Joint Pathologies
Cartilage Injuries of the Knee – causes, assessment and treatment

Knee injuries are one of the most common causes of athletes not being able to play their sport or participate in their event. This is especially the case in sports such as football, skiing, rugby and any type of netball. Most injuries of this type are self-limiting and can be managed without surgery. Knee pain following such injuries can be caused by damage to extra-articular structures or intra-articular structures. Extra-articular structures include the medial or lateral collateral ligaments, the patellar tendon, ligament and retinacula, bursae and muscles and tendons adjacent to the knee. Intra-articular structures comprise the menisci, the anterior and posterior cruciate ligaments and the articular cartilage (hyaline cartilage and joint surface).

The term cartilage regarding knee injuries is sometimes used loosely and can be given different interpretations. For instance, a patient or athlete with a damaged cartilage often has an injury to one of the menisci, while to the doctor, damaged cartilage is an injury to the joint lining articular cartilage.

Cartilage Biology

Cartilage is a specialized connective tissue and is present at several sites in the skeleton, such as ears, intervertebral discs and lining the surfaces of synovial joints, as examples. There are three main types of cartilage; hyaline cartilage, fibrocartilage (the menisci are made of this), and elastic cartilage. These each differ in structure and function. In the knee, hyaline (articular) cartilage provides a smooth, white, glistening layer covering the femur, tibia and undersurface of the patella. The main functions of this hyaline cartilage are: (a) to provide a sort of shock-absorbing structure which can withstand compression, tension and shearing forces, and dissipate load, and (b) to provide an almost frictionless articulating surface.

Hyaline cartilage in the knee has to deal with repetitive mechanical forces that can sometimes reach 65 times that of body weight. It is well adapted for this by way of its biochemical and biophysiological properties: it is composed of a network of collagen fibers and a proteoglycan matrix within which lie cartilage cells. The collagen is responsible for the tensile strength while the proteoglycan matrix, which is 80% water, resists compressive forces.

The issue with articular cartilage is that it lacks an arterial blood supply, venous and lymphatic drainage and derives its nutrition primarily from the synovial fluid and to some extent from the adjacent bone. This has implications with regard to healing since superficial lesions rely solely on very slow cell mitosis and regeneration for repair. Deeper lesions which involve the underlying bone along with the cartilage heal better because there is direct access of the repair cells in the bone to the cartilage defect. This type of repair is still not ideal as the type of cartilage produced is not the original hyaline cartilage, but fibrocartilage which is not as well adapted to the mechanical forces.
generated on weight bearing. It is important to understand the difference between these two forms of repair as it forms the rationale behind the treatment options for these type of injuries.

Causes of Injury
Most articular cartilage defects are caused by trauma. This can either be one single impact injury, such as the edge of the patella, or repeated micro trauma. A specific group of cartilage damage is called osteochondritis dissecans. This is a well-demarcated small area of cartilage and underlying bone that both lose their blood supply and then die. Eventually these will fragment and separate into the knee joint.

A Clinical Look
Often the features of articular cartilage damage are non-specific. These include intermittent pain and swelling. The client may also present with locking or giving way if the fragment has separated into the joint. On examination, there will usually be muscle wasting or inhibition, a reduced range of movement and tenderness over the site of the damage. Often this will be the medial femoral condyle or the patella.

In cases of acute trauma, the patient may have a haemarthrosis (the rapid accumulation of blood in the knee). The fact there is blood in the knee indicates that the cartilage defect is deep and goes down to bone. This is essentially a fracture in the knee and should always be included in the differential diagnosis; the other main causes are an anterior cruciate ligament tear, a peripheral meniscal injury and a severe bone bruise.

Assessments
Since all the above findings can be present in a number of knee pathologies, it can be difficult to confidently reach a clinical diagnosis on clinical findings only. Plain x-rays will only show cartilage damage if it is associated with underlying bone injury, and then small lesions can be easily missed. Lesions appear as a line of demarcation around a small area of bone if the lesion is still attached, land as a crater or loose body if separation has occurred.

A better assessment will use magnetic resonance imaging (MRI) scanning. This will not only show the osteochondral lesion clearly, but will also provide information about the surrounding bone, menisci and anterior cruciate ligament. MRI scanning still compares poorly to direct inspection of the joint surface at the time of an arthroscopy.

Arthroscopies are now common operations where the inside of the knee is viewed with a camera and any necessary procedures undertaken through keyhole scars. At arthroscopy, cartilage defects can be identified and treated. Arthroscopy will also provide the opportunity for the surgeon to examine the knee under anesthesia, inspect and probe the entire articular surface, remove any loose bodies and inspect the menisci and the cruciate ligaments.
Treatment
Chondral damage has been documented in up to 61.5% of knee arthroscopies and it is estimated that 41,000 surgical procedures to repair cartilaginous defects are performed annually in the United States.

The outcome of the treatments available does not depend solely on the surgical intervention itself, but also on the exact nature of the cartilage defect. Size, depth, location, associated pathologies and chronicity will all contribute to the outcome of surgery and have to be taken into account when comparing different treatments.

The goal of any intervention would be the formation of a durable repair tissue providing symptomatic relief, allowing high physical activity and delaying the option of replacement surgery.

Treatment Types
Lavage and debridement involves arthroscopy to remove any unstable articular cartilage flaps. This helps relieve symptoms in three ways: (a) it may help to relieve mechanical symptoms due to unstable cartilage flaps; (b) it can decrease the synovitis and joint effusion induced by cartilage debris; (c) the lavage itself may decrease the concentrations of intra-articular inflammatory mediators. Some reports show a satisfactory early outcome in 68% of patients with such treatment.

Drilling and microfracture during knee arthroscopy involve penetration of the bone just beneath the cartilage defect in an attempt to replace the defect by fibrocartilage. The response to this is unpredictable and while at first it may appear gratifying, the repair tissue lacks the important biomechanical properties of the hyaline cartilage and soon becomes fibrous and then will deteriorate. So this is not for all.

Osteochondral paste, periosteal and perichondral grafting techniques involve taking different tissues from around the knee and transplanting them into the cartilage defect. Osteochondral paste is produced by using a graft of cartilage and underlying bone taken from elsewhere in the knee. This paste is then placed in a microfractured defect. Up to 94% pain relief at two years has been reported in one study using this technique. Periosteal and perichondral grafts are composed of the tissue lining the surface of bone and cartilage respectively. The advantage of such grafts is that they can be placed on large defects and it is believed that cells present in these grafts can give rise to cartilage resembling the original hyaline cartilage. There have been encouraging results from animal models, but this has yet to be proven clinically – it is still quite experimental.

Autologous chondrocyte implantation is a fairly new and exciting new focus. First described in clinical trials in 1994, it involves harvesting cells from the upper outer medial aspect of the femoral condyles during a preliminary arthroscopy. These biopsies are then enzymatically treated and the cartilage cells obtained cultured in vitro. The cultured cells are then reimplanted on to the cartilage defect at a second procedure. The knee is opened, the defect debrided and the cultured cells implanted and secured with a periosteal graft taken from the tibia. This retaining graft is made watertight by adding
fibrin glue over the sutured repair. The original results were encouraging with an excellent outcome in 88% of patients after 32 months. Biopsies of the resultant repair are described as hyaline-like tissue. This technique most likely leads to a more durable repair than that produced by marrow stimulation techniques such as microfracture. In centers with the necessary expertise, it is an ideal option for an isolated large cartilage defect.

Osteochondral allografts involve transplanting cadaveric osteochondral fragments so as to replace the cartilage defect. Disadvantages include donor availability, tissue treatment and handling, and the fear of disease transmission. The best results have been for post traumatic defects in young individuals. There are still unanswered questions regarding immunogenicity, host reactions, mechanical properties, and long-term function.

Sterile artificial matrices which might support and toughen the repair fibrocartilage formed on the surface of joints have been studied. The synthetic scaffolds would provide the initial framework from which the healing process could progress. Such matrices include fibrinogen-based products such as collagen gels, polylactic/polyglycolic meshes, and hydrophilic polymers. These techniques are still under investigation but have been overtaken by the previously described biological techniques.

Osteotomies around the knee are used for articular defects that are too large or advanced to be treated by the above methods. This will be used to delay the progression of generalized arthritis and joint replacement surgery. It involves breaking the femur or the tibia in a controlled manner so as to alter the alignment of the leg. These alignment changes result in a redistribution of forces in the knee. This can protect an early degenerate compartment in the knee. This is the treatment of choice if there is obvious malalignment of the knee.

From: Joseph Borg; Sports Injury Bulletin

**Various Other Joint Conditions:** most of the following information you can also look up in your Pathology text book.

**Osgood-Schlatter Disease**

This is a condition where there is a painful swelling of the tibial tuberosity. This disorder could be due to microtrauma. It can develop in one or both legs. The condition is seen most often in active children, with boys affected more than girls.

This disorder is typified by painful swelling just below the knee at the tibial tuberosity. The area is tender to pressure, and swelling ranges from minimal to very severe. Running, jumping and climbing stairs cause discomfort.
Unlike sprains and other injuries, it is usually not very serious, according to the medical professionals, and has no long term effects other than constant, progressive pain that occurs upon activity. Often medical personnel consider this growing pains or overuse.

Consider that in actuality the rectus femoris muscle is chronically shortened creating a condition in which the patellar tendon and patellar ligaments are pulling on the tibial tuberosity. This will begin to actually lift the periosteum off the bone at the tibial tuberosity allowing blood to fill in that space. Over time, this continues and the blood begins to calcify. As more blood enters and it too calcifies, the tibial tuberosity begins to grow in size respectively.

In most cases, a patient who seeks medical attention for this condition is turned away. Consider what a massage therapist could do to help this person out of pain permanently. By first warming the quadriceps muscles, then providing lengthening techniques for the rectus femoris, a massage therapist could actually stop the progression of this condition. The client would also have to be taught a few very strong, specific stretches for the rectus femoris and then be compliant in performing them daily.

**Patellofemoral Syndrome**

PFS is a condition in which the patellar cartilage becomes damaged as it contacts the femoral cartilage. This situation can be a precursor of osteoarthritis of the knee.

PFS is almost always associated with overuse, though it may be precipitated by a specific injury or trauma. For some time the term patellofemoral syndrome was interchanged with the term Chondromalacia patellae; however, it is now recognized that these terms refer to significantly different types of knee problems. More current synonyms for PFS include anterior knee pain syndrome and over utilization syndrome.

If the patellar cartilage is going to wear out, it usually happens in one of two ways. Each of us is born with a different amount of cartilage on the patella. People with thick cartilage genes may never get PFS. For those with thin cartilage genes, it takes less use to wear through it and end up with PFS.

The second way to wear out the cartilage is misalignment of our knees. If the patella is pulled slightly to one side or the other, the wear on the cartilage is uneven and leaves the person with cartilage damage. The uneven tracking of the patella with PFS usually occurs toward the lateral aspect of the knee.

Symptoms include pain that is usually felt on the anterior aspect of the knee, stiffness after long immobility, difficulty walking down stairs, and a crackling, grinding noise upon movement.

In its early stages, it is difficult to diagnose as there is no visible damage to the bones. Often what is called PFS is really patellar tendinitis. This is significant because while
PFS is largely unaffected by massage, patellar tendinitis responds well and could end up being a pain-free resolution. One clue as to this different condition being the case is if it hurts going up the stairs, where PFS will hurt going down the stairs. These two conditions can both be present, however. It will take imaging type of scans to determine a definitive diagnosis.

Although PFS damage to the patellar cartilage may set up osteoarthritis in the knee, PFS seldom gets to the point of requiring joint replacement. The condition can be irritated by jarring and bouncing type of knee impact, so certain types of activity must be replaced by another type such as swimming, walking, cycling, or skating. This person will want to experiment to find the exercise that works best for him or her.

Physical therapy will often include exercises to strengthen and balance tension in the muscles that cross the knee and that influence the knee’s alignment.

**Osteoarthritis**

Osteoarthritis is the most common type of arthritis. This is also known as degenerative joint disease. This is a condition of synovial joints, especially the weight-bearing ones. They become irritated and inflamed. This is distinguished from other types of arthritis by being directly related to wear and tear of the joint structures.

Again, this is the most common type of arthritis in the world. It affects up to 20 million Americans and is responsible for 7 million doctor visits yearly. It is an occupational hazard for massage therapists due to using too much pressure on joints of the hands if good mechanics are not practiced!!!

Joints, especially the knees and hips, take lots of weight-bearing stress and repetitive movements; their design is to be efficient and durable. Inside the joints, however, the environment is unstable. Any imbalance will have cumulative destructive impact. Once this has begun it is possible to stop its progress, but there will be no regeneration.

This person will have inflammation of a joint capsule. It may be hot, painful and swollen if acute. Mostly it lingers in the chronic state, however. There will be ongoing pain and stiffness, especially if overused. This can be debilitating if it occurs at the hip or knee as it is constantly exacerbated by movement.

**Related Pathologies**

What is degenerative arthritis? Patients are often confused by the diagnosis of degenerative arthritis. What happens during this process? Can degenerative arthritis affect any joint? Are there any treatments which stop the degenerative process?
Facet Arthropathy: this is caused by facet joints becoming arthritic and painful. Facet arthropathy can be a cause of back pain.

What are osteophytes? These are commonly known as bone spurs. They can develop in deteriorating joints damaged by arthritis.

Rheumatoid arthritis versus Osteoarthritis: These are the two most common types of arthritis. There are specific symptoms and distinguishing characteristics which determine the diagnosis and course of treatment.

Paget’s disease of bone versus osteoarthritis: Paget’s disease of bone is completely different from osteoarthritis, yet some of the symptoms are the same. This is a chronic bone disorder where healthy bone is rapidly reabsorbed and replaced with fibrous connective tissue that never fully calcifies. When it causes symptoms, they usually include deep bone pain, local heat, and sometimes visible deformation of the affected bones. There will be a high risk of fracture.

Osteoporosis versus osteoarthritis: While they have similar names, there are two very different conditions with little in common. Due to the name similarity, people confuse them. While it is possible to have both, studies show that people with osteoarthritis are less likely to develop osteoporosis. While people with rheumatoid arthritis may be more likely to develop osteoporosis.

**Osteoporosis**

The word literally means porous bones. In this condition calcium is pulled off the bones faster than it is replaced, leaving them tinned, brittle, chalky and prone to injury. This affects an estimated 10 million Americans, yet it is estimated that up to 18 million more have significant bone thinning and are unaware of it. It affects women about five times more often than men for several reasons: women have lower bone density to begin with; they bear children which is a drain on calcium reserves; and changes in hormone levels have a great influence on how well calcium is added to bone mass.

Small boned, thin women get this condition more often than others. Women who are post menopausal and/or have a history of anorexia are at high risk. White and Asian women are most likely to develop this condition, but African-American and Hispanic women can also develop it.

Bone density is determined only about 60% by heredity and 40% by controllable factors such as diet, smoking, exercise, and stress levels.

Complications of this condition center around pathologically weak bones. Thinning vertebrae lead to a loss of height and the characteristic hyperkyphosis. Chronic and/or acute back pain appears in this stage as the vertebrae continue to degenerate. People with this condition are also prone to other fractures with little or no cause; these are called spontaneous or pathologic fractures. Hips, vertebrae, and wrists are particularly
vulnerable to breakage. Because older folks are naturally low on living osteocytes and growth hormones to help the healing process, it is difficult for them to recover from any severe injury.

Once identified, there are a number of treatment opportunities for osteoporosis. This will be to keep it from getting worse, it cannot be reversed. One treatment is hormone replacement therapy for women. Post menopausal women are very low in estrogen and so this replaces it to help improve calcium uptake. The problem with this is that it is estrogen supplements that are also associated with breast and uterine cancers. There are some studies that show that estrogen supplements are quite ineffective for some. There is a synthetic version of this hormone, Calcitonin. It is said to stimulate osteoblasts and so is another option for treatment.

Exercise will always be part of a treatment strategy for osteoporosis. Weight-bearing stress ensures that maintaining healthy mass is a high priority. So, with this condition, gentle weight training or walking is more beneficial than low-impact cardiovascular exercises such as swimming.

Diet will also be important for this person. Specific vitamins and other substances may improve calcium uptake, even for postmenopausal women.

Massage at this point will be different from person to person. Massage can offer relief from symptoms, but will not reverse the degeneration of bone tissue. One must remember that the bones are at risk when applying pressure.

**Rheumatoïd Arthritis**

RA is an autoimmune condition in which the synovial membranes of various joints are attacked by immune system cells. Unlike most forms of arthritis, RA can also involve inflammation of tissues outside the musculoskeletal system.

This disease affects 2.1 million Americans. Women are affected about three times more frequently than men. It is most common among 20 – to – 40 year olds, but anyone, even children, can get it.

All autoimmune diseases are brought about by a mistake in the vastly complex and usually very effective immune system: normal, healthy tissues are mistakenly identified as threatening invaders and are attacked by immune system agents. Some autoimmune diseases are triggered by pathogens that closely resemble some part of the body’s own proteins. A pathogen’s protein coat needs to have only five amino acids in the same order as some normal, healthy part of the body to trigger a response.

With this disease the synovial membrane thickens and swells. Fluid inside the joint capsule begins to accumulate, which causes pressure and pain. These inflamed tissues release enzymes that erode cartilage, eventually right down to the bone. The joint becomes deformed looking gnarled. Usually this is where it stops, but it may go a couple
of steps further: Fibrous scar tissue may develop to connect the raw ends of bones, then
the scar tissue ossifies and the joint becomes permanently fused and is usually crooked.

Usually a person gets this disease under control after some years and goes into remission.
In this day and age, only about 10% of affected people are permanently disabled.

RA can be difficult to diagnose due to its early symptoms being subtle. Also the
symptoms vary greatly from person to person and are similar to symptoms of many other
conditions. Diagnosis usually consists of a description of symptoms, radiographs, and a
blood test to check for rheumatoid factor.

Once confirmed, the goals of treatment will be to reduce pain, limit inflammation, halt
joint damage, and improve function. There are various medications to help meet these
goals.

Only during the subacute phase of RA should one be massaged.

Gout

Gout is one of the oldest diseases in recorded medical history. It has been known as the
disease of kings because it is associated with rich diets and decadent living. The
following is a list of people from history who suffered with gout: Alexander the Great,
Henry VIII of England, Charles V of Spain and his son Phillip II, Dr. Samuel Johnson,
Wolfgang von Goethe, and Benjamin Franklin.

Gout affects men more than women by a wide margin: 90% of gout sufferers are men
who get this disease at about age 75. 10% of gout sufferers are women, and most of
those are post menopausal. There are about one million gout sufferers in the United
States.

Under normal circumstances, uric acid, which is a naturally occurring by product of
protein digestion, becomes extracted from the blood by the kidneys. If the kidneys are
unable to perform this function due to too much uric acid being present or due to being
otherwise impaired, hyperuricemia (having too much uric acid in the system) develops.
This is the primary risk factor for gout.

The transition from hyperuricemia to acute gout is often begun with a specific event such
as binge eating or drinking, surgery, or a systemic infection. All of these change fluid
levels in the body. When uric acid consolidates, it forms sharp, needle-like crystals that
accumulate in and around the foot, grinding on and irritating synovial capsules, bursae,
tendons, and other tissues. The foot may be the primary area due to gravity, but it may
also have to do with the lower temperature found in the extremities that aids the
crystallization process. Usually this person will go to bed feeling alright, then wakes in the night with a foot that is red, throbbing, and painful.

In later stages there will be deposits of sodium urate (called tophi) develop inside joints. These tophi begin to erode all the joint structures, leading to a complete loss of function. Tophi also grow along tendons and in subcutaneous tissues. They have been found in myocardium, pericardium, aortic valves, and even the ear.

Problems begin with kidneys. With metabolic gout, the kidneys may be functioning normally, but the body is producing too much uric acid for them to keep up. This will be the case with a diet high in protein and alcohol. With renal gout, the uric acid load may be normal, but the kidneys are not functioning well enough to handle the job of excreting the uric acid. It ends up in the blood stream and then in the feet. There can also be cases where both are the issue.

Gout is usually easily recognized by its specific pain profile; however, it sometimes mimics other conditions such as rheumatoid arthritis and septic arthritis. This person must use pain relief drugs other than aspirin, anti-inflammatory drugs, and drugs that modify metabolism and uric acid management. One could take preventive measures including increasing water intake, losing weight and limiting rich foods.

**Ankylosing Spondylitis**

AS is a spinal inflammation (spondylitis) leading to stiff joints (ankylosis). These joints will become permanently fused. AS is a progressive inflammatory arthritis of the spine caused by an autoimmune reaction. It is sometimes called rheumatoid spondylitis.

This is an inherited condition that most often affects men between 16 and 35 years of age. About 1% of the American population have some degree of this condition; 90% are males.

This will usually begin at the sacroiliac joint on one or both sides. Usually it occurs to spinal joints, but it may also affect hips, shoulders, toes and sternoclavicular joints. The affected joints become inflamed acutely. Once the inflammation subsides, the bony surfaces inside joints have become damaged. This condition works its way up the spine damaging vertebrae that may end up fused into flexion. If the progression get to the neck, the cervical vertebrae may fuse with the head in a permanently flexed position.

This usually presents as chronic low back pain in the beginning. It is diagnosed by way of blood tests and radiographs. It may be difficult to identify in its early stages.
Test Your Knowledge – There are two parts to this assignment.

1) Please thoroughly answer all eight questions below (please do not cut and paste someone else’s answers). The assignment is set up to allow you to post a word processing document, so copy the questions and type your answers onto the document. Once your document is complete upload it onto Moodle.

2) Once you have done your research, follow the discussion forum instructions.

1. How is osteoporosis diagnosed and treated? Will massage help it? How? If not, can it hurt it?

2. What are the differences between rheumatoid arthritis and osteoarthritis? If there are any similarities, what are they?

3. What are the differences and similarities between Paget’s disease of bone and osteoarthritis? When is massage indicated for Paget’s?

4. What are the differences between osteoarthritis and osteoporosis? If there are any similarities, what are they?

5. If you had a client with PFS, would you use massage to help the condition? If so, under what circumstances should you massage, and which circumstances would you not massage?

6. Explain what Ankylosing Spondylitis is. What is the best course of treatment for someone with Ankylosing Spondylitis?

7. What recommendations would you give someone who has been diagnosed with osteoporosis? Include any referrals you would make as well.

8. Would you perform massage on someone with gout? If so, under what circumstances would it be appropriate? When wouldn’t it be appropriate?