Knee Ligaments

The anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) form a cross in the center of the knee (curciate means cross). The ACL prevents forward movement of the tibia from below the femur and the PCL prevents backwards movement of the tibia. The lateral collateral ligament (LCL) and medial collateral ligament (MCL) stabilize the knee by preventing the tibia from sliding, respectively, to the outside and to the inside from underneath the femur. ¹ The top of the tibia is covered with a type of cartilage called the meniscus and the bottom of the femur is covered by another type called the articular cartilage. See image below:
Karate training involves movement in 360 degrees, cutting movements and pivots. It involves contact with an opponent as well as impact against equipment. As such, Karate training relies heavily upon ACL, PCL, LCL and MCL in stabilizing the knee joint.

**ACL Nerve Endings Provide Protection and Balance**

Nerve endings run through the ACL which provide balance and stability to the knee by providing information to the central nervous system as to spatial positioning of the knee joint. This is known as *proprioception*. These nerve endings allow the brain to...
reflexively know the state of the knee joint and make near-instant adjustments to prevent injury. During kumite, a sweep or blow to the lower leg can send a signal to retract the lower leg and flex the hamstrings. This protective reflex prevents hyper extension of the knee joint. A tear to the ACL eliminates this important reflex. The good news is that modern surgery can repair it. Additionally, as explained below, the Karate practitioner can condition this reflex action to prevent ACL tears. Further, this reflex can be post-surgically rehabilitated.

**What is an ACL Tear**

An ACL is a common injury in both men and women. It can occur from a blow to the outside of the knee as from a hard sweep. It can also occur from a bad landing as in the jump in the kata Enpi. It can also occur from a misplaced fumikomi technique as in the kata Jion. These jumps and stomping techniques require a **downwards twisting action** that can tear or partially tear the ACL. Such a tear is sometimes accompanied by a tear to the meniscus and damage to the MCL. This triple injury is termed O'Donohue's triad.

**Who Gets ACL Tears**

ACL tears can occur with any sex at any age, but are most common in middle aged men and young women. It is not clear why this injury is so common for young women. Possible causes include muscle balance differences between the sexes, affects of differing hormone balances on muscles, and the increased participation of women in contact sports. The female ACL is about 20% smaller in width than that the male ACL. Equivalent sports intensity between men and women coupled with muscle and ACL differences implies that young females experience more proportional force on their knee joints than men.
Middle aged men may lose muscle conditioning in their legs. They may also have some weight gain. Yet, with their accumulated skill in Karate, they can still apply considerable force to their knee joints when executing techniques. Again, this can put undue strain on the ACL and result in a tear while performing either kumite or kata.

**Preventing ACL Tears**

The ACL tear most commonly results from a downward twisting action placed on the knee joint while the foot is either firmly planted or during a landing. It may also result from a blow to the lower leg, usually from the outside. Imbalanced landings during a jump or a fumikomi can trigger this injury. This injury may also result from a sweep during kumite, an over-shift backwards into a kokutsu-dachi or a hard step forward into zenkutsu-dachi stance where the knee is improperly angled inwards (not aimed over the toe).

To prevent a bad landing, both knees should be bent so that force is transferred through the knee joint into the muscles, especially the thighs and gluteus. A straight leg during a landing coupled with an over-rotation risks damage to the knee. Practitioners should practice low slow jumps with attention to avoiding over-rotation until all muscle groups reflexively master the motion.

The knee joint absorbs undue force when the surrounding muscles are not properly warmed up. Cold, inflexible muscles have a shortened range of expansion and contraction, which, in turn, can place too much force on the tendons and ligaments of the knee joint. Practitioners should warm-up thoroughly before practicing Karate techniques. Even after a good warm-up and stretching, practitioners should perform their movements at a medium rate and then gradually build-up to full speed. Karate

Ken Kraisler, ACL Knee Recovery for the Practicing Blackbelt, page 5
techniques are designed to deliver an amazing amount of channelled force into a relatively small target. Without proper body alignment, some or all of this force can end up directed into the joints and bones of the practitioner rather than the target. Imagine punching the maki-wara full speed with a loose fist and bent wrist. Practitioners should refer to the Textbook of Modern Karate for a proper warm-up.\(^5\)

The knee joint is vulnerable to long-term injury when the surrounding muscles are unconditioned. Karate practitioners should adopt the exercises listed later in this article to develop their calf muscles, shin muscles, quadriceps, hamstrings, lower abdominals and gluteus. Making these exercises a routine part of one's training will go a long way to preventing injury. After an ACL tear or other serious injury, athletes who have successfully returned to their sports will have adopted these routines or ones like them. Their successful return-rate and avoidance of re-injury correlates with well conditioned leg muscles. Interestingly, because they have learned to develop a focused muscle-maintenance routine, their legs are likely stronger than before the injury. In many cases, the injury could have been avoided if they had adopted these routines ahead of time.\(^6\)

Conditioning exercises should focus on the goals listed in table 1. These goals are listed in priority order but they are also overlapping. For example, when working on balance one is also working on strength, however balance is the primary focus at this stage. Also, one should focus on strength along the complete length of the target muscles so
as to develop strength with maximum ROM.

<table>
<thead>
<tr>
<th>table 1: Goals for muscle conditioning In Karate for prevention / rehabilitation of knee injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Range of Motion (ROM)</td>
</tr>
<tr>
<td>2 Balance and proprioception</td>
</tr>
<tr>
<td>3 Strength</td>
</tr>
<tr>
<td>4 Speed</td>
</tr>
<tr>
<td>5 Rotation and directional changes and complex foot work</td>
</tr>
</tbody>
</table>

Conditioning exercises tend to increase the ratio of muscle to overall body weight.

Practitioners should seek to control their body weight. Even a small increase in weight, say 5 pounds, can result in a large increase in undue force traveling through the knee joint. This is especially true for techniques that require a downward and twisting motion of the body center as in the 3 fumikomi techniques of Heian Sandan or Jion.

As part of prevention, practitioners should manage any knee swelling. See below for more on this topic.

**Should the Karate Practitioner Get or Skip Surgery**

The decision to get surgery depends upon many factors and should be made in consultation with an orthopedic surgeon. Such a doctor can readily assess if the ACL is, in fact, torn. The doctor can commonly make this determination even without the use of an x-ray or MRI. However, a visit to the orthopedic doctor will likely include an x-ray and a scheduled MRI.

Typically, doctors will not perform surgery immediately after an ACL tear. They prefer to wait until swelling has decreased and give the patient a chance to undergo pre-surgical
rehabilitation (pre-habilitation). This has been shown to positively reduce the time needed to return to sports\(^7\).

"Unfortunately, the ACL rarely heals by itself and, even if it does, it may not be adequate enough to return to sports (see our research articles). Reconstruction surgery may therefore be necessary\(^8\) Practitioners can perform Karate without an ACL although they will need to make significant modifications to their techniques as well as develop a leg conditioning regimen as discussed later in this report. See table 2 for examples of limitations.

<table>
<thead>
<tr>
<th>Technique Example</th>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stances such as kokutsu-dachi, kiba-dachi</td>
<td>The knee lacks stability when driving outwards or inwards and not over the center of the foot. As the tibia moves from underneath the femur, it tends to wobble and feel unstable.</td>
<td>Raise the stance height, shorten the length and keep the knee aimed towards the big toe. Keep the knee only slightly bent so that it is directly above and slightly forward of the center of the foot rather than directly over the toe.</td>
</tr>
<tr>
<td>Yoko-geri kekomi</td>
<td>The support leg cannot extend past the base-area without giving out or feeling wobbly.</td>
<td>Switch to a mae-geri aimed to the side. Keep the body center well within the base-area.</td>
</tr>
<tr>
<td>Mawashi-geri</td>
<td>The support leg cannot consistently provide support during rotation.</td>
<td>Switch to mae-geri and avoid mawashi-geri.</td>
</tr>
<tr>
<td>Jumps</td>
<td>The landing leg cannot support a landing and a rotation</td>
<td>Do not jump. Keep at least one foot on the ground and step back into a similar technique.</td>
</tr>
</tbody>
</table>
### Table 2: Some examples of limitations and modifications for those lacking an ACL

<table>
<thead>
<tr>
<th></th>
<th>The landing leg cannot support a land and a rotation.</th>
<th>Rotate early and place the foot down without high impact.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stomps</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rotation / Directional Changes</strong></td>
<td>The support leg cannot extend near or past the base-area during a rotation.</td>
<td>Break this motion down into two components and avoid extending the body center near the base-area. Rotate to the center first, pause, then drive straight towards the new direction.</td>
</tr>
<tr>
<td><strong>Sitting in seiza, duck-walks, deep knee squats.</strong></td>
<td>Deep bends on the knee causes pain</td>
<td>Avoid seiza and other activities where the knee is bent such that the angle at the back of the knee is 90 degrees or less. Even while stretching, keep the angle greater than 90 degrees.</td>
</tr>
</tbody>
</table>

Although these limitations are significant and seemingly discouraging, Karateka can still manage to perform a great many of their techniques even without an ACL.

Typically, younger people, those in competition and those who are otherwise healthy will opt to get surgery after an ACL tear. Those who cannot or should not undergo knee surgery will opt to forgo such a procedure.

**Swelling**

Whether choosing surgery or not, practitioners should manage any knee swelling after training. Rather than RICE (rest, ice, compression, elevation), the Karate practitioner will likely benefit from MICE (movement, ice, compression, elevation) for non-acute injuries. If swelling occurs after a training, then move the M to the end. That is to say, avoid long periods of inactivity after a training session. Instead, get moving as soon as possible.

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Movement promotes healing whereas immobilization promotes atrophy and risks re-injury due to diminished conditioning.

**Table 3: Managing knee swelling after training for non-acute injuries.**

<table>
<thead>
<tr>
<th>Step</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apply ice for at least 20 minutes and no more than 60 minutes</td>
</tr>
<tr>
<td>Apply compression or massage to the swollen areas to increase blood flow and move excess fluid out of the joint.</td>
</tr>
<tr>
<td>Elevate the knee.</td>
</tr>
</tbody>
</table>

For non-acute injuries, light exercise and stretching the next day will ensure blood flow and move excess fluid out of the knee joint.

If the injury is acute with swelling and pain, then movement will only make matters worse. A complete ACL tear can become non-acute after several days of rest. The practitioner should use this time to consult an orthopedic surgeon and construct a plan for no surgery, surgery, pre-habilitation and rehabilitation.

**Knee Braces**

Whether skipping surgery or undergoing pre-habilitation or rehabilitation, knee braces can play a helpful role. There are three broad categories for knee braces. They are hinged support, non-hinged support and compression only. The practitioner will need to weigh the plusses and minuses. A brace can greatly reduce the rate of re-injury, but it is no substitute for a consistent regimen of rehabilitation and conditioning exercises. See table 4.
<table>
<thead>
<tr>
<th>Hinged Support Brace</th>
<th><img src="image1.png" alt="Image" /></th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximizes protection from impact.</td>
<td></td>
</tr>
<tr>
<td>Maximizes support in 360 degrees.</td>
<td></td>
</tr>
<tr>
<td>Provides compression, heat for increased blood flow and reduced swelling.</td>
<td></td>
</tr>
<tr>
<td>Limits ROM and speed. Limits height of kicks due to weight of the brace.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Non-Hinged Support Brace</th>
<th><img src="image2.png" alt="Image" /></th>
</tr>
</thead>
<tbody>
<tr>
<td>Offers some protection from impact.</td>
<td></td>
</tr>
<tr>
<td>Offers some support in 360 degrees.</td>
<td></td>
</tr>
<tr>
<td>Provides compression, heat for increased blood flow and mobility and reduced swelling.</td>
<td></td>
</tr>
<tr>
<td>More ROM and speed than a hinged brace. Weighs less.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compression-Only Support</th>
<th><img src="image3.png" alt="Image" /></th>
</tr>
</thead>
<tbody>
<tr>
<td>Offers no protection from impact.</td>
<td></td>
</tr>
<tr>
<td>Offers no support in 360 degrees.</td>
<td></td>
</tr>
<tr>
<td>Provides compression, heat for increased blood flow and mobility and reduced swelling.</td>
<td></td>
</tr>
<tr>
<td>More ROM and speed than a non-hinged brace. Least weight.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No Brace</th>
<th><img src="image4.png" alt="Image" /></th>
</tr>
</thead>
<tbody>
<tr>
<td>Requires practitioner to rely upon rehabilitation and muscle development exercises</td>
<td></td>
</tr>
<tr>
<td>to re-acquire pre-injury capabilities.</td>
<td></td>
</tr>
<tr>
<td>Requires practitioner to safely warm-up injured knee prior to training.</td>
<td></td>
</tr>
</tbody>
</table>

**Psychological Effects of an ACL Tear**

The ACL tear is painful in the short-term and leaves the Karate practitioner unable to continue normally with his/her trainings in the medium to long run. Up-coming tournaments, dan exams, camps, and special trainings have to be set aside. Immediate goals and plans will have to be pushed out. The practitioner may feel isolated and lose confidence in his/her ability to return to martial arts. Surgery itself is always intimidating. Without insurance, costs can be extensive. These factors can lead to depression.
The good news is that ACL surgery is highly effective with an extremely high rate of return to pre-injury sports activities\textsuperscript{10}. Furthermore, Karate practitioners can return to partial training in 3 months, significant training in 6 months and resume nearly full activities in 9 to 12 months.

To reduce negative psychological effects, practitioners should re-align their goals towards pre-habilitation and rehabilitation. They can build up the non-injured parts of their bodies. They can participate in classes and events by teaching and judging and supporting the Karate community. They can form study goals including instructor’s training, judging manuals and martial arts books. Practitioners can form several short-term goals, and, before they know it, they will be all consumed with the business of advanced leg conditioning and a full resumption of their Karate training. Through dedication, practitioners can come out of an ACL injury physically stronger and more knowledgeable than they were prior to it. The key ingredients to success are planning, patience and persistence. An ACL tear is a good test of the "Endeavor" portion of the dojo kun. Do not give up. Dedicated practitioners can emerge from this injury stronger than when they went into it.

**When Can the Karate Athlete Return to Training After Surgery**

"The desire to return to sports as quickly as possible should not outweigh the importance of ensuring a good long-term outcome."\textsuperscript{11} The Karate practitioner should never rush the healing and rehabilitation process. Recovery time lines vary among individuals. The following serves as a rough guideline for restarting Karate techniques following ACL knee surgery. This guideline assumes that in addition to the Karate techniques, the practitioner is also performing the physical therapy and condition
exercises outlined later in this report. Do not undertake this plan without a thorough and honest consultation with the orthopedic surgeon.

| 0 to 3 months       | Physical therapy only.  
|                     | No Karate techniques.   
|                     | ROM, balance, strength. |

| 3 to 6 months       | Continue with all rehabilitation and leg conditioning exercises.  
|                     | No high impact. No slides or shifts. No kata due to rotational requirements. No jumps. No bends of the knee such that the angle at the back of the knee is 90 degrees or less. Keep speed rate to medium.  
|                     | Absolutely avoid any rotations, including turns as used throughout Heian Shodan.  
| This is the period of highest risk for re-injury. | Forwards, backwards stepping techniques without kicks are OK.  
|                     | Side to side stepping techniques without kicks are OK.  
|                     | Slow front or side kicks for muscle development OK. No mawashi-geri or kicks involving rotation. In place back kick OK. Lifting knee into mawashi-geri position OK. |

| 6 to 9 months       | Continue with all rehabilitation and leg conditioning exercises.  
|                     | Increase speed to nearly full for single forward and backward motions or single side to side motions. No full speed combinations.  
|                     | Sliding OK.  
|                     | Start practicing all kata without any jumps.  
|                     | Slow mawashi-geri and other rotation kicks OK. Modify the kicks by rotating the foot and knee first and then the hip. This avoids rotating while simultaneously bearing full body weight on the injured leg.  
|                     | When moving fast, only practice yoko-geri kekomi starting from a side stance such as kiba-dachi. Starting such a technique from a front stance forces the injured knee to bear weight while twisting into a side-facing position. |
table 5: Guideline for post-surgical return to Karate techniques

| 9 to 12 months | • Continue with all rehabilitation and leg conditioning exercises.  
• Practice isolation exercises for rotation and directional changes at medium to full speed.  
• Start practicing light mawashi-geri and other rotating kicks. Maintain the kick modification for rotating kicks by pre-rotating the foot first, followed by the hip.  
• Start practicing low, light jumps, but **avoid** landings where the knee is compressed such that the angle at the back the knee is 90 degrees or less.  
• Start practicing san-bon, ippon and jiyu-ippon kumite with minimal rotations. |
| 12 months and beyond.  
Fully healed. | • Continue with all rehabilitation and leg conditioning exercises.  
• Resume normal Karate training activities, but beware of the post-surgical limitations outlined in table 6 below. |

Limitations After a Fully Healed Surgical Repair

On average, full healing runs approximately one year. This time will vary among individuals and the degree of the injury. Long term limitations include landings from which bend the knee less than 90 degrees, as well as kicks and stomps where the injured supporting leg bears significant weight while rotating. These limitations will likely persist up to and perhaps beyond the full healing time frame. Time combined with a regular regimen of muscle development may very well make these limitations altogether disappear.

It is important to strive for a complete healing. During pre-habilitation and prior to a full healing, practitioners should avoid more advanced exercises that even slightly re-tear or otherwise sprain the injured knee. An incomplete healing can lead to long term limitations.

The ACL surgery not only reconstructs the ligament, but also re-establishes the nerve that travels through it. The nerve must regrow through the ligament. This nerve provides
proprioception as described above. The practitioner must guard against hyperextension of the leg, especially during kumite. There is no sprain-like pain or other biofeedback during the period at which this nerve regrows. Therefore, it is important for the practitioner to protect the knee throughout the one year full healing time frame.

**Surgical Options**

Practitioners must decide on surgery or no surgery. Those wanting to continue with the full range of their training will likely opt for surgical reconstruction. The ACL is reconstructed using a graft typically from 1 of 3 sources. They are a donor, the patella tendon and the hamstring. Each source has advantages and disadvantages that go beyond the scope of this report. Practitioners should study the options and discuss them with the physician.

One option is to use the hamstring. There are 3 hamstring muscles per leg. The grafting process slices 1 of them in half. This means that the practitioner will permanently lose 1/2 of 1/3 of their hamstring capacity in one leg. This is about a 16.5% loss of strength. While this may seem debilitating, it is not. Practitioners should be able to rebuild the remaining muscles and continue to have an excellent snap back motion for mae-geri and other snapping kicks.

**Surgical and Rehab Goals**

After surgery, the practitioner should setup a series of goals so as to ensure a successful recovery.

- An intact ACL with the potential for re-establishing complete nerve sensitivity.
- Development of full ROM.
- Development of balance.
• Development of symmetrical strength between both legs.
• Prevention of re-injury.
• A return to Karate in a limited fashion.
• A full return to training.

The immediate surgical goal is to have an intact ACL with the potential for re-establishing complete nerve sensitivity.

Soon after surgery, the leg muscles will have some degree of atrophy and loss of range of motion. So, the next goal is to develop a full ROM.

Next comes balance.

Following this is the re-establishment of symmetrical strength between both legs. It is critical that the injured leg reach reasonable parity with the healthy one. For those opting for the hamstring graft, there will be a permanent 16.5% loss of strength. However, with a regular regimen of leg development, this may be eclipsed by having stronger legs than before the injury.

Following ROM, balance and symmetrical strength development comes prevention of re-injury. Immediately following surgery, care must be taken to avoid infection. Once the wound is healed, care must be taken not to perform exercises that go beyond the capacity of the non-fully healed ACL. The period from 3 to 6 months is most vulnerable to re-injury. During this phase, the practitioner senses an upward trend of mobility and strength, but no longer feels the pain from the surgery. Meanwhile, immediately following surgery, the graft has more or less shut-down. It is considered dead tissue. At 3 months, the graft starts to "come alive" and regrow. It is far from fully healed. There is no pain biofeedback to indicate that the graft remains vulnerable. The practitioner must
trust in this fact, let the graft fully heal and limit the rehabilitation exercises to those described in table 5 above.

The next goal is to return to Karate in a limited fashion, and the final goal is a full return to training.

**Pre-Surgery Preparation**

Immediately following the injury, the practitioner should consult with an orthopedic surgeon to determine precisely what is damaged. Assuming an ACL tear that involves reconstructive surgery, the practitioner should begin a pre-habilitation program. This includes reducing swelling and developing the leg muscles so as to reduce post-surgical atrophy. The development goals should be ROM (flexibility), balance and strength. Speed, snap back, complex footwork and impact should be eliminated from this phase of training. At this point, the practitioner should depart from his/her normal training routines. Competitors should set aside exercises that might help prepare them for tournaments. Such activities may aggravate and worsen the injury. Table 6 below lists indicators of improper or over-training:

<table>
<thead>
<tr>
<th>pain</th>
<th>Practitioners should not &quot;push-through&quot; or ignore pain in the injured knee. Tear sensations within the knee may be damaging cartilage or meniscus.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sudden loss of balance due to the knee giving way.</td>
<td>Without an ACL, the tibia moves too far from underneath the femur which causes failure of the leg to support the body.</td>
</tr>
<tr>
<td>Swelling</td>
<td>An injured knee will likely always exhibit some swelling. Practitioners should seek to reduce swelling and avoid exercises that produce too much swelling through post exercise ice, compression and elevation for at least 20 minutes.</td>
</tr>
</tbody>
</table>
Practitioners should seek to isolate and develop all muscles from the foot to the lower abdominals and lower back. The knee is not an isolated joint. It works in conjunction with all parts of the lower half from the foot to the lower torso so as to maintain balance and provide mobility.

<table>
<thead>
<tr>
<th>Table 7: Muscles to focus on for pre and rehabilitation for ACL injury</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>toes, ball of foot, arch of foot, top of foot</strong></td>
</tr>
<tr>
<td><strong>Ankle</strong></td>
</tr>
<tr>
<td><strong>Peroneus and tibialis</strong></td>
</tr>
<tr>
<td><strong>hamstrings</strong></td>
</tr>
<tr>
<td><strong>quadriceps</strong></td>
</tr>
<tr>
<td><strong>Adductors / inner thigh</strong></td>
</tr>
<tr>
<td><strong>IT band / outer thigh</strong></td>
</tr>
<tr>
<td><strong>gluteus</strong></td>
</tr>
<tr>
<td><strong>lower abdominals</strong></td>
</tr>
</tbody>
</table>

The practitioner should maximize ROM, flexibility and strength using lighter weights and higher repetitions. A good starting point is 3 sets of 12 repetitions. The practitioner should also practice slow kata, no jumps and slow kicks. The practitioner may perform
fast upper body techniques, but avoid slides and steps by using a static stance. The practitioner should shorten and raise stances, so as to place pressure on the injured knee joint.

**Rehabilitation Exercises Overview**

The exercises shown below represent only some of the many possibilities. Use these exercises as a guide to the types of conditioning that the practitioner should under-take, and as a supplement to what is suggested by the doctor and physical therapist. Let these exercises inspire the practitioner to develop a long range leg conditioning regimen.

**Post-Surgery**

Immediately following surgery, the practitioner should make maximum use of an ice cuff machine. This machine is typically not covered by insurance, however it is invaluable. Crutches will be useful for the next 6 weeks.

**2 Weeks After Surgery**

Goals are ROM and a reduction of swelling.

2 weeks after surgery, practitioners typically begin physical therapy. This may not be fully covered by insurance, but is well worth the extra fees and should be continued for 2 to 3 months.

At this early stage, practitioners should perform exercises about 4 times per day so as to reduce swelling and reverse atrophy. An important initial exercise involves contracting the quadriceps so as to move the patella into position over the knee joint. This pushes swelling out of the knee, reduces pain, increases healing and starts to reverse atrophy.
Those opting for the hamstring graft, will begin work on these muscles as well as the quadriceps.

1 Month After Surgery

Goals are ROM, balance and a reversal of astrophy.

Physical therapy training should **fatigue the targeted muscles and not strain them**.

Keep the knee positioned above the center of the foot rather than the big toe. Karate stances typically bend the knee such that it reaches towards or over the big toe, however, when performing rehabilitation exercises, the knee should remain over the center of the foot. This means the gluteus will bend outwards during squats and side to side motions. A completely vertical up-right posture with hips tucked under is NOT critical for many of these leg conditioning exercises.

Try to perform **about 3 sets of each exercise with about 8 to 12 repetitions per set**.

Perform exercises symmetrically. That is, avoid more repetitions or weight on the non-injured leg. Perform exercises the same on both sides so that the injured leg eventually matches the capabilities of the non-injured one.

During workouts, wear a brace as needed. After workouts, apply ice and compression.
Calf and shin:

Contract calf

Contract calf & muscles along shin

Contract muscles along shin

IT Band and adductors:

Side to side stepping emphasizes adductors and IT bands as well as the gluteus. Keep knees over the center of the fee and back straight. Back may lean and gluteus may bend outwards. Again, this is not the same as side stepping into kosa-dachi where the back remains vertical. The goal here is to develop the lateral upper leg muscles and gluteus.

Hamstrings:

(Prior to 3 months, avoid the plate weight).
This exercises focuses on the hamstrings. Try with both heels down and lift the hips off the floor. Next, repeat with one heel down, then the other.

**Lower abdominals, gluteus, quadriceps:**

(Avoid free weights prior to 3 months after surgery).

Use bosu ball for balance development. Squats on the ball focuses on muscles in the lower leg. Squats with hand weights requires more balance.

(Avoid leg lifts prior to 3 months after surgery).

Lunges with slow rear and front leg lifts emphasizes quadriceps, ROM, balance and flexibility. Keep the forward knee bent over the center of the foot and not the big toe.
3 Months After Surgery

Goals are ROM, balance, strength and limited speed without risk of re-injury.

Practitioners may begin the Karate techniques outlined above in table 5. Increase the weight and number of repetitions in the conditioning regimen.

The grafted ACL is highly vulnerable at this stage. It is starting to heal after a period of dormancy. There is no sensation of pain to indicate its vulnerability.

Practitioners must avoid all weight bearing rotations on the knee.

Continue with the prior section's exercises while adding in the ones in this section.

During workouts, wear a brace as needed. After workouts, apply ice and compression.

**IT Band and adductors:**

*Add free weights to increase the balance and strength requirements.*

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Add a rubber ankle band to increase balance and strength requirements.

Use a rubber ankle band to develop the adductor muscles.

Hamstrings
This exercises works the hamstrings and gluteus. Keep legs straight, back straight, start with a light weight or just a bar.

**Lower abdominals, gluteus, quadriceps:**

(Initially avoid the plate weight).

This exercise works the gluteus, quads and lower abs. Hold for about 30 to 60 seconds per leg.
Use the back of the bosu ball for one legged balance development. Keep back straight. Free weights increase the balance challenge.

Lifting free hand weights on one leg focuses on balance and fatigues muscles in the lower leg and around the knee.

6 Months After Surgery

Goals are strength, speed (not rotational, only linear) while continuing with ROM and balance.
The ACL graft is getting stronger. After consulting with a physician, practitioners should start executing kicking techniques either slowly or medium speed. Start practicing kata with fast forward, backward and side to side motions. So as to ensure the knee remains stable, break the rotations into distinct parts: a quick inward motion, a pause, and then a quick outward motion. Perform kicks such as mawashi-geri slowly only. Continue with the prior sections' exercises while adding in the ones in this section. During workouts, wear a brace as needed. After workouts, apply ice and compression.

**Calf and shin:**

*(The bosu balance ball can be used to work all core muscles, however, for the purposes of ACL rehabilitation, it is used to develop balance using the muscles of the lower leg and around the knee).*

Slow practice of side kicks emphasizes balance and develops the muscles around the lower leg and knee.
Slow practice of front and back leg lifts increases balance and prepares the body for kicking techniques.

**Lower abdominals, gluteus, quadriceps:**

*(Initially use a very light weight or just a bar).*
Lunges with a weight strengths leg muscles, especially the quadriceps and gluteus.

Lunges with slow mawashi-geri knee lift safely maintains/develops muscles necessary for this kick without unwanted twisting of the knee.

This exercise emphasizes the quadriceps as well as all core muscles necessary for yoko geri kekomi. It also emphasizes balance and works the muscles around the ankle and knee joints.
Use ankle weights to develop balance and strength. Move slowly. Avoid until mawshi-geri about 6 to 9 months after surgery.

9 Months After Surgery

Goals are increasing strength and speed while continue with ROM and balance.

After consulting a physician, practitioners should consider returning to most of their Karate training activities. Avoid compressing the knee less than 90 degrees. Avoid impact. Avoid full speed jiyu kumite. Avoid kicking a bag or stomping. Avoid high jumps. Practice light full speed kicks. Perform mawashi-geri and ushiro-geri at medium speed. Pre-rotate the ankle prior to executing these kicks. Start to practice slow rotations, changes in direction and complex foot work. Continue with the prior sections' exercises while adding in the ones in this section. During workouts, wear a brace as needed. After workouts, apply ice and compression.
In order to avoid twisting the knee while it bears full weight, practice rotating the foot first, then lifting the rear leg. After the full year, full heal timeframe, these steps may be combined.

**Lower abdominals, gluteus, quadriceps:**

One legged squat with twist safely builds muscles around knee. Limit this exercise to 6 months after surgery. Keep the back straight and lift the rear foot high.
1 Year After Surgery

Goals are full strength and speed with a full return to all Karate activities. This includes rotational movements, changes in direction and complex foot work.

The knee is considered fully healed. Still, there are limitations. It is important to avoid re-injury. Be careful with rotations especially when combined with high impact.

In order to prevent re-injury, maintain a full regimen of leg exercises. Watch for weight gain as even a small amount can place a lot of stress on the knees.

Continue with the above mentioned exercises as part of the overall Karate training.

As always, during workouts, wear a brace as needed. After workouts, apply ice and compression.

Conclusion

An ACL injury is very common. Once it occurs, karateka are significantly limited in what they can perform. The good news is that ACL reconstruction is highly successful and Karate practitioners have a very high chance of a full return to their training. Time to
return to sports ranges by injury and individual. A limited return can be made in as early as 3 months, and a full healing generally takes 1 year. The ACL injury not only affects the knee joint's stability, but cuts off proprioception. This is where the central nervous system reflexively adjusts the knee joint based on feedback from nerve endings that travel through the ACL.

Success depends upon practitioners' willingness to devise and undertake pre and post surgery rehabilitation, as well as sustain a routine of leg conditioning exercises beyond the full healing timeframe. Practitioners must dedicate themselves to these exercises so that they may enjoy a lifetime of Karate training.

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End Notes

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