- Activate hip abductors to slide the leg into abduction on the board without moving the trunk.

Advantages

- Low load on hip and gravity eliminated
- Abduction mobility in a neutral position of the hip (required for stance) without balance requirements or high levels of muscle activation

Teaching tips

- Common errors to correct:
 - Watch for generalized trunk motion rather than hip abduction.

- Methods to address or prevent compensations:
 - The patient can flex the uninvolved leg and place some pressure through the foot to help stabilize the pelvis.
 - The patient can place his or her hands on the pelvis to help monitor for motion.

Alternatives

- Placing the foot on a roller skate provides the same assistance.
- Buoyancy-assisted movement (with a float on the lower leg or without if standing) if there are no contraindications for aquatic therapy.

Progression

- Increase range.
- Increase repetitions.
- Increase hold at the end range.
- Reduce assistance by removing sliding board or friction-minimizing surface.
- Gravity-resisted abduction in standing holding onto the plinth or a table requires good standing balance, and the patient should be closely monitored for trunk compensations.
- Progress to standing or side-lying abduction to improve muscle activation, endurance, and strength (Exercise 9.26B).



Fig. 9.6

GENERALIZED AEROBIC MOBILITY

9.7 Stationary bike: mobility focus

See Fig. 9.7A–C.

Purpose

- Increase range of motion
- Warm-up before mobility exercise or manual techniques
- General endurance

Precautions

- Use care with range of motion if there are hip flexion precautions after hip surgery (total hip replacement) or with hip labral tears.

Position

- Seated on bike
- Adjust seat height so the knee is slightly flexed (~10 degrees) when the foot is at the lowest point of the pedal cycle and ensure patient can move pedal throughout the entire cycle range.
- Toe straps may be used to promote ankle motion.

Action

1. Controlled forward and backward pedal motion to end-range/restriction through a half or quarter revolution
2. Emphasis can be changed to hip, knee, or ankle motion by changing the seat height or by cueing.

Advantages

- The bike can be used for long-duration, repetitive movement.
- The de-loaded position is useful for individuals with osteoarthritis, or meniscus or other cartilage damage.

- The consistent movement is useful for reducing effusion and for warm-up.
- The exercise can be adjusted for various range of motion deficits.
- The exercise can also be used for muscle endurance or generalized endurance if needed.
- Weight-bearing movement compensations are not as prevalent.

Teaching tips

- Common errors to correct:
 - Avoid hiking the hip as the knee flexes at the top of the pedal cycle or laterally flexing away from the hypomobile side.
 - Avoid letting the hips rotate instead of the knee and hip flexion; keep the legs in the sagittal plane.

Alternatives

- Recumbent bike
- Seated pedal
- Elliptical (Exercise 11.41)
- Airdyne bike (Exercise 10.29)

Progression

- Full revolutions
- Increase seat height to target hip and knee extension.
- Decrease seat height to target hip and knee flexion.
- Change foot position on the pedal to target plantar flexion (toes on pedal) or dorsiflexion (heel on pedal).
- Increase duration.
- Increase resistance.



Fig. 9.7