

Managing Post-Operative Knee Stiffness

IMMEDIATE PRACTICAL MANAGEMENT STRATEGIES

- **ACKNOWLEDGE & ADDRESS COMMON POST-OPERATIVE REACTIONS**
 - Effectively resolve **pain & swelling**
 - Emphasize the fact that this must be the “first domino to fall” to assure success with all other post-operative recovery goals (ROM, quad reactivation, normal gait pattern, etc.)
 - Cryotherapy, elevation, compression
 - Activity modification, periods of rest with limb elevation (take it easy in the 1st week)
 - Address **joint mobility impairments**
 - Patellofemoral (PF) compartment and extensor mechanism mobility
 - Perform passive patellar mobilizations (all directions per precautions), with emphasis on proximal/superior glides to prevent infrapatellar scarring
 - Perform mobilizations (per location of incisions) to the other areas of mobile tissue around the PF compartment (quad tendon, suprapatellar pouch, patellar tendon, infrapatellar fat pad)
 - Guarding/stiffening
 - See below under “manage muscular co-contraction”
 - Address hamstring (HS) tone, irritability (often related to HS graft harvest)
 - Swelling
 - In addition to techniques noted above, perform manual techniques, apply compression garments, kinesiotaping for extra-articular limb edema
 - Soft tissue and/or nerve irritability
 - Gentle soft tissue techniques to address the mobile tissues about the knee that were impacted by the surgery with goals of clearing swelling and improving tissue mobility and comfort
 - Graft harvest sites and the associated muscle bellies, drilling/fixation sites, areas of focal swelling, tendon mobility
 - Nerve gliding to reduce irritability in positions of end range joint motion
 - Maximize healthy **muscular activation** about the knee joint
 - Establish an effective quadriceps muscle contraction
 - This creates proximal gliding of the patella which mobilizes the entire extensor mechanism to address potential stiffness at the suprapatellar pouch,

infrapatellar region (anterior interval), and mobilizes the tendon and the patellofemoral (PF) compartment

- Manage inhibition at agonist muscle groups (quadriceps for knee extension, hamstrings for knee flexion)
 - Early neuromuscular electrical stimulation (NMES) to overcome central activation deficit, inhibition related to surgical trauma
- Manage muscular co-contraction (with attempted quad activation) and antagonist muscle tone impacting joint motion (i.e. hamstrings and/or gastrocnemius “splinting” with attempted quadriceps activation, holding the knee stiff in stance and with gait)
 - Consider emphasizing passive and/or active hinging movements to create a more specific “task” for the joint or a target muscle through an arc of movement (per precautions) to avoid knee stiffening with co-contraction.
 - Employ therapeutic ROM to nourish the knee (easy hinging at the knee through comfortable arc of motion with the limb supported)
 - Stretching or relaxation techniques for antagonist muscle groups
 - Address “stiff knee habits” with sitting, standing, and gait (holding knee in mid-range flexion while sitting, slight flexion and off-loaded while standing, stiff knee throughout the gait cycle)
- Manage **fear and anxiety** about the procedure and post-op symptoms
 - Appropriate amount and degree of education (enough to establish calm, not so much to induce fear and anxiety)
 - Patient-initiated ROM activities (not therapist-initiated) with the limb supported in a fashion that makes the limb visible to the patient and easy to move
 - Honor symptoms and allow the patient to gradually explore greater ROM, per their confidence and comfort, once initial joint reaction and guarding reduces
 - Consider supportive modalities such as pool therapy to allow more supported environment to create mobility with less protective guarding
- **PT CLINIC VISIT FREQUENCY**
 - Visit frequency should remain high (3 visits per week) in the first 2 to 6 weeks after surgery until consistent success is achieved with the elements listed above.
 - Reduce visit frequency when shifting emphasis to strength building and work capacity, but assure the patient continues with effective self-management to continue to manage knee irritability, facilitate quad activation, and recover final degrees of ROM
 - Higher visit frequency (5 visits per week) may be indicated in patients undergoing a secondary procedure to address arthrofibrosis (Lysis of adhesions (LOA), manipulation under anesthesia (MUA), posterior capsule release), following more complex surgery that creates a higher level of post-operative disability, and in patients who require assistance for performing ROM activities and do not have consistent support at home (i.e. prone ROM following PCL-R).

RELEVANT BASIC SCIENCE CONSIDERATIONS**• RELEVANT KNEE JOINT ANATOMY FOR ADDRESSING POST-OPERATIVE STIFFNESS**

- The extensor mechanism (quadriceps muscle, quadriceps tendon, patella, patellar tendon)
 - At baseline, this is a very mobile system at the anterior knee
 - Quad tendon-Patella-Patellar tendon complex behaves like the rope gliding freely over a pulley (the trochlea) to maximize quadriceps muscle force production as the knee moves through various angles of knee flexion
 - Patella should freely glide inferior<>superior, to a lesser extent medial<>lateral
 - Inferior glide with flexion, superior glide with knee extension
 - Patellar and quadriceps tendon are common graft harvest sites for ligament reconstruction
- Mobile soft tissue structures
 - Infrapatellar fat pad (deep to the patellar tendon and inferior patellar pole)
 - Impacted with arthroscopic portal access to the knee joint
 - Often becomes inflamed and swollen post-operatively (contributes to pain and inhibition with quad activation that tensions the patellar tendon, compressing the fat pad)
 - The patellar tendon and patella should move freely and separately over the fat pad
 - Suprapatellar pouch
 - Typically in a “deflated” state, proximal to the superior patellar border, deep to the quadriceps tendon
 - Often becomes distended with fluid after surgery (contributes to pain and inhibition with quad activation that tensions the tendon over the pouch, compressing it)
 - The quadriceps tendon should move freely and separately over the pouch
 - Pes Anserine Tendons (Semitendinosus, Gracilis, Sartorius)
 - Wraps around the medial aspect of the proximal tibia with a small bursa deep to the tendons
 - Semitendinosus is a common graft harvest tissue (may contribute to pain with active knee flexion engaging the hamstrings)

- **RELEVANT KNEE JOINT BIOMECHANICS FOR ADDRESSING POST-OPERATIVE STIFFNESS**
 - Knee flexion
 - Patella glides inferiorly (slightly medial)
 - Tibia glides posterior on the femur, slight tibial IR
 - Knee flexion is dynamically created by hamstring muscle contraction which creates a pulling force through the posterior knee capsule (posterior meniscus translation) and the tendon attachments on the tibia (pes anserine) and fibular head (long head biceps femoris). During open chain knee flexion, the pulling of the hamstrings gains a mechanical advantage at the tibia once the knee moves beyond 30° of knee flexion, resulting in posterior tibial translation (PTT). The patella is pulled inferiorly into the trochlear groove by the patellar tendon as the knee flexes. It engages in the trochlear groove and translates slightly medial once the knee moves beyond approximately 20° flexion, becoming more stable within the groove with increasing compression between the patella and trochlea.
 - Knee extension
 - Patella glides superiorly in the trochlea (slightly lateral in last 30 degrees)
 - Tibia glides anteriorly on the femur, slight ER into screw home in terminal extension
 - Knee extension is dynamically created by quadriceps muscle contraction which creates a pulling force through the patella tendon's attachment at the tibial tubercle. During open chain knee extension, the pulling of the quadriceps (based on the line of pull of the patellar tendon) creates a slight posteriorly directed pull resulting in posterior tibial translation in deeper angles of knee flexion (>70°) and then transitions into an anterior directed pull with associated anterior tibial translation (ATT) as the knee passes mid-range and enters the last 45° of knee extension. There is negligible anterior or posterior translation at mid-range, around 60° knee flexion. The patella is pulled proximally by the quadriceps tendon during active extension and glides slightly lateral as it exits the confines of the trochlea in the last 20 to 30° of knee extension. The patella then relies more on tension from the medial soft tissue restraints against excessive lateral translation (MPFL, MPTFL, MQTFL) as it emerges out of the trochlear groove.

SURGICAL DETAILS AND POST-OPERATIVE PRECAUTIONS

- **SURGICAL DETAILS** (impacting bone and soft tissue around the knee)
 - Graft harvest locations (patellar tendon, quadriceps tendon, semitendinosus, ITB)
 - Corresponding muscle bellies of harvested tendons
 - Local edema and early healing response at the harvest site
 - Disruption or irritation of structures impacted with gaining surgical exposure to a certain region of the joint
 - Retraction of tissue
 - Take down (and secondary fixation) of tissue

- Regions of hardware or suture fixation (and the adjacent soft tissue)
- **PRECAUTION CONSIDERATIONS:** Be aware of precautions, creatively work within them, but avoid applying more restrictions than the maximum required.
 - Common precautions and their rationale:
 - **Knee hyperextension** can place stress on the structures that normally resist this movement and is therefore avoided or limited following some procedures.
 - Hyperextension (HE) stretching is prohibited s/p DB PCL-R, PLC-R for a minimum of 8 weeks
 - HE is avoided s/p FCL-R in the first 2 weeks then limited to less than or equal to the contralateral knee after that point (commonly there is a hyperextension injury mechanism in patients who undergo FCL reconstruction)
 - Full extension to 0° should always be the goal, even when a HE limit is applied
 - Progression into **deeper knee flexion ROM** can place tension on structures within the knee. Flexion is often limited in the first 2 weeks (typically 0-90°) to protect tissue(s) during early healing phases (inflammatory and proliferation phases).
 - Ligament reconstructions (not ACL)
 - Meniscus repairs (especially root or radial repairs)
 - Quad or patellar tendon repairs (often require greater flexion angle limit)
 - OATS (if large capsulotomy required)
 - Tibial tubercle osteotomy (TTO)
 - **Modified body positions** with ROM and exercise are intended to limit passive positional stress to healing structures.
 - Prone position with PROM following DB PCL-R to limit posterior tibial translation (PTT) related to body position/weight of the lower leg hanging at the knee
 - **Passive range of motion (PROM)** helps to mitigate normal biomechanics (joint translation) of the knee joint associated with muscular pulling that may impact early healing of repaired/reconstructed structures.
 - Hamstring pulling into knee flexion creates tension at the tendon insertion site, induces posterior tibial translation (PTT) once beyond 30° knee flexion, and induces posterior translation of the meniscus which merits caution and a period of PROM flexion following:
 - Biceps femoris repair
 - DB PCL-R, FCL-R (early phases)
 - Meniscus root repair, meniscus radial repair
 - Quadriceps activation creates pulling through the extensor mechanism which creates tension at the tibial tubercle and induces anterior tibial translation, most

notably in the last 45° of knee extension. This merits caution and a period of PROM extension following:

- Quadriceps or patellar tendon repair/reconstruction
- Tibial tubercle osteotomy
- Scar/adhesion considerations
 - Clinician awareness of the body's scarring tendencies after surgery is crucial, especially in the context of revision surgery or secondary surgeries intended to address ROM deficits and/or arthrofibrosis (LOA, MUA, posterior capsule release)
 - Educate the patient on the normal healing phases/timelines and on post-operative scarring. Scarring is part of the normal healing process, but the goal is to minimize the formation of highly thickened or excessive scar that interferes with motion. This is most critical in the first 6 weeks following surgery.
 - Begin to address mobility immediately after surgery, but honor the first 48-72 hours when the patient is within the inflammatory phase of healing.
 - Provoking excessive joint irritability in this phase can stimulate the body to create more scar.
 - Guide healing with targeted ROM activities and OKC strengthening activities that facilitate ROM during the proliferative phase of healing (days 2 to 14 post-surgery) to minimize excessive scarring and maximize joint mobility.

WHEN IN DOUBT, COMMUNICATE!

- Don't wait until knee stiffness has persisted for several weeks to reach out for collaborative support from the surgeon and his/her associated physical therapy team. Time is of the essence and a delayed or inadequate response to knee stiffness only allows the problem to persist longer and to a greater extent, interfering with your ability to progress other elements of the care plan.
- Stiffness happens – work together with trusted colleagues to problem solve on behalf of the patient.