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TOTAL KNEE ARTHROPLASTY

Physical Therapy, Strength and Conditioning

PHASE I: MAXIMUM PROTECTION (WEEKS 0 TO 2)

Weeks 0-1

- Weight bearing as tolerated with crutches/walker. Wean from crutches as tolerated (Average of 6 weeks)

Goals
- Reduce inflammation
- Normalize patella mobility with manual mobilizations
- Full extension both passive and active
- Good quadriceps activation
- No extension lag

Exercise Progression
- Gait training
- Increase weight bearing
- Extension—heel props for full extension as needed
- Flexion—off table or wall slides
- Quadriceps setting using NMES as needed
- Multi-plane straight leg raises
- Bilateral calf raises

Cardiovascular Exercise
- Stationary biking

Recommended Loading
- Short but frequent bouts of ROM and quadriceps activation 3+x/day

Weeks 1-2

Goals
- Reduce inflammation
- Increase extension/hyperextension
- No extension lag
- Increase ROM as tolerated

Exercise Progression
- Continue with 0-1 week program
- Extension—continue with heel props or add prone hangs (as needed)
- Flexion—wall or heel slides
- Ball bridge and/or isometric hamstring activation

Cardiovascular Exercise

- Stationary biking
- Short walks using crutches/walker as needed

Recommended Loading
- Short but frequent bouts of ROM and quadriceps activation 3x/day

Phase I Clinical Pearls:

1. *Control inflammation with frequent icing and elevation. It is important for the patient to avoid extensive periods with their leg in a dependent position, especially during the first week. Limit time at work and school during the first three days following surgery.*
2. *Short frequent bouts of ROM and activation exercises is key during phase 1. Avoid over-prescribing exercise sessions where a patient is trying to perform three, one hour sessions/day. Three 20 minute sessions is more appropriate during phase 1. Focusing on quality will limit inflammation and improve results.*
3. *Retrograde effleurage with leg elevation is beneficial for edema reduction and corresponding increases in ROM and quad control.*
4. *Obtaining full extension early is essential for a successful outcome.*
5. *Patients may have difficulty generating an adequate VMO contraction secondary to both disuse atrophy and reflex inhibition related to swelling. Use NMES as needed.*
6. *Perform PROM exercises 3x/day to maximize ROM return. Instruct patient on the importance of restoring ROM before concentrating on strength.*
7. *Begin soft tissue mobilization to the hamstrings and gastrocnemius to reduce muscle tightness, myofascial restriction, and trigger points, which will subsequently improve knee extension. Integrate soft tissue mobilization and myofascial release of the quadriceps, IT band, and adductor groups as appropriate.*
8. *Restoring normal patellofemoral (PF) arthrokinematics is essential for restoration of normal PF tracking and ultimately a successful outcome. Manual mobilization of the patella with medial/lateral/superior/inferior glides, medial/lateral tilts. These mobilizations can be performed with the knee In full extension (loose-packed position for the patellofemoral joint) and slight knee flexion (approximately 30°).*
9. *Educate the patient on the importance of core control using level 1 core exercises. Reinforce that the patient is using and integrating "neutral spine" mechanics throughout the phase 1 program.*

PHASE II: PROGRESSIVE STRETCHING AND EARLY STRENGTHENING (WEEKS 2 TO 6)

Weeks 2-6

Goals
- Progress off crutches/walker (average is 6 weeks)
- Full knee extension/hyperextension
- Knee flexion to progress to full as tolerated
- Normalize gait mechanics
- Normalize patellofemoral joint and scar mobility

Exercise Progression

- Extension—heel props and prone hangs as needed
- Flexion—continue with end range heel slides
- Bilateral squat progression—focus on proper alignment
- Multi-plane open and closed kinetic chain hip strengthening
- Step-up progression—focus on proper alignment
- Hamstring activation with bridge on floor, ball or box
- Progress to unilateral heel raise off the floor then off a step
- Proprioception drills

Cardiovascular Exercise
- Stationary biking
- Treadmill/outdoor walking with focus on proper gait mechanics

Recommended Loading
- ROM: 2-3x/day
- Strength: 1x/day open chain; 3x/week closed chain
- Cardiovascular: 20 minutes/day with low intensity

Weeks 4 to 6

Goals
- Reduce inflammation
- Normal gait
- >90 degrees of knee flexion, progress as tolerated

Exercise Progression
- Controlled movement series—warm-up
- Leg press, hamstrings curls
- Single leg RDL's

Cardiovascular Exercise
- Increase intensity/duration
- Stationary biking
- Treadmill/outdoor walking with focus on proper gait mechanics
- Arc trainer or elliptical

Recommended Loading
- ROM: 2x/day
- Strength: 3x/week on closed chain loading
- Cardiovascular: 20-30 minutes/day with low to moderate intensity

Phase II Clinical Pearls:

1. *Continue with soft tissue mobilization and myofascial release to the quadriceps, hamstrings, gastrocnemius, IT band, and adductors prior to beginning ROM.*
2. *Perform patellar mobilizations and soft tissue work to the anterior interval in 0 and 30° flexion prior to beginning therapeutic exercises. Patient may begin self-maintenance of soft tissue using a foam roller or massage stick.*
3. *Scar tissue mobilizations to reduce adhesions.*
4. *Continue to normalize gait mechanics and patellofemoral tracking. Stretching the quadriceps, hamstrings and calf between closed chain sets is an excellent way to free the PF joint to allow pain-free loading.*
5. *Develop strength and muscular endurance through low intensity cardiovascular exercise on*

the bike, elliptical, walking (outside or treadmill) or deep water pool program. Aim for 20-30 minutes, 5x/week.

6. *Ongoing emphasis on core integration, neutral spine and good alignment with all phase 2 exercises. Use the base core program to normalize global compensatory patterns to prepare for more complex movement patterns and loading encountered during phase 3.*
7. *Walking briskly outside is preferable to treadmill due to different ground reaction forces with heel contact and push off. Use intermittent elevation to create more push off if using a treadmill.*
8. *Unilateral closed kinetic chain exercises are useful for encouraging co-contraction of muscles with reduced shear forces at the knee joint and should be progressed in a safe and logical manner. Instruct the patient to maintain good alignment of the knees relative to the hips and feet, avoiding valgus collapse. Exercises should start with partial progressing to full-range and concentric progressing to eccentric loading based on the patient's ability to control hip, knee and foot alignment.*
9. *As the patient begins a more strenuous strengthening program at the 4-6 week mark it is important to factor in additional recovery. 3x/week with closed chain work is appropriate with at least 24 hours rest between loading sessions. Varying exercises to provide differing loading patterns will continue to challenge the patient. Sample week:*

3x12-15 of each of the following exercises 3 x/week:

- *Leg press or squats (choose 1)*
- *12" step-ups or unilateral leg press*
- *Hamstring curl machine, glut-ham or RDL's*
- *Calf raises bilateral off a step or on machine*
- *Using this format allows you to select a bilateral and unilateral closed chain exercise as well as one exercise of the hamstrings and calf while avoiding too much volume in one exercise session.*

10. *Cardiovascular work should also alternate between hard and easy days (i.e. Monday—25 minute brisk walk, Tuesday—30 stationary bike with light resistance, Wednesday—24 minutes elliptical etc.)*

PHASE III: ADVANCED STRENGTHENING AND ENDURANCE TRAINING (WEEKS 6 TO 8)

Goals
- Control inflammation with increasing loads
- Full knee flexion and extension with terminal stretch
- Progressive strengthening
- Increase muscular endurance

Movement Prep
- Foam roller
- Controlled movement series

Exercise Progression
- Weighted squat progression
- Single leg squat/lunge progression (dips, retro, walk and split), focus on eccentric control and alignment.
- Monster walks

Core Program
- Front plank—full, may advance to alternating leg lift
- Bridge—marching or single leg
- Side plank—full
- Dead bug progression
- Quadruped alternating arm-leg

Cardiovascular Exercise
- Stationary biking
- Treadmill/outdoor walking with focus on proper gait mechanics
- Arc trainer or elliptical

Sports Specific Activity Progression
- Outdoor biking—week 6
- Shallow water pool running—week 6
- Swimming freestyle—week 6

Recommended Loading
- ROM: 1-2x/day
- Strength: 3x/week on closed chain loading
- Cardiovascular: 20-45 minutes 5x/week with moderate intensity and intervals.

Phase II Clinical Pearls:

1. *Manual work in this phase will begin to decline relative to treatment time spent performing therapeutic exercises for specific stretching, advanced strengthening, and higher-level functional task training. Keep in mind it is important to maintain proper PF tracking by using patella mobilization as needed.*
2. *Emphasize the importance of proper alignment with all bilateral and unilateral impact and non-impact closed chain loading. In the sagittal plane, the hip, knee and foot should maintain a straight alignment without the knee falling into a valgus position. With proper frontal plane alignment, the knees do not cross beyond the end of the toes, the hips drop posterior while the torso inclines forward, this allows the patient/athlete to maintain their center of gravity while dampening vertical load with take-off and landing.*
3. *Proper dynamic warm-up, muscle activation series and self-directed soft tissue mobilization using a foam roller are important preparatory exercise prior to weight room and cardiovascular activity. Patients commonly develop PF pain when they reduce their intrinsic hip stability and soft tissue mobility exercises in the later stages of their rehab program.*
4. *Educate patients on proper frequency and intensity for performance of their HEP; LE strengthening should be performed a maximum of 3x/week to allow for adequate muscle recovery between sessions. Higher intensity/interval cardiovascular days should be followed by lighter recovery work. Follow the LE workout design outlined in phase 2 with increasing resistance. Error on the side of caution when prescribing both load and recovery!*
5. *Building muscular endurance is critical during phase 3. Interval training offers a higher intensity non-impact loading that will build muscular strength, endurance and girth without overstressing articular cartilage and remodeling connective tissue.*
6. *Increase eccentric load with all closed chain work. Retrograde elevated treadmill walking at 10-12% elevation is an excellent way to add quality eccentric work. A typical program will consist of 4 sets, 20 minutes total; 3 minutes forward at 10-15% @ 3.0-4.0 MPH and 2 minutes backward 10-12% @ 2.8-3.5 MPH, 2x/week. Reverse sled pulls and stadium stair walks may be used as an alternate exercise selection.*

7. *Ideal take-off and landing mechanics include hip flexion, knee flexion and ankle dorsiflexion; teaching "foot flat" mechanics optimally transfers proper squatting alignment into ballistic impact activity offering the safest transition to impact loading.*