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ACL Reconstruction with Cartilage Resurfacing Protocol:

The patient underwent Carticel / Denovo Implantation of the **Femoral Condyle**. Their rehabilitation program will be individualized but general guidelines follow. It is important to note that patients will progress in rehab at a different pace which is dependent on lesion size, location, tissue quality, age, and concomitant procedures performed. At all times the patient should be monitored for new or increased joint line pain, effusion and symptomatic complaints. The primary goal of the rehab program is to continue to avoid deleterious forces to the graft site, including excessive compression and shear forces during exercise progression.

Phase I - Protection Phase (0-6wks): The patient will be wearing a brace at all times including nighttime and the brace will be locked at zero degrees for weight-bearing activities. For the first 1 to 2 wks the patient will be NWB, TDWB will begin between wks 2 and 3 with PWB (1/4% body wt) beginning at wks 4 and 5. Range of motion exercises should be performed 6 to 8 hours per day postoperatively with full passive knee extension allowed immediately. A CPM will be initiated beginning on day one for a total of 8 to 12 hours per day with motion from 0-40 degrees for the first 2-3 wks. CPM range of motion should be increased daily by 5-10 degrees. The CPM will be utilized for 6 weeks. Patellar mobilization should be performed 4-6 times per day. Knee flexion range of motion goal is 90 degrees by two weeks, 105 degrees by 4 weeks and 120 degrees by 6 weeks. A strengthening program will also be initiated during this timeframe.

Phase 2 - Transition Phase (6-12wks): The brace will be discontinued by week 6 and a custom unloader brace will be prescribed. FWB should be attained by 9 weeks. Progressive knee flexion to 135 degrees should be attained. Strengthening should continue per the protocol.

Phase 3 - Maturation Phase (12-26wks): The goals during this phase are to improve muscular strength and endurance and increase functional activities.

Phase 4 - Functional Activities Phase (26-52wks): Gradual return to full unrestricted functional activities.

The patient underwent Carticel / Denovo Implantation of the **Trochlea**. Their rehabilitation program will be individualized but general guidelines follow. It is important to note that patients will progress in rehab at a different pes which is dependent on lesion size, location, tissue quality, age, and concomitant procedures performed. At all times the patient should be monitored for new or increased joint line pain,

effusion and symptomatic complaints. The primary goal of the rehab program is to continue to avoid deleterious forces to the graft site, including excessive compression and shear forces during exercise progression.

Phase I - Protection Phase (0-6wks): The patient will be wearing a brace at all times including nighttime and the brace will be locked at zero degrees for weight-bearing activities and nighttime. Immediate PWB (25% body wt) will be allowed so long as the brace is locked, and the knee is in full extension. At the two-week juncture 50% WB will be allowed with a brace in place and locked in full extension followed by 75% WB at 4 weeks with the brace locked and in full extension. Range of motion exercises should be performed 6 to 8 hours per day postoperatively with full passive knee extension allowed immediately. A CPM will be initiated beginning on day one for a total of 8 to 12 hours per day with motion from 0-40 degrees for the first 2-3 wks. CPM range of motion should be increased daily by 5-10 degrees. The CPM will be utilized for 6 weeks. Patellar mobilization should be performed 4-6 times per day. Knee flexion range of motion goal is 90 degrees by two weeks, 105 degrees by 4 weeks and 120 degrees by 6 weeks. A strengthening program will also be initiated during this timeframe.

Phase 2 - Transition Phase (6-12wks): The brace will be discontinued by week 6. FWB should be attained by 9 wks. Progressive knee flexion to 125 degrees should be attained by wk 8. Strengthening should continue per the protocol.

Phase 3 - Remodeling Phase (13-32wks): The goals during this phase are to improve muscular strength and endurance and increase functional activities and obtain 135 degrees of flexion.

Phase 4 - Maturation Phase (8-15months): Gradual return to full unrestricted functional activities

ACL reconstruction protocol (hamstring autograft) with cartilage resurfacing of Trochlear and Meniscus repair: The patient underwent ACL reconstruction with an autograft hamstring in addition to a cartilage resurfacing of the medial / lateral trochlea as well as a medial / lateral meniscal repair all inside / hybrid technique. The chondral lesion articulates with the patella at 20° of knee flexion. A postop hinged knee brace set from 0 to 90° has been placed on the patient. A CPM device was initiated in the recovery room with the ROM set from 0-20° for the first 48 hours after which a gradual incremental increase in degrees of flexion up to 60 is allowed. Until the 1st PO visit WB should be 50% with the brace locked at 0 degrees. After the 1st PO visit FWB will be allowed while wearing a postop hinged knee brace locked at 0° of extension for the next 4 weeks. The brace may be removed while in the CPM. At the first postop visit a gradual incremental increase to 90° passive motion is allowed for the next 3 weeks after which an increase to full passive motion is allowed. PT should begin on POD 3 with an initial focus on graft protection. The CPM is to be utilized for at least 8 hours a day for 6 weeks, at 4 weeks postoperatively ROM may be increased to 120° followed by a gradual progression to full ROM. Closed kinetic chain exercises such as stationary bicycle for 10 minutes is allowed when indicated by the ACL reconstructive protocol and may be increased incrementally with the goal of 1 hour per day. Limited arc strengthening exercises are initiated in the ROM that avoids contact with the repaired lesion as determined intraoperatively and that is again consistent with the ACL protocol. Supervised PT will be utilized

anywhere from 4 to 7 months with the general guidelines that the patient should have their brace locked in full extension for the first 2 weeks whenever they are not using the CPM or performing their therapy exercises, this time frame may be extended. The brace may be weaned between 6 and 7 weeks postoperatively as may the crutches so long as the patient is ambulating well with adequate quad function. Exercise advancement should follow the ACL protocol once the appropriate goals have been reached. Straight ahead running is delayed to 4 months because of the cartilage resurfacing technique and the initiation of cutting and pivoting activities should be anticipated by 6 months postoperatively. A functional ACL brace will be recommended for 1 year duration starting at the 6-month postoperative date when participating in athletics to allow for complete graft incorporation.

ACL reconstruction protocol (hamstring autograft) with cartilage resurfacing femoral condyle and Meniscus repair: The patient underwent arthroscopic assisted ACL reconstruction with an autograft hamstring in addition to a cartilage resurfacing of the medial / lateral femoral condyle as well as a medial / lateral meniscal repair all inside / hybrid technique. The chondral lesion articulates from 30-45° of knee flexion. A postop hinged knee brace set from 0 to 90° has been placed on the patient. A CPM device was initiated in the recovery room with the ROM set from 0-60° with a gradual incremental increase to 90° passive motion. PT has been arranged to begin on POD 3 with an initial focus on graft protection. The CPM is to be utilized for at least 8 hours a day for 6 weeks, at 4 weeks postoperatively ROM may be increased to 120° followed by a gradual progression to full ROM. Immediately following surgery partial weightbearing of 25% with crutches is allowed, at the 1st postoperative visit weightbearing will be increased to 50% for 5 weeks after which a gradual increase to FWB will be initiated. Closed kinetic chain exercises such as stationary bicycle for 10 minutes is allowed when indicated by the ACL reconstructive protocol and may be increased incrementally with the goal of 1 hour per day. Limited arc strengthening exercises are initiated in the ROM that avoids contact with the repaired lesion as determined intraoperatively and that is again consistent with the ACL protocol. Supervised PT will be utilized anywhere from 4 to 7 months with the general guidelines that the patient should have their brace locked in full extension for the first 2 weeks whenever they are not using the CPM or performing their therapy exercises, this time frame may be extended. The brace may be weaned between 3 and 4 weeks postoperatively. After 4 weeks the brace should only be utilized when the patient is in vulnerable situations. Exercise advancement should follow the ACL protocol once the appropriate goals have been reached. Straight ahead running is delayed to 4 months because of the cartilage resurfacing technique and the initiation of cutting and pivoting activities should be anticipated by 6 months postoperatively. A functional ACL brace will be recommended for 1 year duration starting at the 6-month postoperative date when participating in athletics to allow for complete graft incorporation.

ACL reconstruction protocol Bone-patellar tendon-bone autograft technique with cartilage resurfacing medial femoral condyle: The patient underwent an ACL reconstruction utilizing a bone-patellar tendon-bone autograft in addition to a cartilage resurfacing of the medial femoral condyle. The chondral lesion articulates from zero to 30° of knee flexion. A neutral to slight varus knee alignment is present. Physical

therapy begins on postoperative day 3 with an initial focus on graft protection. Supervised PT will be utilized anywhere from 4 to 7 months with the goal being symmetric ROM with dynamic control of the knee. A CPM device will be utilized for 8 hours qd for the 1st 6wks. ROM will initially be set at 0-45 degrees with incremental increases over the next 3 days to achieve a maximum of 0-90. The pt is to sleep with post-op brace locked at 0 degrees extension for the 1st 4 weeks to maintain full extension unless using the CPM at night. The pt should perform patellar mobes every day. No driving for 6wks. Immediately following surgery partial weightbearing of 25% with crutches is allowed, at the 1st postoperative visit weightbearing will be increased to 50% for 5 weeks after which a gradual increase to FWB will be initiated. Closed kinetic chain exercises such as stationary bicycle for 10 minutes is allowed when indicated by the ACL reconstructive protocol and may be increased incrementally with the goal of 1 hour per day. Limited arc strengthening exercises are initiated in the ROM that avoids contact with the repaired lesion as determined intraoperatively and that is again consistent with the ACL protocol. In PACU, with a postop hinged brace set from 0 to 90 degrees, the pt should use a towel wrapped around the foot to do straight leg raises on their own (thus immediately achieving full extension), then with the same towel flex the knee down to 90 degrees, this is to be done for 60 cycles daily for the 1st 4 weeks. At their 1st postoperative visit WB with crutches and the brace set for motion from a 0 to 90 degrees is allowed. The brace may be weaned between 3 and 4 weeks postoperatively as may the crutches so long as the patient is ambulating well with adequate quad function. Exercise advancement should follow the ACL protocol once the appropriate goals have been reached. Straight ahead running is delayed to 4 months because of the cartilage resurfacing technique and the initiation of cutting and pivoting activities should be anticipated by 6 months postoperatively. A functional ACL brace will be recommended for 1 year duration starting at the 6-month postop date when participating in athletics to allow for complete graft incorporation. Hamstring precautions listed in protocol are not necessary given graft choice.

Rehab Phase I: Weeks 0-4

- Goals: Protect graft and graft fixation with use of brace and specific exercises, minimize effects of immobilization, Control inflammation and swelling, Full active and passive extension range of motion, Educate pt on rehab progression, Flexion to 90 degrees only (in order to protect graft fixation), Restore normal gait on level surfaces
- Brace:
    - 0-1 week- post-op brace locked in full extension for ambulation (PWB) and sleeping
    - 1-3 weeks- unlock brace (0-90 degrees) at all times except for sleep
    - 3-4 weeks- wean from brace as pt demonstrates good quad control and normal gait mechanics, pt should still wear brace at night locked in 0 degrees for the full 4 weeks for extension maintenance
    - 4-8 weeks- pt should only use brace in vulnerable situations (e.g. crowds, uneven terrain)
- WB status:
    - 0-1 week- PWB with two crutches to assist with balance and brace locked at 0 degrees

  - 1-4 weeks- progress to FWB with normal gait mechanics
  - Wean from crutches/brace for ambulation by 4 weeks as pt demonstrates normal gait mechanics and good quad control as defined as lack of quadriceps lag
- Exercises:
  - Active-assisted leg curls 0-1 week. Progress to active as tolerated after 1 week
  - Heel slides (limit to 90 degrees)
  - Quad sets
  - Gastroc/Soleus stretching
  - Very gentle hamstring stretching at 1 week
  - SLR, all planes, with brace in full extension until quadriceps strength is sufficient to prevent extension lag- add weight as tolerated to hip abduction, adduction and extension
  - Quadriceps isometrics at 60 and 90 degrees
  - If available, aquatic therapy (once sutures removed) for normalizing gait, weightbearing, strengthening, deep-water aqua jogging for ROM and swelling

Rehab Phase II: Weeks 4-12

Criteria for Advancement to phase II: Full extension, good quad set, SLR without extension lag, Flexion to 90 degrees, Minimal swelling/inflammation, Normal gait on level surfaces

- Goals: Restore normal gait with stair climbing, maintain full extension (progress toward full flexion range of motion), Protect graft and graft fixation, Increase hip and quadriceps and calf strength, Increase proprioception
- Brace/Weightbearing Status:
  - If necessary, only use brace in vulnerable situations (e.g. crowds, uneven terrain)
  - FWB
- Exercises:
  - Continue with ROM/flexibility exercises as appropriate for the pt
  - Initiate closed kinetic chain quad strengthening and progress as tolerated (wall sits, step-ups, mini-squats, Leg Press 90 to 30 degrees, lunges, eccentric quads if good control)
  - Progressive hip, hamstring, calf strengthening (gradually add resistance to open chain hamstring exercises at week 12)
  - Continue hamstring, Gastroc/Soleus stretches
  - Stairmaster (begin with short steps, avoid hyperextension)
  - Stationary Biking
  - Single leg balance/proprioception work (ball toss, balance beam, mini-tramp balance work)
  - If available, begin running in the pool (waist deep) at 10-12 weeks

Rehab Phase III: Week 12-18

Criteria for Advancement to phase III: No patellofemoral pain, Minimum of 120 degrees of Flexion, Sufficient strength and proprioception to initiate running (unweighted or in pool), Minimal swelling/inflammation

- Goals: FROM, Improve strength and endurance and proprioception of the lower extremity to prepare for sport activities, Avoid overstressing the graft, Progressively increase resistance for hamstring strengthening, Protect the patellofemoral joint, Normalize running mechanics,Strength approximately 70% of the uninvolved lower extremity per isokinetic evaluation
- Exercises:
    - Continue flexibility and ROM exercises as appropriate for pt
    - Progress toward FWB straight ahead running starting at 12 weeks
    - Begin swimming if desired
    - Recommend isokinetic test with anti-shear device at 14-16 weeks to guide continued strengthening
    - Progressive hip, quad, hamstring, calf strengthening
    - Cardiovascular/endurance training via stairmaster, elliptical, bike
    - Advance proprioceptive activities

Rehab Phase IV: Post-operative months 4 ½ through 7

Criteria for Advancement to phase VI: No significant swelling/inflammation, Full, pain-free ROM, no evidence of patellofemoral joint irritation, Strength approximately 70% of uninvolved lower extremity per isokinetic evaluation, Sufficient strength and proprioception to initiate agility activities, Normal running gait

- Goals: Symmetric performance of basic and sport specific agility drills, Single hop and three hop tests 85% of uninvolved leg, Quadriceps and hamstring strength at least 85% of uninvolved lower extremity per isokinetic strength test
- Exercises:
    - Continue and progress flexibility and strengthening program based on individual needs and deficits
    - Initiate plyometric program as appropriate for patient's athletic goals
    - Agility progression including, but not limited to: Side steps, Crossovers, Figure 8 running, Shuttle running, One leg and two leg jumping, Cutting, Acceleration/deceleration/springs, Agility ladder drills
    - Continue progression of running distance based on pt needs
    - Initiate sport-specific drills as appropriate for pt

Rehab Phase V: at Post-operative months 6 or 7

Criteria for Advancement to phase V: No patellofemoral or soft tissue complaints, Necessary joint ROM and strength and endurance and proprioception to safely return to work or athletics, Physician clearance to resume partial or full activity

- Goals: Safe return to athletics/work, Maintenance of strength and endurance and proprioception, Patient education with regards to any possible limitations
- Exercises:
    - Gradual return to sports participation
    - Maintenance program for strength, endurance
    - Initiate Functional brace use for activities for 1 year duration