

Western New York



Cartilage Restoration Center

Restoring Function through Science

*Western New York
Cartilage Restoration Center*

*160 Farber Hall
3435 Main Street
Buffalo, New York 14214
(716) 829-2070*

www.wnycrc.buffalo.edu

*Affiliated with University Orthopaedic Services, Inc.
and the University at Buffalo School of Medicine & Biomedical Sciences*

Joint pain is not normal. It does not need to be tolerated as it is not “just a part of the aging process.” Rather, joint pain is your body’s “warning light.” As with your car, you should find the source of the problem causing the warning light to activate.

Similarly, you should not merely take pain medication to mask joint pain; you should determine the source of the pain. The problem could be a small one which responds quickly to an exercise program, or a more involved process requiring surgery; ignoring the problem is the wrong approach.

Cartilage injury is the most common source of knee pain. 20 to 70% of all knee injuries involve the articular cartilage. Over two million people in the U.S. suffer cartilage problems each year. The cause may be secondary to injury, or may develop gradually without trauma. Whatever the cause, areas of damaged cartilage may cause pain and at times swelling; both of which make it difficult to maintain an active lifestyle. Fortunately there are several new treatment options, many only recently available.

The **Western New York Cartilage Restoration Center (WNYCRC)** has been established to offer a full range of contemporary treatment options for knee cartilage injuries. These include the latest minimally invasive procedures adapted for both arthroscopic and joint replacement surgery. Some techniques allow for outpatient treatment, while more advanced problems may require no more than an overnight stay or brief hospitalization. Our expertise comes from our ability to determine the underlying cause of the cartilage injury, and tailor treatment based on that individual need. We will match the physical demands of the patient’s lifestyle, and address predisposing conditions.

In some cases, not only will these procedures resolve pain and restore function, but may also delay the progression of arthritis. By sharing information on a regular basis with other regional Cartilage Restoration Centers in North America, our surgeons and research assistants are striving to advance cartilage restoration.



Our Mission

The WNYCRC dedicates itself to the treatment of knee disorders involving the injury and aging of articular cartilage. The WNYCRC was founded based on the need for specialized patient care, and strongly emphasizes the importance of patient education and research. Our center employs safe and innovative techniques for restoring cartilage injury, and is supported by validated outcome studies.

Our Staff

The staff at the WNYCRC is composed of both **arthroscopic** (cartilage restoration) and **arthroplasty** (cartilage replacement) board certified orthopaedic surgeons.

Each of our staff members has spent an additional year of training in a fellowship program specifically designed for the treatment of articular cartilage injuries of the knee. These fellowships include some of the top ranked hospitals in the country; including Johns Hopkins, Harvard (Massachusetts General) and the Cleveland Clinic. Our staff all carry UB faculty appointments in the School of Medicine and Biomedical Sciences.

Our affiliation with the University at Buffalo, its research facilities, and resources allows us to provide state of the art care in diagnosing and treating cartilage injuries.

William M. Wind Jr., M.D. (Director)

Geoffrey A. Bernas, M.D.

Lawrence B. Bone, M.D.

Marc S. Fineberg, M.D.

Kenneth A. Krackow, M.D.

Matthew J. Phillips, M.D.

Michael A. Rauh, M.D.

Robert J. Smolinski, M.D.

Knee Basics

The knee has the difficult task of transferring the load of the body, while at the same time having the freedom to allow rapid change of direction and speed.

This necessary twisting and rotating adds to the stress the joint endures. With certain activities, the knee is subjected to nearly ten times body weight (another reason to keep body weight optimal).

The Knee Joint

The knee joint is made up of three bones, two different types of cartilage and four major ligament groups. The bones in the knee are:

Femur (thigh bone): At the knee joint there are two separate prominences called condyles. Touching your knees together brings the inside condyles closer together—the medial femoral condyles. The outer condyle is the lateral femoral condyle. The motion of the condyles includes rocking, gliding, and rotating.

Tibia (shin bone): Meets the femur at the knee with two areas on which the two femoral condyles “ride.” These are the medial and lateral tibial plateaus.

Patella (knee cap) - Rides in a shallow groove (or sulcus) over the front part of the femur called the trochlea. The patella acts as a lever arm to help the quadriceps muscle extend the knee.

The ends of these bones are covered by **articular (hyaline) cartilage**. This glistening white substance has somewhat the consistency of firm rubber, but is actually a mixture of collagen and special large sponge-like molecules, all maintained by living cells (chondrocytes). With normal joint fluid, the surface is more slippery than water on ice. This allows the normal smooth and easy joint motion.

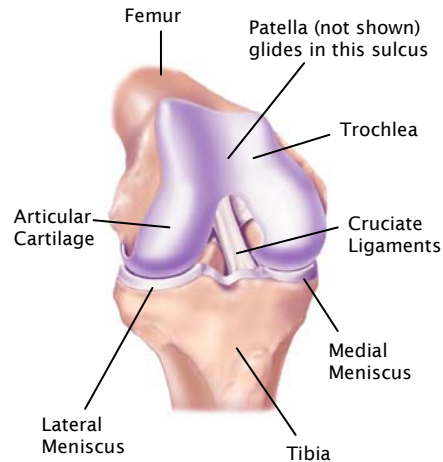
The other type of knee cartilage is called the **meniscal (fibro) cartilage**. These C-shaped pads are located between the thigh bone and shin bone. There is one meniscus on each side of the knee.

The **medial meniscus** resides on the inner thigh aspect and **lateral meniscus** on the outer side. These menisci are attached predominantly to the tibial plateaus. They serve as shock absorbers for the articular cartilage and transfer joint force. They accomplish this by distributing joint forces over a larger area of the joint, transferring force from the curved femoral condylar margins to the flatter tibial plateaus.

Injury to either type of cartilage can upset the normal loading of the joint. This “injury” is not limited to trauma; it may occur with normal daily activities. Once the delicate balance of the knee is upset, the resulting abnormal loads then lead to “overload damage”. Over time, initially small defects in the articular cartilage, or tears in the meniscal cartilage can progress. This gradual deterioration can lead to degenerative joint disease (*osteoarthritis*).

Ligaments

Ligaments are rope-like structures which connect two bones. There are four main ligaments in the knee: two inner, cruciate (cross) and two outer, collateral (side) ligaments. The main function of the knee ligaments is to stabilize the knee joint and to protect the articular cartilage and menisci from injury.



Conservative Approaches

Activity Modifications, Weight Control, & Rehabilitation

Patients are counseled to maintain an active lifestyle, with the avoidance of high impact activities. Weight reduction will decrease the load on the knee. Strengthening and flexibility exercises are encouraged to increase muscular support. The use of a knee sleeve or an unloader brace may improve knee joint position sense or unload diseased articular cartilage, respectively.

Antiinflammatories & Nutritional Supplementation

Nonsteroidal anti-inflammatory medications (NSAID's) work by decreasing the inflammation in the joint. Over-the-counter nutritional supplements (Glucosamine & Chondroitin Sulfate) are vitamin pills for the knee cartilage, and have shown to be effective for some patients. These supplements are important because there are no nutrients for articular cartilage present in our every day diet.



Injections—Corticosteroid & Viscosupplementation

Judicious use of corticosteroid injections (3-4 times per year) can result in a decrease in joint pain, but will not prevent cartilage disease progression. More frequent injections may actually harm the articular cartilage.

Viscosupplementation (joint lubricants) help to restore the smooth gliding function and improve the biochemical environment of the knee joint. One injection is given per week for three weeks for a total of three injections.



Results are variable and dependent on the degree of osteoarthritis present. Success tends to increase with milder forms of arthritis. When symptomatic improvement occurs, significant relief of symptoms can last for six months or longer.

The Meniscus

Tears of the meniscal knee cartilage represent the most common knee problem leading to surgery in America. Meniscus damage can occur with activities of daily living without specific trauma, as well as trauma that occurs in sport or the work place.



Once there is an injury to the meniscal cartilage, the body's response is often pain and swelling. At times, the knee may "lock", "give way" or "go out". The meniscal tear causes the body's weight to be distributed unevenly.

As a result of increased stress over time, articular cartilage may break down, which can lead to degenerative arthritis.

Preserving the Meniscus

The goal of the WNYCRC is to maintain normal anatomy. In the case of meniscal tears, the first line treatment is an attempt at repair. Historically, in the days of open meniscus surgery, the entire meniscus was removed. With the advent of arthroscopy, standard treatment evolved to remove only the damaged area.

Unfortunately, long term follow up studies of these patients have found that many go on to develop degenerative arthritis. Today, cartilage surgeons recognize the protective value of the meniscal cartilage, and make every effort to preserve this valuable tissue.

Restoring the Meniscus

To maintain the meniscal function following a tear, surgeons may repair the meniscus using a variety of techniques. Repair is performed arthroscopically using special sutures or absorbable implants to secure the tear. Only tears located in the periphery of the meniscus where there is a good blood supply for healing are amenable to repair.

Even with the newest techniques available, certain tears are not repairable due to the location and pattern of the tear. A partial meniscectomy with removal of only the torn cartilage is then performed. The remainder of the meniscus is preserved to maintain its function.

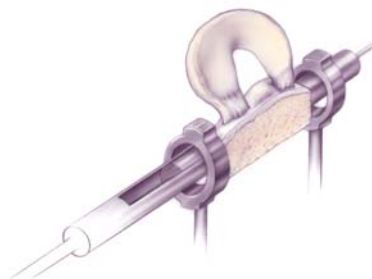


Suture Repair of Meniscal Tear

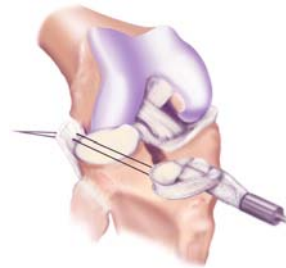
Meniscus Transplantation—Replacing the Meniscus

For patients who have had the meniscus removed from a prior surgery, the WNYCRC offers an innovative solution called a meniscal transplant. It is important to remember that even though only a part of the meniscus was removed, at times the effect on the knee from a biomechanical standpoint is the same as a total meniscectomy.

This procedure is indicated for younger patients who have not yet developed significant arthritis. Unlike other forms of tissue transplantation, this procedure does not require patients to be on medications to prevent rejection. Using this technique, a donated meniscus (tested for transmittable diseases) is transplanted under arthroscopic guidance to fulfill the role of the native meniscus and delay the progression to arthritis. Intermediate term follow-up studies in the literature are encouraging.



Preparing/Shaping the Meniscal Transplant



Inserting the Meniscal Transplant into Place

Future Trends

Investigators are now examining the potential of using collagen or another biological tissue to serve as a bridge or scaffold for the body's own healing/repair mechanism to use in re-establishing meniscal form and function. The long term goal is to prevent the development or progression of arthritis. Through this effort, it is hoped that it may be possible to eliminate or decrease the need for later surgeries such as a total knee replacement.

Articular Cartilage Restoration

The glistening white tissue that covers the ends of the bones (the joint surface) is known as the articular cartilage. It is made of a material called hyaline cartilage which is both tough and resilient. It is not only important for smooth gliding of the joint, but also to “soften” the impact during loading, much the same as a shock absorber.

Articular cartilage may not appear to be alive, but in fact it is. The number of cells (chondrocytes) which reside in the tissue is indeed small (approximately 1-5%), but they have the job of keeping the matrix around them healthy. Think of the cells as a few marshmallows suspended in a jello (the matrix) mold.

As with most body tissues, there is a constant wear out and replacement activity of this matrix. The cells (marshmallows) keep the matrix (jello) repaired. Unfortunately, the cells themselves do not replicate, and thus articular cartilage has a low capacity for healing once injured.

Once the cells are damaged or lost, the surrounding matrix gradually degenerates. Without help, the body is typically unable to repair these articular cartilage defects. Both superficial and deep cartilage injuries may lead to osteoarthritis. The larger the cartilage defect, the faster the potential for progression of arthritis. It is at that point that the WNYCRC surgeons consider helping the body start a healing response.

Early Intervention

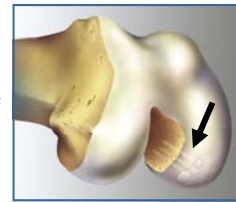
The WNYCRC offers several options for regeneration and/or repair of damaged articular cartilage. From the proceeding discussion, it is easy to appreciate the need for early intervention, because without intervention, degeneration may occur. Methods that address articular cartilage damage include:

Arthroscopic Chondroplasty and Cartilage Repair

Using the familiar arthroscopic approach through 1/4 inch incisions, surgeons locate the damaged cartilage (chondral) tissue and trim away or stabilize (repair) the area. This prevents flaking off of the damaged tissue, which often irritates the lining of the joint leading to swelling.

The “clean up” or debridement surgery of the joint surface is called a chondroplasty. This technique is aimed at relieving pain, without repair of the cartilage defect. When the area of injury is less than one centimeter (3/8”), it has a low probability of progressing provided the knee has normal alignment, stability and menisci.

When the injured cartilage breaks off with a small piece of bone attached, the cartilage may potentially be repaired to its native location with small absorbable pins. This procedure is termed cartilage repair.



Cartilage Repair

Microfracture

The body can be stimulated arthroscopically to produce repair tissue. This repair tissue develops from cells brought to the area in the blood deep to the bone underneath the cartilage. The repair cells enter through small holes made through the bone by using a small “ice pick” to create microfractures.

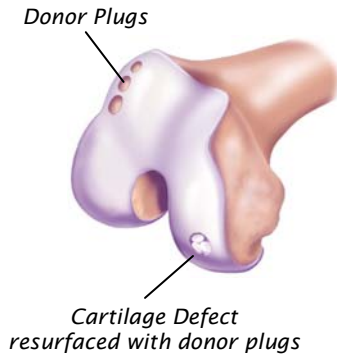


Microfracture Instrumentation

This can be thought of as repairing “potholes” (cartilage defects) in a road, to lessen the problem of the hole spreading to involve the whole road. The “potholes” fill in with a form of scar cartilage, which has biomechanical properties inferior to normal cartilage. It may not last as long as a “normal road”, but these techniques are successful in eliminating symptoms for many patients.

Repairing Larger Defects— Cartilage Restoration

For patients with more extensive cartilage damage, the WNYCRC offers a number of different methods for cartilage restoration.



Osteochondral Autograft

This technique is analogous to a hair-plug transfer. The surgeon removes a small cylindrical section of the patient's own cartilage along with the underlying bone plug. This is obtained from an area which does not participate in high loading.

The typical site of harvest is at the margin of the femoral trochlea, where the patella glides; if that area is involved with damage then this technique may not be possible. The size of the defect treatable with this method is usually between one and two square centimeters, or slightly larger than a thumbnail.

This bone and cartilage (hence osteo—chondral) local graft is then transferred to the defect where a receiving hole has been prepared. Obviously, there is a limit to the amount of tissue available for "harvesting". The advantage of this technique is the transfer of normal, mature cartilage to the area of injury. The donor, nonweightbearing area will eventually heal with scar cartilage, much like the micro-fracture technique.

Autologous Cartilage Cell Implantation

For articular cartilage defects greater than two centimeters, one of the more advanced techniques for cartilage restoration is ACI (Autologous Chondrocyte Implantation).

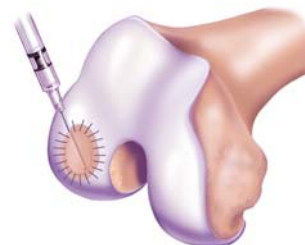
This technique originated in Sweden over ten years ago and was initially available in the United States in 1995. ACI was approved by the FDA in 1997 and has since been implemented at Cartilage Restoration Centers across the U.S.



Chondrocyte Harvest

ACI is a two stage process. The first stage may be performed when initially assessing the knee joint arthroscopically. A small amount of the patient's own articular cartilage is harvested from a nonweightbearing area. Through cell growth and culturing techniques, the cell chondrocyte number is increased from a few hundred thousand to over 10 million cells.

These autologous (your own) cultured chondrocyte cells are then implanted in the knee in a second surgical procedure, under a patch which is sewn to the neighboring cartilage. As per the jello-marshmallow analogy, the chondrocyte cells (the marshmallows) represent only 1-5% of the volume of the matrix (the jello). These cells must synthesize (create) matrix over several months to reestablish the articular surface.

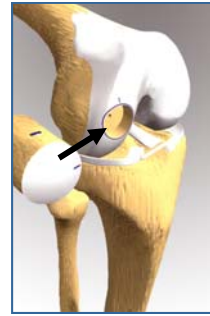


Chondrocyte Implantation

Osteochondral Allograft

For larger defects of both bone and cartilage loss, surgeons may custom fit an implant of freshly donated cadaver cartilage and bone. This implant is press fit into the prepared articular cartilage-bone defect.

Specialized instruments provide for the precise matching of the donated tissue. This transplant may allow restoration of the joint surface.



*Osteochondral Allograft
Insertion into prepared defect*

Future Techniques

Biologic tissue engineering is continuing to transfer exciting new approaches from the lab to the clinical arena. It may be possible to use primitive cells from the bone marrow or periosteum (which have the potential to develop into several different types of cells, thus called pluripotent cells or in this case mesenchymal stem cells) and induce them to transform into hyaline cartilage.

A variety of growth factors or local hormones may also be developed to create the right "local environment" for hyaline cartilage to grow and remain healthy, or even allow the hyaline cartilage to heal itself. Also in the early testing phase are a variety of patches to directly repair a defect. These biopatches, such as porcine small intestinal submucosa (SIS) have demonstrated the ability to take on the characteristics of the tissues where implanted elsewhere in the body.

Other biopatches may have the predominant purpose of acting as a temporary home for chondrocytes or "pre-chondrocytes". They may be used to deliver and maintain the cells in proper position until the healing response takes effect. This exciting field will offer many new options which will hopefully lead to opportunities for restoring function by less invasive means.

Ligament Reconstruction

Knee stability is important to protect the articular and meniscal cartilage from injury. Patients who tear their anterior cruciate ligament (ACL) are at risk for further damage to these structures if they desire to continue in activities such as running, jumping and pivoting on the knee.

For this reason, it is recommended that patients undergo arthroscopic-assisted reconstruction of this ligament to protect the knee. ACL reconstruction may be performed in conjunction with the above cartilage restoration procedures in those patients with combined injury.



For current updates, please visit our website

www.wnycrc.buffalo.edu

Anterior Cruciate Ligament Reconstruction

Established Arthritis

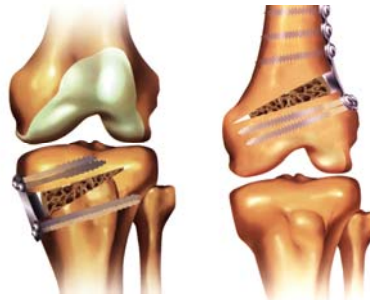
The end stage of cartilage injury or degeneration is arthritis. Many patients suffer for years with arthritis that limits even the simplest activities. For these patients, current cartilage restoration procedures may not apply. These patients have diffuse involvement of cartilage degeneration as opposed to a focal injury. Cartilage is eventually worn down to "bone-on-bone."

When patients have developed established arthritis, joint replacement, not restoration, procedures are recommended. The WNYCRC provides the entire spectrum of care for knee cartilage injury and thus also offers a number of joint replacement and realignment options.

Osteotomy

Normally, our legs are straight from our hips to our ankles. Some patients may develop a "knock-knee" or "bow-leg" deformity over time. This is referred to as knee malalignment.

When the bones do not align properly, joint forces are not evenly distributed and may overload one side causing pain and possibly degeneration. An osteotomy is a cut in the femur or tibia bone for the purpose of realignment to a straight leg. The cut in the bone is then typically fixed with a plate and screws.



Knee Osteotomy for Malalignment

After healing, the bones are in a new position and force (weight) is shifted from the overloaded or damaged side to the more normal or underloaded side of the joint. Osteotomies have gained wide acceptance for treatment in younger or athletic patients with mild-moderate arthritis on one side of a malaligned knee joint.

Joint Replacement

Unicompartmental Joint Replacement

This procedure replaces the worn cartilage in just one compartment (side) of the knee with metal and/or plastic, leaving the remainder of the knee intact. It is less invasive than a total knee replacement with a shorter recovery time, but requires a stable knee with minimal arthritis in the neighboring compartments.

Patellofemoral Knee Replacement

Similar to a unicompartmental knee replacement, the patellofemoral knee replacement replaces only the worn articular surface underneath the patella and its articulating trochlear surface. It is indicated for those patients with isolated patellofemoral arthritis after failure of more conservative treatment options.

Total Joint Replacement

If there is extensive damage which precludes the use of the above procedures, then the entire knee joint surface is replaced with metal and plastic components. In this technique, the femoral condyles, tibial plateau and patellofemoral cartilage surfaces are all resurfaced. A total knee replacement typically results in significant pain relief, and increased mobility and function for many years.



Metal and Plastic Components for Total Knee Replacement

Computerized "Navigational" Knee Replacement

Computer assisted total knee replacement is a technique being performed regionally only at the WNYCRC. Each cut in the bone during a total knee replacement is checked using infrared beams and a computer.

The end result is a knee replacement with perfectly placed components for optimal patient results and function.

In the future, all knee replacements will be computer assisted, but currently it is only offered at certain hospitals, and only by the orthopaedic surgeons at the WNYCRC.



*Computerized
"Navigational" Knee System*

Results & Research

With the appropriate indications, treatment of cartilage injuries has proven to have excellent results in most patients. We have found this through careful record keeping and patient outcome studies.

Our affiliation with the University at Buffalo and the Center for Advanced Technology provides our staff with the latest technologies and basic science necessary to offer our patients the highest quality of care and best chance at a successful result.

At the WNYCRC our goal is *"restoring function through science"*.

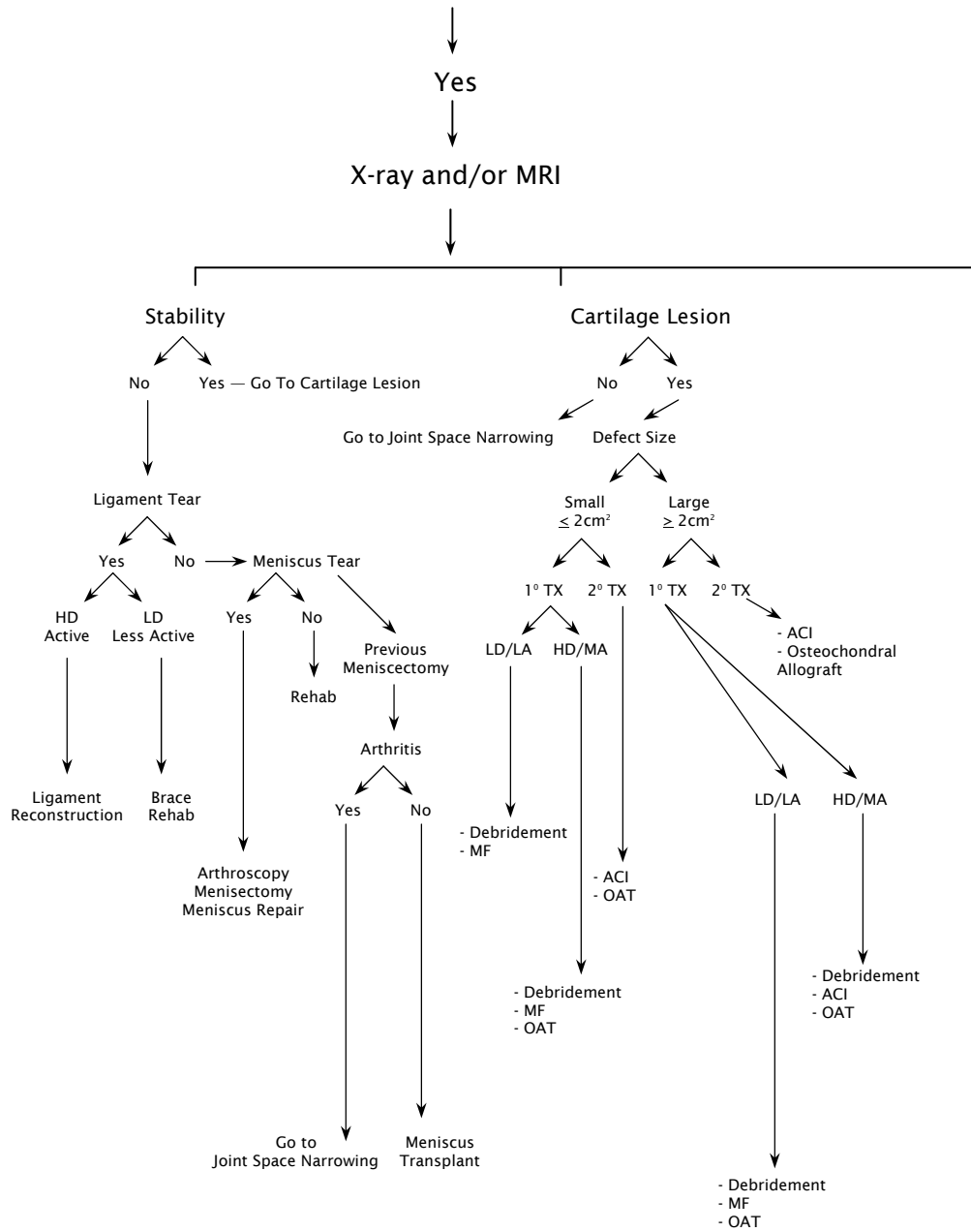
We are a division of the University at Buffalo Department of Orthopaedics and University Orthopaedics, Inc.

The physicians and staff of the WNYCRC are dedicated to providing you with the latest health and wellness information; we encourage you to visit our web site at www.wnycrc.buffalo.edu and add it to your bookmarks.

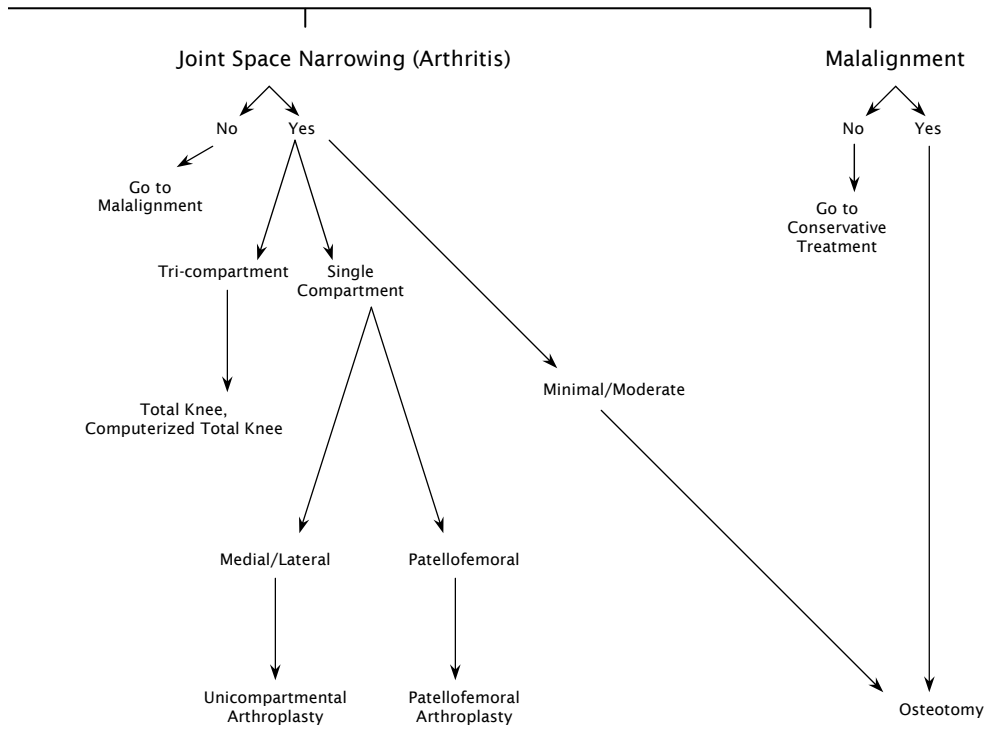
For more information, or to schedule an appointment, please call us at (716) 829-2070

Knee Algorithm

KNEE SYMPTOMS (*pain, catching, swelling, giving way*)



→ NO - Conservative Treatment (NSAID's, Rehab, Injection)



HD = High Demand
LD = Low Demand
10 = Primary Treatment
20 = Secondary Treatment
ACI = Autologous Chondrocyte Implantation
OAT = Osteochondral Autograft Transplant
MF = Microfractures
NSAID = Nonsteroidal Anti-inflammatory Drug

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