

= Osteochondritis dissecans =

Osteochondritis dissecans ( OCD or OD ) is a joint disorder in which cracks form in the articular cartilage and the underlying subchondral bone . OCD usually causes pain and swelling of the affected joint which catches and locks during movement . Physical examination typically reveals an effusion , tenderness , and a crackling sound with joint movement .

OCD is caused by blood deprivation in the subchondral bone . This loss of blood flow causes the subchondral bone to die in a process called avascular necrosis . The bone is then reabsorbed by the body , leaving the articular cartilage it supported prone to damage . The result is fragmentation ( dissection ) of both cartilage and bone , and the free movement of these bone and cartilage fragments within the joint space , causing pain and further damage . OCD can be difficult to diagnose because these symptoms are found with other diseases . However , the disease can be confirmed by X @-@ rays , computed tomography ( CT ) or magnetic resonance imaging ( MRI ) scans .

Non @-@ surgical treatment is rarely an option as the ability for articular cartilage to heal is limited . As a result , even moderate cases require some form of surgery . When possible , non @-@ operative forms of management such as protected reduced or non @-@ weight bearing and immobilization are used . Surgical treatment includes arthroscopic drilling of intact lesions , securing of cartilage flap lesions with pins or screws , drilling and replacement of cartilage plugs , stem cell transplantation , and joint replacement . After surgery rehabilitation is usually a two @-@ stage process of immobilization and physical therapy . Most rehabilitation programs combine efforts to protect the joint with muscle strengthening and range of motion . During the immobilization period , isometric exercises , such as straight leg raises , are commonly used to restore muscle loss without disturbing the cartilage of the affected joint . Once the immobilization period has ended , physical therapy involves continuous passive motion ( CPM ) and / or low impact activities , such as walking or swimming .

OCD occurs in 15 to 30 people per 100 @,@ 000 in the general population each year . Although rare , it is an important cause of joint pain in physically active adolescents . Because their bones are still growing , adolescents are more likely than adults to recover from OCD ; recovery in adolescents can be attributed to the bone 's ability to repair damaged or dead bone tissue and cartilage in a process called bone remodeling . While OCD may affect any joint , the knee tends to be the most commonly affected , and constitutes 75 % of all cases . Franz König coined the term osteochondritis dissecans in 1887 , describing it as an inflammation of the bone ? cartilage interface . Many other conditions were once confused with OCD when attempting to describe how the disease affected the joint , including osteochondral fracture , osteonecrosis , accessory ossification center , osteochondrosis , and hereditary epiphyseal dysplasia . Some authors have used the terms osteochondrosis dissecans and osteochondral fragments as synonyms for OCD .

= = Signs and symptoms = =

In osteochondritis dissecans , fragments of cartilage or bone become loose within a joint , leading to pain and inflammation . These fragments are sometimes referred to as joint mice . OCD is a type of osteochondrosis in which a lesion has formed within the cartilage layer itself , giving rise to secondary inflammation . OCD most commonly affects the knee , although it can affect other joints such as the ankle or the elbow .

People with OCD report activity @-@ related pain that develops gradually . Individual complaints usually consist of mechanical symptoms including pain , swelling , catching , locking , popping noises , and buckling / giving way ; the primary presenting symptom may be a restriction in the range of movement . Symptoms typically present within the initial weeks of stage I ; however , the onset of stage II occurs within months and offers little time for diagnosis . The disease progresses rapidly beyond stage II , as OCD lesions quickly move from stable cysts or fissures to unstable fragments . Non @-@ specific symptoms , caused by similar injuries such as sprains and strains , can delay a definitive diagnosis .

Physical examination typically reveals fluid in the joint , tenderness , and crepitus . The tenderness may initially spread , but often reverts to a well @-@ defined focal point as the lesion progresses . Just as OCD shares symptoms with common maladies , acute osteochondral fracture has a similar presentation with tenderness in the affected joint , but is usually associated with a fatty hemarthrosis . Although there is no significant pathologic gait or characteristic alignment abnormality associated with OCD , the patient may walk with the involved leg externally rotated in an attempt to avoid tibial spine impingement on the lateral aspect of the medial condyle of the femur .

= = Causes = =

Despite much research , the causes remain unclear but include repetitive physical trauma , ischemia ( restriction of blood flow ) , hereditary and endocrine factors , avascular necrosis ( loss of blood flow ) , rapid growth , deficiencies and imbalances in the ratio of calcium to phosphorus , and problems of bone formation . Although the name " osteochondritis " implies inflammation , the lack of inflammatory cells in histological examination suggests a non @-@ inflammatory cause . It is thought that repetitive microtrauma , which leads to microfractures and sometimes an interruption of blood supply to the subchondral bone , may cause subsequent localized loss of blood supply or alteration of growth .

Trauma , rather than avascular necrosis , is thought to cause osteochondritis dissecans in juveniles . In adults , trauma is thought to be the main or perhaps the sole cause , and may be endogenous , exogenous or both . The incidence of repetitive strain injury in young athletes is on the rise and accounts for a significant number of visits to primary care ; this reinforces the theory that OCD may be associated with increased participation in sports and subsequent trauma . High @-@ impact sports such as Gymnastics , soccer , basketball , lacrosse , football , tennis , squash , baseball and weight lifting may put participants at a higher risk of OCD in stressed joints ( knees , ankles and elbows ) .

Recent case reports suggest that some people may be genetically predisposed to OCD . Studies in horses have implicated specific genetic defects .

= = Pathophysiology = =

Osteochondritis dissecans differs from " wear and tear " degenerative arthritis , which is primarily an articular surface problem . Instead , OCD is a problem of the bone underlying the cartilage , which may secondarily affect the articular cartilage . Left untreated , OCD can lead to the development of degenerative arthritis secondary to joint incongruity and abnormal wear patterns .

OCD occurs when a loose piece of bone or cartilage partially ( or fully ) separates from the end of the bone , often because of a loss of blood supply ( osteonecrosis ) and decalcification of the trabecular bone matrix . The loose piece may stay in place or slide around , making the joint stiff and unstable . OCD in humans most commonly affects the knees , ankles , and elbow but can affect any joint .

In skeletally immature individuals , the blood supply to the epiphyseal bone is good , supporting both osteogenesis and chondrogenesis . With disruption of the epiphyseal plate vessels , varying degrees and depth of necrosis occur , resulting in a cessation of growth to both osteocytes and chondrocytes . In turn , this pattern leads to disordered ossification of cartilage , resulting in subchondral avascular necrosis and consequently OCD .

Four minor stages of OCD have been identified after trauma . These include revascularization and formation of granulation ( scar ) tissue , absorption of necrotic fragments , intertrabecular osteoid deposition , and remodeling of new bone . With delay in the revascularization stage , an OCD lesion develops . A lesion can lead to articular @-@ surface irregularities , which in turn may cause progressive arthritic deterioration .

= = Diagnosis = =

To diagnose osteochondritis dissecans , an X @-@ ray , CT scan or MRI scan can be performed to show necrosis of subchondral bone , formation of loose fragments , or both . Occasionally a nuclear medicine bone scan is used to assess the degree of loosening within the joint .

### == Physical examination ==

Physical examination often begins with examination of the patient 's gait . In OCD of the knee , people may walk with the involved leg externally rotated in an attempt to avoid tibial spine impingement on the lateral aspect of the medial condyle of the femur .

Next , the examining physician may check for weakness of the quadriceps . This examination may reveal fluid in the joint , tenderness , and crepitus . The Wilson test is also useful in locating OCD lesions of the femoral condyle . The test is performed by slowly extending the knee from 90 degrees , maintaining internal rotation . Pain at 30 degrees of flexion and relief with tibial external rotation is indicative of OCD .

Physical examination of a patient with ankle OCD often returns symptoms of joint effusion , crepitus , and diffuse or localized tenderness . Examination often reveals symptoms of generalized joint pain , swelling , and times with limited range of motion . Some with loose body lesions may report catching , locking , or both . The possibility of microtrauma emphasizes a need for evaluation of biomechanical forces at the knee in a physical examination . As a result , the alignment and rotation of all major joints in the affected extremity is common , as are extrinsic and intrinsic abnormalities concerning the affected joint , including laxity .

### == Diagnostic imaging ==

X @-@ rays show lucency of the ossification front in juveniles . In older people , the lesion typically appears as an area of osteosclerotic bone with a radiolucent line between the osteochondral defect and the epiphysis . The visibility of the lesion depends on its location and on the amount of knee flexion used . Harding described the lateral X @-@ ray as a method to identify the site of an OCD lesion .

Magnetic resonance imaging ( MRI ) is useful for staging OCD lesions , evaluating the integrity of the joint surface , and distinguishing normal variants of bone formation from OCD by showing bone and cartilage edema in the area of the irregularity . MRI provides information regarding features of the articular cartilage and bone under the cartilage , including edema , fractures , fluid interfaces , articular surface integrity , and fragment displacement . A low T1 and high T2 signal at the fragment interface is seen in active lesions . This indicates an unstable lesion or recent microfractures . While MRI and arthroscopy have a close correlation , X @-@ ray films tend to be less inductive of similar MRI results .

Computed tomography ( CT ) scans and Technetium @-@ 99m bone scans are also sometimes used to monitor the progress of treatment . Unlike plain radiographs ( X @-@ rays ) , CT scans and MRI scans can show the exact location and extent of the lesion . Technetium bone scans can detect regional blood flow and the amount of osseous uptake . Both of these seem to be closely correlated to the potential for healing in the fragment .

### == Classification ==

OCD is classified by the progression of the disease in stages . There are two main staging classifications used ; one is determined by MRI diagnostic imaging while the other is determined arthroscopically . However , both stagings represent the pathological conditions associated with OCD 's natural progression .

While the arthroscopic classification of bone and cartilage lesions is considered standard , the Anderson MRI staging is the main form of staging used in this article . Stages I and II are stable lesions . Stages III and IV describe unstable lesions in which a lesion of the cartilage has allowed synovial fluid between the fragment and bone .

== Treatment ==

Treatment options include modified activity with or without weight bearing ; immobilization ; cryotherapy ; anti @-@ inflammatory medication ; drilling of subchondral bone ; microfracture ; removal or reattachment of loose bodies ; mosaicplasty and osteoarticular transfer system ( OATS ) procedures . The primary goals of treatment are :

Enhance the healing potential of subchondral bone ;

Fix unstable fragments while maintaining joint congruity ; and

Replace damaged bone and cartilage with implanted tissues or cells that can grow cartilage .

The articular cartilage 's capacity for repair is limited : partial @-@ thickness defects in the articular cartilage do not heal spontaneously , and injuries of the articular cartilage which fail to penetrate subchondral bone tend to lead to deterioration of the articular surface . As a result , surgery is often required in even moderate cases where the osteochondral fragment has not detached from the bone ( Anderson Stage II , III ) .

== Non @-@ surgical treatment ==

Candidates for non @-@ operative treatment are limited to skeletally immature teenagers with a relatively small , intact lesion and the absence of loose bodies . Non @-@ operative management may include activity modification , protected weight bearing ( partial or non @-@ weight bearing ) , and immobilization . The goal of non @-@ operative intervention is to promote healing in the subchondral bone and prevent potential chondral collapse , subsequent fracture , and crater formation .

Once candidates for treatment have been screened , treatment proceeds according to the lesion 's location . For example , those with OCD of the knee are immobilized for four to six weeks in extension to remove shear stress from the involved area ; however , they are permitted to walk with weight bearing as tolerated . X @-@ rays are usually taken three months after the start of non @-@ operative therapy ; if they reveal that the lesion has healed , a gradual return to activities is instituted . Those demonstrating healing by increased radiodensity in the subchondral region , or those whose lesions are unchanged , are candidates to repeat the above described three @-@ month protocol until healing is noted .

== Surgical treatment ==

The choice of surgical versus non @-@ surgical treatments for osteochondritis dissecans is controversial . Consequently , the type and extent of surgery necessary varies based on patient age , severity of the lesion , and personal bias of the treating surgeon ? entailing an exhaustive list of suggested treatments . A variety of surgical options exist for the treatment of persistently symptomatic , intact , partially detached , and completely detached OCD lesions . Post @-@ surgery reparative cartilage is inferior to healthy hyaline cartilage in glycosaminoglycan concentration , histological , and immunohistochemical appearance . As a result , surgery is often avoided if non @-@ operative treatment is viable .

== Intact lesions ==

If non @-@ surgical measures are unsuccessful , drilling may be considered to stimulate healing of the subchondral bone . Arthroscopic drilling may be performed by using an antegrade ( from the front ) approach from the joint space through the articular cartilage , or by using a retrograde ( from behind ) approach through the bone outside of the joint to avoid penetration of the articular cartilage . This has proven successful with positive results at one @-@ year follow @-@ up with antegrade drilling in nine out of eleven teenagers with the juvenile form of OCD , and in 18 of 20 skeletally immature people ( follow @-@ up of five years ) who had failed prior conservative programs .

===== Hinged lesions =====

Pins and screws can be used to secure flap ( sometimes referred to as hinged ) lesions . Bone pegs , metallic pins and screws , and other bioresorbable screws may be used to secure these types of lesions .

===== Full thickness lesions =====

The three methods most commonly used in treating full thickness lesions are arthroscopic drilling , abrasion , and microfracturing .

In 1946 , Magnusson established the use of stem cells from bone marrow with the first surgical debridement of an OCD lesion . These cells typically differentiate into fibrocartilage and rarely form hyaline cartilage . While small lesions can be resurfaced using this form of surgery , the repair tissue tends to have less strength than normal hyaline cartilage and must be protected for 6 to 12 months . Results for large lesions tend to diminish over time ; this can be attributed to the decreased resilience and poor wear characteristics of the fibrocartilage .

In attempts to address the weaker structure of the reparative fibrocartilage , new techniques have been designed to fill the defect with tissue that more closely simulates normal hyaline articular cartilage . One such technique is autologous chondrocyte implantation ( ACI ) , which is useful for large , isolated femoral defects in younger people . In this surgery , chondrocytes are arthroscopically extracted from the intercondylar notch of the articular surface . The chondrocytes are grown and injected into the defect under a periosteal patch . ACI surgery has reported good to excellent results for reduced swelling , pain and locking in clinical follow @-@ up examinations . However , some physicians have preferred to use undifferentiated pluripotential cells , such as periosteal cells and bone marrow stem cells , as opposed to chondrocytes . These too have demonstrated the ability to regenerate both the cartilage and the underlying subchondral bone .

Similar to OATS , arthroscopic articular cartilage paste grafting is a surgical procedure offering cost @-@ effective , long @-@ lasting results for stage IV lesions . A bone and cartilage paste derived from crushed plugs of the non @-@ weight @-@ bearing intercondylar notch can achieve pain relief , repair damaged tissue , and restore function .

===== Unstable lesions =====

Some methods of fixation for unstable lesions include countersunk compression screws and Herbert screws or pins made of stainless steel or materials that can be absorbed by the body . If loose bodies are found , they are removed . Although each case is unique and treatment is chosen on an individual basis , ACI is generally performed on large defects in skeletally mature people .

===== Rehabilitation =====

Continuous passive motion ( CPM ) has been used to improve healing of the articular surface during the postoperative period for people with full @-@ thickness lesions . It has been shown to promote articular cartilage healing for small ( < 3 mm in diameter ) lesions in rabbits . Similarly , Rodrigo and Steadman reported that CPM for six hours per day for eight weeks produced an improved clinical outcome in humans .

A rehabilitation program often involves protection of the compromised articular surface and underlying subchondral bone combined with maintenance of strength and range of motion . Post @-@ operative analgesics , namely a mix of opioids and NSAIDs , are usually required to control pain , inflammation and swelling . Straight leg raising and other isometric exercises are encouraged during the post @-@ operative or immobilization period . A six to eight @-@ week home or formal physical therapy program is usually instituted once the immobilization period has ended , incorporating range of motion , stretching , progressive strengthening , and functional or sport @-@

specific training . During this time , patients are advised to avoid running and jumping , but are permitted to perform low impact activities , such as walking or swimming . If patients return to activity before the cartilage has become firm , they will typically complain of pain during maneuvers such as squatting or jumping .

#### = = Prognosis = =

The prognosis after different treatments varies and is based on several factors which include the age of the patient , the affected joint , the stage of the lesion and , most importantly , the state of the growth plate . It follows that the two main forms of osteochondritis dissecans are defined by skeletal maturity . The juvenile form of the disease occurs in open growth plates , usually affecting children between the ages of 5 and 15 years . The adult form commonly occurs between ages 16 to 50 , although it is unclear whether these adults developed the disease after skeletal maturity or were undiagnosed as children .

The prognosis is good for stable lesions ( stage I and II ) in juveniles with open growth plates ; treated conservatively ? typically without surgery ? 50 % of cases will heal . Recovery in juveniles can be attributed to the bone 's ability to repair damaged or dead bone tissue and cartilage in a process called bone remodeling . Open growth plates are characterized by increased numbers of undifferentiated chondrocytes ( stem cells ) which are precursors to both bone and cartilaginous tissue . As a result , open growth plates allow for more of the stem cells necessary for repair in the affected joint . Unstable , large , full @-@ thickness lesions ( stage III and IV ) or lesions of any stage found in the skeletally mature are more likely to fail non @-@ operative treatment . These lesions offer a worse prognosis and surgery is required in most cases .

#### = = Epidemiology = =

OCD is a relatively rare disorder , with an estimated incidence of 15 to 30 cases per 100 @, @ 000 persons per year . Widuchowski W et al. found OCD to be the cause of articular cartilage defects in 2 % of cases in a study of 25 @, @ 124 knee arthroscopies . Although rare , OCD is noted as an important cause of joint pain in active adolescents . The juvenile form of the disease occurs in children with open growth plates , usually between the ages 5 and 15 years and occurs more commonly in males than females , with a ratio between 2 : 1 and 3 : 1 . However , OCD has become more common among adolescent females as they become more active in sports . The adult form , which occurs in those who have reached skeletal maturity , is most commonly found in people 16 to 50 years old .

While OCD may affect any joint , the knee ? specifically the medial femoral condyle in 75 ? 85 % of knee cases ? tends to be the most commonly affected , and constitutes 75 % of all cases . The elbow ( specifically the capitulum of the humerus ) is the second most affected joint with 6 % of cases ; the talar dome of the ankle represents 4 % of cases . Less frequent locations include the patella , vertebrae , the femoral head , and the glenoid of the scapula .

#### = = History = =

The condition was initially described by Alexander Monro ( primus ) in 1738 . In 1870 , James Paget described the disease process for the first time , but it was not until 1887 that Franz König published a paper on the cause of loose bodies in the joint . In his paper , König concluded that :

Trauma had to be very severe to break off parts of the joint surface .

Less severe trauma might contuse the bone to cause an area of necrosis which might then separate .

In some cases , the absence of notable trauma made it likely that there existed some spontaneous cause of separation .

König named the disease " osteochondritis dissecans " , describing it as a subchondral inflammatory process of the knee , resulting in a loose fragment of cartilage from the femoral

condyle . In 1922 , Kappis described this process in the ankle joint . On review of all literature describing transchondral fractures of the talus , Berndt and Harty developed a classification system for staging of osteochondral lesions of the talus ( OLTs ) . The term osteochondritis dissecans has persisted , and has since been broadened to describe a similar process occurring in many other joints , including the knee , hip , elbow , and metatarsophalangeal joints .

= = Notable cases = =

Michael Russell , American tennis player

Kristina Vaculik , Canadian artistic gymnast

Jonathan Vilma , American football linebacker

= = Veterinary aspects = =

OCD also is found in animals , and is of particular concern in horses , as there may be a hereditary component in some horse breeds . Feeding for forced growth and selective breeding for increased size are also factors . OCD has also been studied in other animals ? mainly dogs , especially the German Shepherd ? where it is a common primary cause of elbow dysplasia in medium @-@ large breeds .

In animals , OCD is considered a developmental and metabolic disorder related to cartilage growth and endochondral ossification . Osteochondritis itself signifies the disturbance of the usual growth process of cartilage , and OCD is the term used when this affects joint cartilage causing a fragment to become loose .

The Merck Veterinary Manual states that developmental orthopedic diseases ( DOD ) in companion animals are related to nutrition and include either excess calcium and energy ( carbohydrate ) in dogs or taurine deficiency in cats that is related to blindness .

According to the Columbia Animal Hospital the frequency of affected animals is dogs , humans , pigs , horses , cattle , chickens , and turkeys , and in dogs the most commonly affected breeds include the German Shepherd , Golden and Labrador Retriever , Rottweiler , Great Dane , Bernese Mountain Dog , and Saint Bernard . Although any joint may be affected , those commonly affected by OCD in the dog are : shoulder ( often bilaterally ) , elbow , knee and tarsus .

The problem develops in puppyhood although often subclinically , and there may be pain or stiffness , discomfort on extension , or other compensating characteristics . Diagnosis generally depends on X @-@ rays , arthroscopy , or MRI scans . While cases of OCD of the stifle go undetected and heal spontaneously , others are exhibited in acute lameness . Surgery is recommended once the animal has been deemed lame .

Osteochondritis dissecans is difficult to diagnose clinically as the animal may only exhibit an unusual gait . Consequently , OCD may be masked by , or misdiagnosed as , other skeletal and joint conditions such as hip dysplasia .