



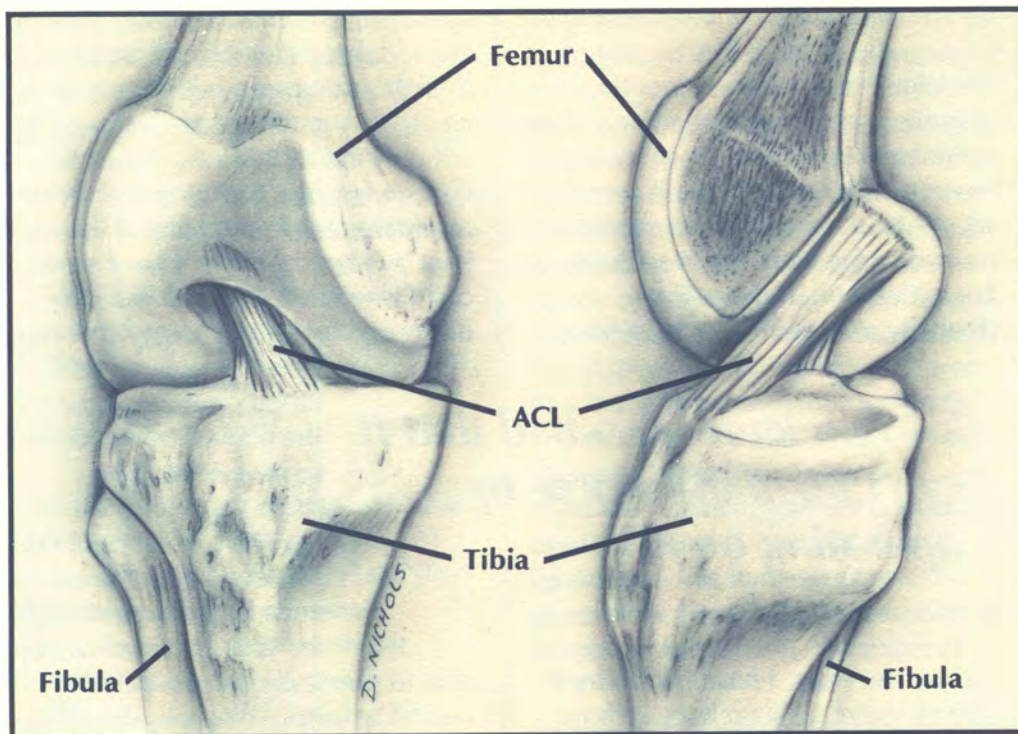
Hughston Health Alert

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For a Healthier Lifestyle

FALL, 1992



In Perspective: Anterior Cruciate Ligament Tears

Dr. Jack C. Hughston, one of the world's most respected authorities on knee ligament surgery, shares some thoughts regarding injuries to the ACL.

"You tore your anterior cruciate ligament." On hearing your physician speak those words, you are filled with a sense of dread. You envision the end of your athletic life, even recreational sports.

Today, a torn ACL has almost become a household word. Through friends, newspapers, television, sports magazines, and even our physicians, we are inundated with the hype that the knee joint will deteriorate and become arthritic if the ACL is not operated on as soon as possible.

You have been convinced that to save your knee you must have an operation immediately to repair the ligament. Your surgery is scheduled for the following day. You are scared.

But there is an old truism in orthopaedic surgery that says "no knee is so bad that it can't be made worse by operating on it."

For many years, torn ACLs were treated as an emergency and were operated on immediately, even

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Fig. 1

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Knee Ligament Injuries: The ACL

In the last decade, much attention and publicity has been focused on the treatment of injuries to one of the major knee ligaments -- the **anterior cruciate ligament**, or ACL.

Unfortunately, so much attention has been concentrated on injury to this one structure that attention has been drawn away from other important issues regarding knee ligament

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Knee Ligament Injuries

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surgery. For this reason, we find the public is often confused to learn there may be many and varied approaches to treating a "torn ACL."

Just as a "soft drink" may not always mean a "Coke," the term "an ACL tear" may be used to describe a whole host of injuries. In fact, much of the research and study carried out over the years at the Hughston Sports Medicine Foundation has been devoted to the patterns of injuries to knee ligaments. What our research and that of others has shown us is that a knee injury in which the ACL is torn without any other ligaments being torn is quite rare (1% to 2%). However, "a torn ACL" has become the catchall term used to describe most knee ligament injuries despite their complexity.

The appropriate treatment for any torn ligament depends on a variety of factors, such as the severity of the injury, the age of the patient, the demands a person places on his or her knee, the patient's occupation, and the presence of other associated diseases or conditions (e.g., arthritis). Probably one of the most important factors used to determine the appropriate treatment for a knee ligament tear, however, is the pattern of injury to all the ligaments.

We have devoted this issue to a brief description of some of the approaches currently used to treat the "torn ACL" in the hope of improving your understanding of the differences among and reasons behind these methods. The decision to embark on any given course of treatment should come only after the physician has performed a very thorough examination of the injured knee and has formed a strong opinion as to exactly what has been damaged underneath the skin. This information coupled with the other factors listed above allows patients and physicians

to arrive at a course of treatment that is "tailor made" for each patient. Thus, we hope this issue offers you a better understanding of why two people -- each with a "torn ACL" -- may have vastly different treatments.

Fred Flandry, M.D., F.A.C.S.
Editor

ACL Ligament Tears

From page 1

before the initial pain and swelling of the injury subsided. The trauma of the injury plus the trauma of the operation added insult to injury, often resulting in the formation of scar tissue. Sometimes the results were stiff, painful knees without normal motion or function. The result was knees that caused the patient disability, even with simple walking.

"... no knee is so bad that it can't be made worse by operating on it."

Over the years, I have had to try to correct these problem knees. Those that were less stiff often responded to concentrated rehabilitation exercises and regained acceptable functional status. Others, however, required surgical release, and some had to have multiple operations to remove scar tissue to loosen the joint.

Isn't there an alternative to this all too common scene? Another treatment approach that isn't as frightful? The answer is a definite "YES"! In many instances, nonsurgical treatment is successful. In other cases, surgery is necessary. Immediate surgery may be needed to repair other ligaments and torn menisci in the knee. But if **only** the ACL is torn,

immediate repair is not necessary.

If the knee is shown to be loose during the physical exam, then most likely other ligaments in addition to the ACL have been damaged. These other ligaments, when torn badly enough, may need to be surgically repaired within the first week. After they have been repaired and after a good rehabilitation program of six or more months, the decision to reconstruct the ACL can be made. If, at this time, there is a functional need for a ligament replacement, the operation can be done without the risk of subsequent stiffness and disability that can result from emergency repairs of the ACL.

If only the ACL is torn, it may be difficult for your physician to confirm any looseness or instability of the knee joint by physical exam. I have seen cases where the ACL tear was only diagnosed by **MRI** or some other form

of imaging study, and, based on those findings, the patients were advised to have immediate surgery to repair the ligament. Be wary of this sort of advice. If your knee is not loose enough for your physician to be

able to physically demonstrate the instability to you, then you should get a second opinion before having surgery.

In other cases, when the ACL and other ligaments are damaged and there is significant joint instability, surgery can be planned when the pain and swelling have subsided and knee motion has returned to almost normal. This usually occurs six weeks or more after the injury. In the meantime, you will have been performing prescribed daily rehabilitation exercises and using crutches to aid with your walking. When the knee is re-examined, there will be less discomfort and your physician will be able to perform a

better evaluation. If the looseness is severe enough, an ACL reconstruction can be performed and the chance of complications is less than with an emergency operation.

The important thing to remember in all of this is that you don't need to be frightened that your knee will be ruined forever if the torn ACL is not repaired immediately. On the contrary, **a torn ACL by itself is not a reason for emergency surgery.** Rather, it is time for calm, conservative management and appropriate follow-up. If this does not seem to be the approach your physician is taking, don't hesitate to get a second opinion.

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The ACL: Its Anatomy and Function

At first glance, you might think that knee motion is uncomplicated. On the contrary, movement and stability of the knee depend on many ligaments, each with a particular function.

Although your knee joint looks similar to a door hinge in its movement, a small amount of rotation occurs as you straighten your leg. This motion is controlled somewhat by the shape of the bones that make up the joint and by the ligaments that hold the bones of the knee together.

Intra-articular ligaments are ligaments located within the joint. **Extra-articular** ligaments lie outside the joint.

The two ligaments that sit right in the middle of your knee are the intra-articular ligaments. Because they cross each other, they are called the cruciate or crossed ligaments (Fig. 2).

The **anterior** cruciate ligament (ACL) passes in front of the **posterior** cruciate ligament. It is about the size of your little finger, and it attaches to the upper end of the tibia, or shin bone, and runs upward to insert on

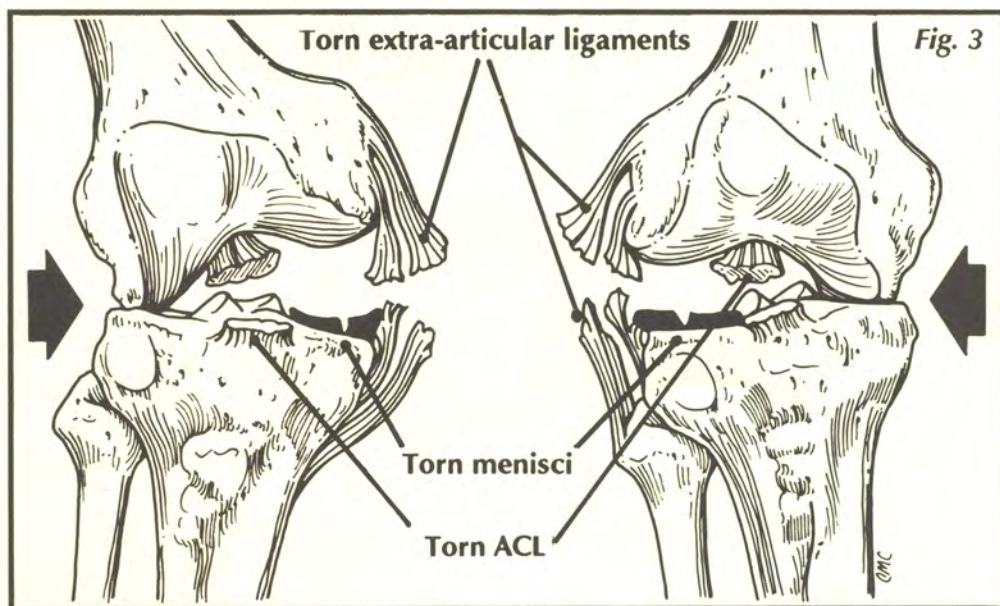
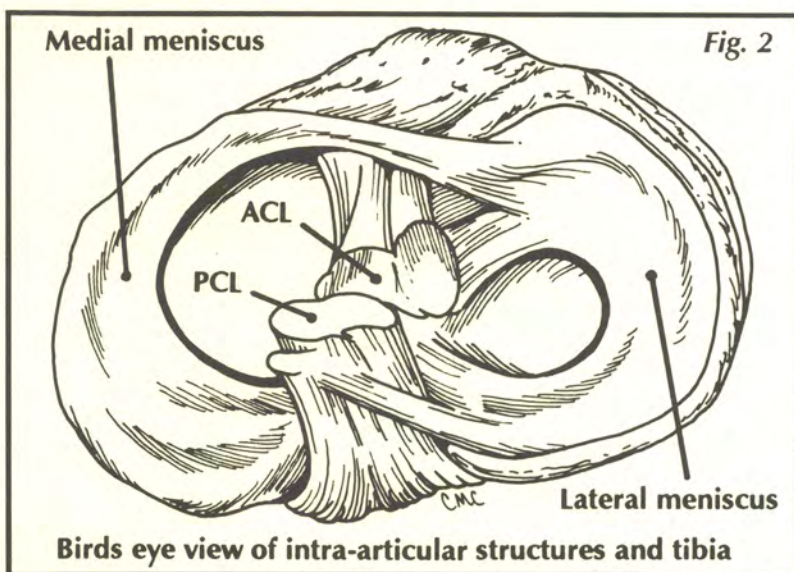
the lower end of the femur, or thigh bone (see Fig. 1). Because of its location, the primary function of the ACL is to provide stability to the knee by resisting forward motion of the upper leg, especially when the knee is slightly bent. Its location also means that it is easily stretched by the force that is applied to the knee in sports.

It is rare for the ACL to be the only ligament torn when a knee is injured. Most often, damage also occurs to the **medial** or **lateral** extra-articular ligaments. This damage causes uncontrolled excessive joint motion or instability. In addition, the **menisci**,

the crescent-shaped cartilage structures that cushion the joint, are frequently torn along with the ACL.

If the ligaments located along the medial side of the knee are damaged, the knee tends to buckle inwards (Fig. 3A), whereas if the lateral ligaments are damaged, the knee tends to buckle outwards (Fig. 3B). These unstable motions can be quite disabling, especially in physically demanding occupations or in sports that require rapid turning or change of direction.

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Nonsurgical Treatment of ACL Injuries

Recovery Without An Operation

The main goal of nonsurgical treatment is to allow patients to be free of discomfort and to return to the work and the sports activities they were involved in before they were injured. Not all patients, however, can be treated nonsurgically, and the decision to pursue this form of treatment should be made in consultation with your doctor. Nonsurgical management of an ACL injury is divided into three general phases: **acute**, **sub-acute**, and **advanced**.

Three Phases of Treatment

In the **acute** phase (right after the injury has occurred), treatment is started immediately to minimize pain and swelling. Ice and a snug bandage are applied to the injured knee, and the leg is elevated (Fig. 4). If the knee is significantly unstable because of the injury, a brace or cast is applied to prevent further damage. Crutches can provide additional protection while walking. Basic **isometric** exercises to strengthen the **quadriceps** and **hamstring muscles** may be started during the acute phase (Fig. 5).

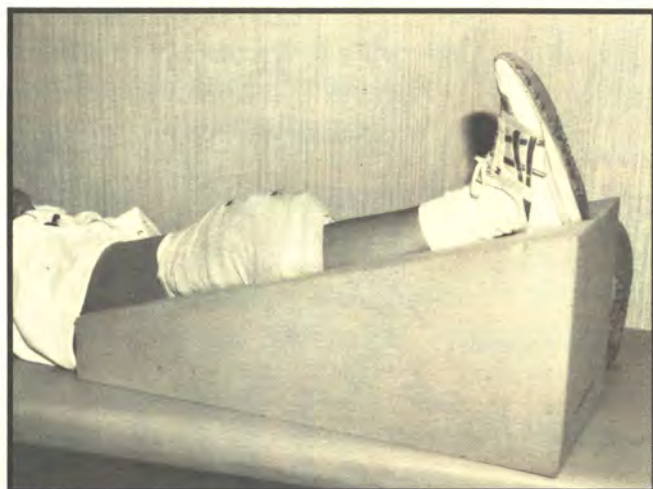


Fig. 4

The **subacute** phase begins after the pain and swelling have been brought under control. The primary aim during this phase is to protect the ACL and other joint structures from further damage; to re-establish full, painless range of knee motion; and to strengthen the muscles surrounding the knee. To accomplish this, a physical therapist measures the muscle girth, muscle strength, and range of motion of the injured knee and designs a specific exercise program based on the assessment.

Early in the subacute phase, the patient can perform basic rehabilitation exercises for the hip, knee, and calf muscles, as well as range of motion exercises for the knee. The intensity of these exercises is determined by the number of repetitions accomplished and any changes in the resistance, speed, or frequency with which the exercises are performed. Emphasis is placed on strengthening the hamstring muscles (which must now compensate for the weakened ACL) so that their strength, power, and endurance are equal to or greater than that of the quadriceps muscles (Fig. 6). Gentle flexibility exercises also are started at this time.

Once adequate range of motion and functional control of the knee are achieved, the patient begins more difficult exercises, such as stationary bike riding, side step-ups, balancing activities, squats, jumping rope, and walking. Testing and rehabilitation can also be performed with the use of isokinetic machines, such as the Cybex dynamometer.

The **advanced** phase is dedicated to returning the patient to their preinjury level of activity.

Transition from the

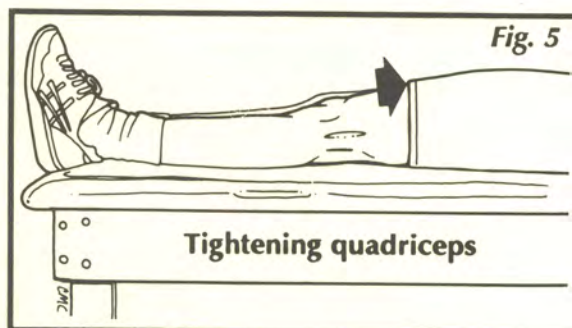


Fig. 5

Tightening quadriceps

subacute to the advanced phase is marked by the start of a running program. Running is not begun, however, until strength in the affected leg has been regained and any limp has been eliminated. The patient begins the running program with light jogging, progresses to short sprints, and finishes with cutting and agility drills. To return to athletic competition, the patient must be able to complete drills and activities specific to his or her sport without swelling of the knee joint or episodes of the knee "giving way."

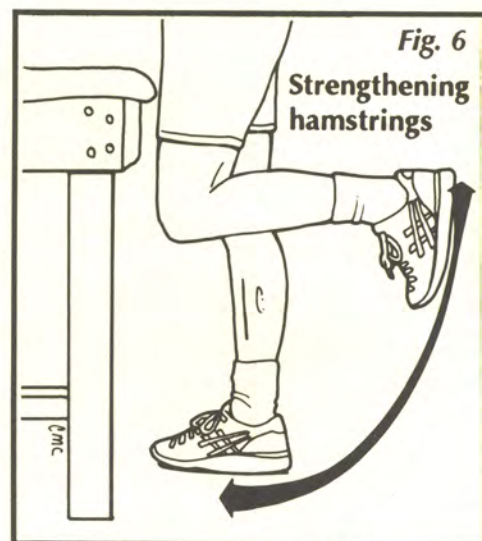


Fig. 6

Strengthening hamstrings

The keys to successful rehabilitation include a personalized, structured exercise program supervised by trained personnel and the motivation and perseverance to remain committed to the exercise program until the goals are achieved.

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Extra-articular Reconstruction After an ACL Tear

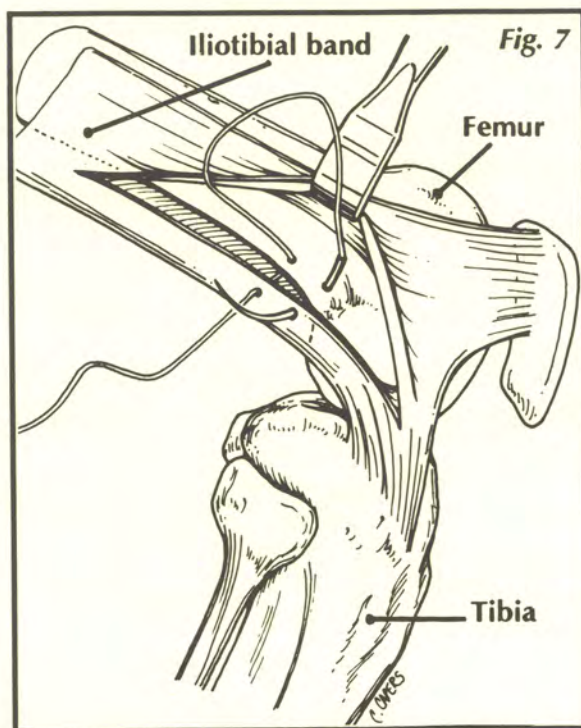
Surgical options for knees that are painful and unstable after an injury include intra-articular or extra-articular reconstruction, or a combination of the two. With intra-articular reconstruction, the surgeon replaces only the ACL, which is located within the joint capsule. With extra-articular reconstruction, the surgeon repairs injured ligaments that are part of or outside the capsule.

In the past, reconstruction of the extra-articular ligaments was the sole means of stabilizing knees with a torn ACL. In recent years, however, many of these knees have been treated with intra-articular reconstruction. The main disadvantage of extra-articular reconstruction is the prolonged rehabilitation after surgery, which begins with a 6-week period of immobilization.

"So," you might ask, "who would need extra-articular surgery?" **The procedure continues to be used in young children and adolescents who are still growing (intra-articular surgery cannot be done in these cases) and in adults with decreased activity levels who will not place excessive demands on their knees.** It is also used in combination with intra-articular reconstruction in adults with excessive functional instability due to injury to multiple extra-articular ligaments, as well as the ACL.

The primary goal of extra-articular reconstruction is to eliminate "giving way," or the excessive forward motion and rotation of the **tibia** on the **femur**, a condition that occurs when both the ACL and the lateral

ligaments are injured. Although there are different extra-articular techniques to accomplish this goal, all are aimed at creating a restraining band on the lateral (outside) aspect of the knee by attaching the **iliotibial band** to the outside of the femur, just above the knee joint (Fig. 7).



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Rehabilitation After Extra-articular Surgery

Extra-articular surgery refers to operations performed to repair damage to knee ligaments that lie outside of the joint, the so-called capsular ligaments. Extra-articular surgery may be performed alone or in conjunction with ACL or PCL reconstruction.

In the latter case, the rehabilitation program after surgery is the same as that for cruciate (ACL or PCL)

reconstruction. When extra-articular surgery is performed alone, a rather different recovery course is followed.

After extra-articular surgery, the patient's leg is immobilized in a long-leg cast, with the knee bent between 45° and 60°, for approximately six weeks. During this time, exercises to maintain proper circulation and improve quadriceps muscle strength are performed frequently.

When the cast is removed, the knee will be tight and stiff and the muscles weak. A physical therapy program is begun to restore range of motion of the joint and to increase the strength of the muscles surrounding the knee, primarily the quadriceps and hamstring muscles.

Range of motion is restored with active exercises (in which the patient performs the motions without assistance) using the power of the quadriceps. Exercises are performed three times a day. Swimming pool exercises can also be used to improve range of motion. As the quadriceps becomes stronger, the rehabilitation program is geared toward the patient's regaining the ability to straighten the knee an average of 10° to 15° a month.

Crutches are used for walking until the patient is almost able to straighten the knee completely (to 10° or less of full extension. When the patient is able to flex the knee to 110°), stationary bike riding exercises are started. Weight-resistance exercises and functional exercises geared to returning the patient to his or her sport or previous lifestyle also are begun. To accomplish this goal, the patient must have normal range of motion and good quadriceps strength. Complete rehabilitation takes approximately nine months, but this will vary, of course, with individual patients.

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Substitutions for the ACL: Autografts/Allografts/Prostheses

Once the decision has been made to reconstruct a torn ACL, the surgeon must select a **graft** material to replace the ligament. Several options are available: an **autograft**, an **allograft**, or a **prosthetic ligament**. Autografts are tissue (usually a portion of the **patellar tendon**) taken from the patient's own body. Allografts are obtained from a **cadaver**. Prosthetic ligaments are made of artificial materials such as Gore-Tex. All have been successfully used; however, the most commonly used graft is the patellar tendon graft. Because prosthetic ligaments have a high rate of failure at this time, the U.S. Food and Drug Administration limits their use of to cases where multiple, previous surgical attempts to replace the ACL have failed.

Autografts/Allografts: Patellar Tendon Graft Surgery

The patellar tendon, or patellar ligament, connects the bottom of the patella with the tibia. Most often, it is the middle third of this tendon that is removed and used for an ACL substitute (Fig. 8). Small pieces, or plugs, of bone where the tendon attaches to the patella and to the tibia are also removed along with the strip of tendon to create the graft that replaces the torn ACL (Fig. 8A).

Once the graft has been obtained, the surgeon (often using an **arthroscope** rather than "opening up" the knee) looks into the joint for any other damage that may have occurred when the ACL was injured. In particular, both menisci are checked for tears. If torn, the meniscus is either partially removed or is repaired with stitches. The stumps of the torn ACL are removed.

The surgeon is then ready to replace the ACL with the graft.

First, the locations where the torn ACL was attached to the tibia and femur are determined, and a special instrument is used to drill a tunnel through these two bony areas (Fig. 8B). When the drilling is complete, the patellar tendon graft is passed through the tunnels. The graft is then positioned with the bone plugs lying above the knee in the femoral tunnel and below the knee in the tibial tunnel. At this point, the patellar tendon is situated in the center of the knee joint in the same location as the previously intact ACL (Fig. 8C).

When the surgeon is satisfied with the graft placement, the graft is "anchored" at both ends to prevent slipping. This is accomplished by placing a large screw into the bony tunnels of the tibia and femur (Fig. 8D). The bony piece of the graft is "squeezed" between the screw and the bony side of the tunnel to provide strong fixation. This step is important to the rehabilitation process because it allows the physical therapist to bend and straighten the patient's knee without fear of the graft slipping. The patient is encouraged to begin moving the knee as soon after surgery as possible.

The usual hospital stay after surgery is two to three days. This allows the patient time to become familiar with the rehabilitation exercises, to regain motion of the knee, and to begin walking without assistance. During this period, the surgeon also is able to observe the surgical results, correct any problems, and monitor the healing process.

Prosthetic Ligaments

Prosthetic, or artificial, ligaments from synthetic materials were originally developed to avoid potential problems such as blood-borne diseases (hepatitis, AIDS), associated with graft tissue obtained

from patients or cadavers.

Since then, however, it has been discovered that an advantage of prosthetic ligaments is that these grafts maintain their strength immediately after surgery. This is not the case with autografts or allografts, which are significantly weak during the early period following surgery because of diminished blood supply. Thus, patients with prosthetic ligaments do not require the postoperative protection necessary for those who receive human tissue replacement grafts.

The major disadvantage to using a prosthetic ligament is that the graft is subject to failure from "wear and tear," or abrasion. Once the prosthetic ligament has been placed inside the knee, the bony surfaces of the joint tend to damage the ligament where contact is made. This causes graft particles to be shed into the joint. If enough particles are shed, there is resultant joint irritation, leading to fluid build-up within the knee, pain, muscle weakness, and possible failure of the graft.

The Hughston Orthopaedic Clinic has studied one of the largest groups of patients with prosthetic ligament implants in this country. Although after implantation most patients had a decrease in pain, swelling, locking, and "giving way" of the knee, 55% of the results were considered unsatisfactory because of the presence of persistent abnormal joint motion. Of note, however, is that many of these patients with unsatisfactory results considered their knee improved by surgery and felt, therefore, that the procedure was successful. Ten percent of the patients required replacement of the prosthetic ligament with a new prosthetic ligament because the original graft failed.

It is important to keep in mind that the failure rate in these patients' knees is higher than would be

expected with a normal population because the patients approved by the F.D.A. for inclusion in this study had undergone multiple surgical attempts that failed to stabilize their knee. It is anticipated that new developments in

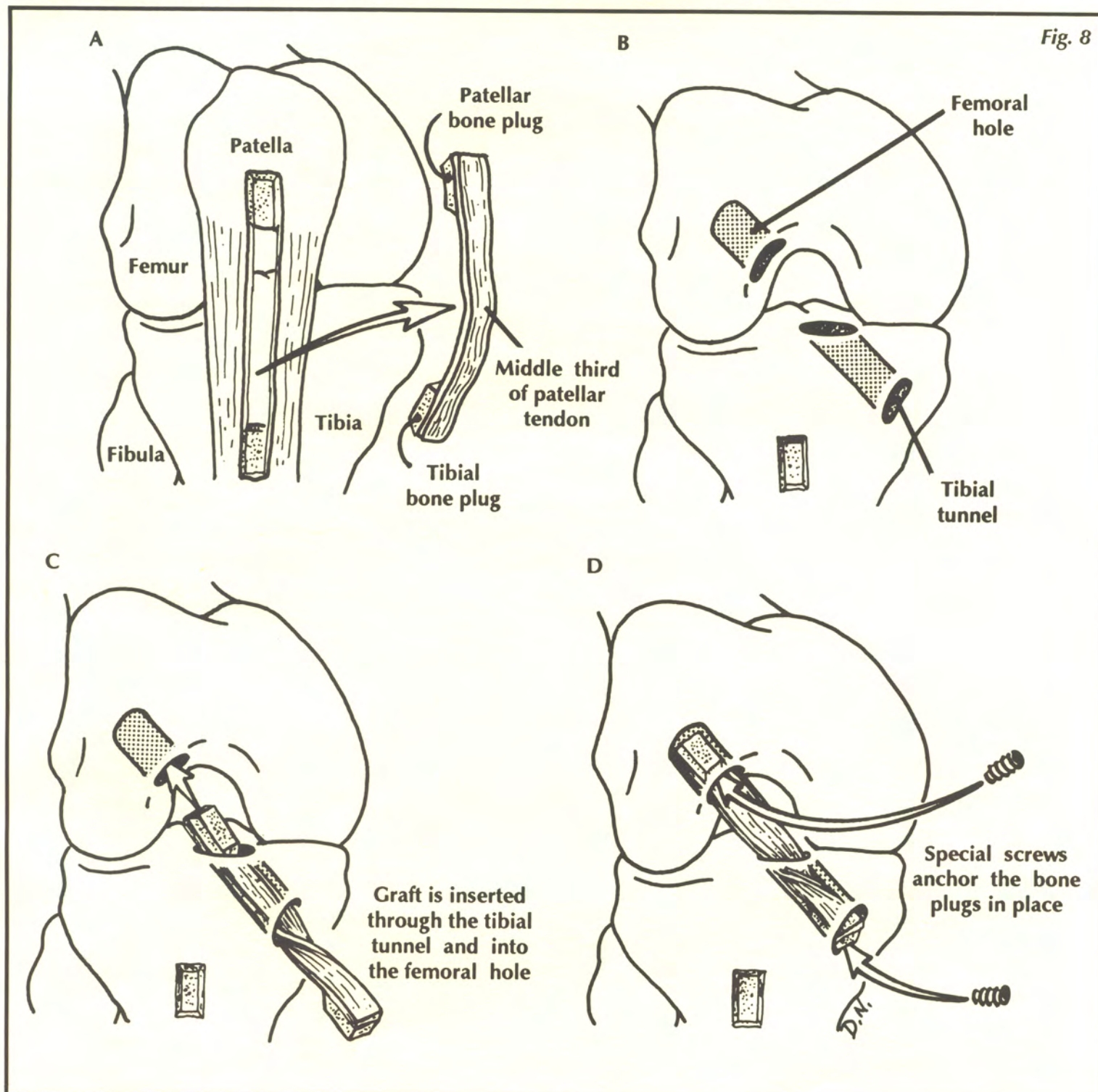
technique and material will make the use of prosthetic grafts a better alternative for these patients.

At this time, prosthetic ligaments are not an alternative to human tissue grafts in first-time ACL reconstructive

surgery. Further research is needed to determine the role they will eventually play in knee ligament surgery.

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ACL SUBSTITUTION USING A PATELLAR TENDON GRAFT



Rehabilitation After Intra-articular Reconstruction: A More Rapid Return

Unlike the rehabilitation that follows extra-articular surgery, the recovery program following intra-articular procedures is characterized by rapid resumption of full mobility, early strengthening, and early weightbearing. The anticipated time of return to participation in one's preinjury activities (e.g., sports) may be sooner, as well, but care should be taken to protect the graft in the first 6 to 12 months after surgery.

Further, whenever intra-articular surgery is done (even if in association with an extra-articular procedure), rehabilitation should be conducted as it is for an isolated intra-articular procedure.

Because of concern over the strength of the graft and the belief that straightening the knee past the last 30° of extension would place excessive stress on the graft, patients were rehabilitated while avoiding this last 30° of extension. As a result, these patients did not achieve full **extension** after surgery, and overall outcome was not as good as hoped.

Since then, research by orthopaedic surgeons and physical therapists has shown the graft material to be very

strong, except for the very early postoperative period, and not stressed when the knee is fully extended. Overall rehabilitation time has been shortened from a previous minimum time of 10 to 12 months to 6 to 8 months. The primary reason for this quicker return to normal activities is the ability of the patient to regain full range of motion within 2 to 4 weeks after surgery. This decreases stiffness and pain, allowing the patient to strengthen the lower leg more quickly and thoroughly. The knee is immobilized with a special brace for anywhere from 2 to 20 weeks after surgery. The brace is removed during exercises. Crutches also are used for approximately 2 to 6 weeks after surgery.

Once the patient can **flex** and extend the knee fully, an aggressive daily exercise program performed twice a day is begun to strengthen the muscles around the knee. Within 3 to 4 days, the patient is allowed to put weight on the leg, as long as discomfort is minimal and swelling around the knee does not occur.

Approximately 1 month after surgery, exercises with weights are begun in a limited capacity. In addition, the patient is allowed to use a stair-climbing machine, again as long as swelling does not develop. At 2 to 3 months, depending on the patient's progress, agility exercises and one-legged balance activities are used to build up leg strength and

"reteach" the knee how to handle unusual stresses in a controlled situation. At 4 to 5 months, a jogging and running program is started.

With this earlier and more aggressive approach, rehabilitation outcomes have improved significantly, and patients usually are able to return to their previous lifestyle or sport within 8 to 10 months.

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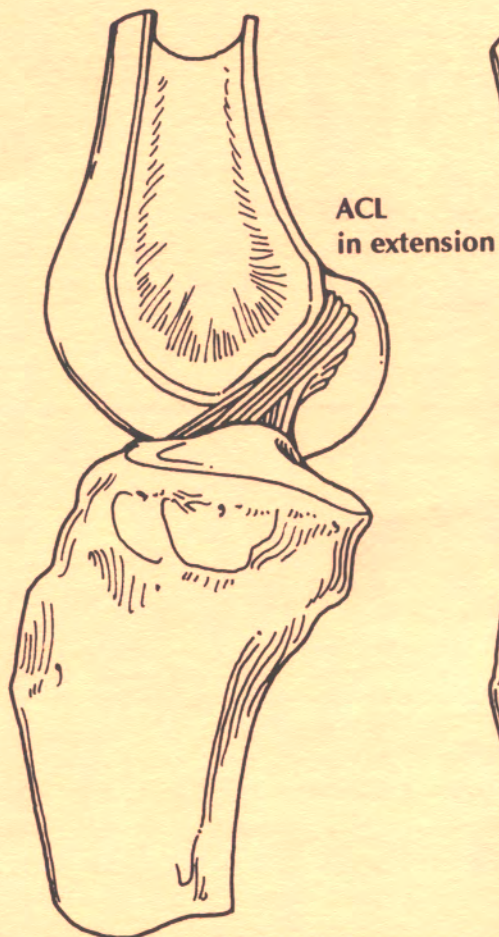
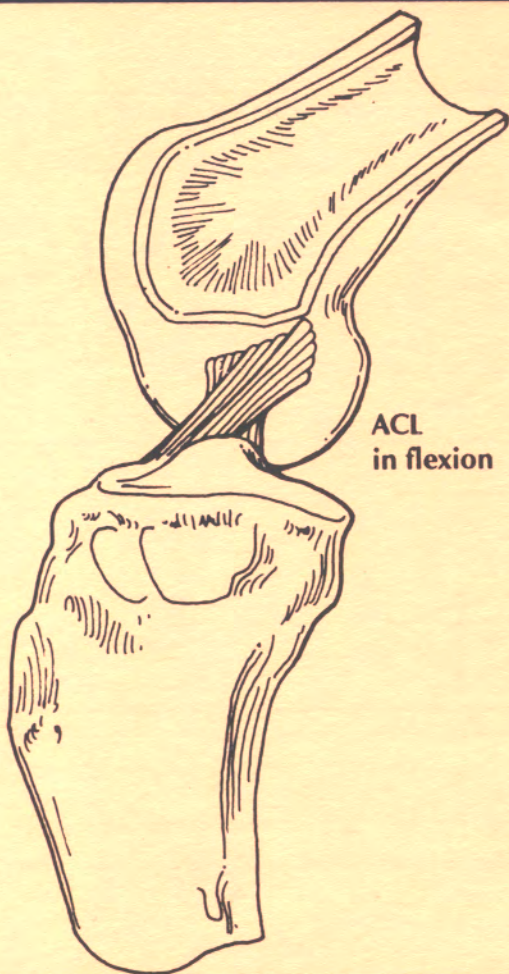
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