Current Surgical Versus Conservative Management in the Treatment of Osteochondritis Dissecans


C. Wayne McIlwraith BVSc, PhD, DACVS, DACVSMR

Take Home Message: Conservative versus surgical options for the treatment of various entities of osteochondritis dissecans (OCD) exist. Treatment options when clinical signs are present include conservative and surgical options for femoropatellar, metacarpophalangeal/metatarsophalangeal and glenohumeral OCD depending on the nature of the lesion. In the tarsocrural joint, arthroscopic surgery is recommended for all cases accompanied by clinical signs. Treatment of radiographic lesions of OCD in yearlings is also practiced but must be accompanied with transparency with regard to those manipulations.

The paper reviews current knowledge on conservative versus surgical options for the treatment of osteochondrosis entities in the horse. Clinical and radiographic signs of each significant osteochondrosis entity in the horse are presented, followed by the value of conservative treatment versus arthroscopic surgery options as well as the results for each option with the various entities. The entities presented in detail include, osteochondritis dissecans (OCD) of the femoropatellar, tarsocrural, metacarpophalangeal and metatarsophalangeal, and glenohumeral articulations. The various treatment options for subchondral cystic lesions of the medial femoral condyle are detailed with evidence for the value of various treatments and subchondral cystic lesions in other locations are briefly reviewed.

Author’s address—Gail Holmes Equine Orthopaedic Research Center, College of Veterinary Medicine and Biomedical Sciences, Colorado State University, Fort Collins, CO, 80523; e-mail: wayne.mcilwraith@colostate.edu

I. INTRODUCTION

Osteochondritis dissecans (OCD) is arguably the most important entity within the developmental orthopaedic disease complex. It is a common cause of lameness in young athletic horses and is the most frequent condition of the complex requiring surgical intervention. Osteochondritis dissecans has been classically considered as a manifestation of osteochondrosis. Rejno and Stromberg described the first stages of osteochondrosis as a disturbance of cellular differentiation in the growing cartilage, and the second as involving the process of basal forces within the joint, giving rise to fissures in the damaged cartilage. The terms osteochondrosis, osteochondritis dissecans and osteochondrosis dissecans have been regularly used as synonyms, but this is misleading. Poulos distinguished them as follows: osteochondrosis is the disease, osteochondritis is the inflammatory response to the disease, and OCD is the condition in which a flap (an area of cartilage or osteochondral separation) can be demonstrated. This is a simple but appropriate representation.

Subchondral bone cysts or subchondral cystic lesions (SCLs) were also proposed by Stromberg and Rejno as a manifestation of osteochondrosis. It is usually assumed that SCLs showing up clinically in the first two years of life are indeed manifestations of osteochondrosis. However, they represent quite a different disease than OCD. Examination of the lining of enucleated SCLs in the medial femoral condyle showed that they produce increased levels of PGE2, neutral metalloproteinases, and nitric oxide (NO), and that there was enhanced osteoclastic resorption activity attributable to the tissue. In situ hybridization of sections of fibrous tissue of SCLs showed that mRNA of IL-1β was upregulated at the periphery of the cystic lesion and IL-6 was upregulated in the fibrin tissue of the center. Other work showed that SCLs could be produced after 5mm wide, 3mm deep defects were created in the subchondral bone plate at the central weight-bearing area of the medial femoral condyle, leading to an alternative pathogenesis for clinical disease in older horses.

Based on the well-recognized association between osteochondrosis and both OCD and SCLs, the options for surgical management will be presented for both clinical entities. Figure 1 illustrates the proposed pathways of osteochondrosis leading to both OCD and SCLs.

II. OSTEochondritis dissecans (OCD)

Disease Manifestations

Three categories of OCD lesions are recognized:
1. Those showing clinical and radiographic signs
2. Those showing clinical signs without radiographic (but arthroscopic) signs
3. Those showing radiographic, but no clinical signs.

Fig. 1. The proposed pathways of osteochondrosis leading to both OCD and SCLs. Reproduced with permission from, McIlwraith CW. Lameness in the Young Horse: Osteochondrosis. Chapter 11e. In, Adams and Stashak’s Lameness in Horses, 6th ed, GM Baxter (Ed). Wiley Blackwell 2011.

Data from the first two categories of disease have been tabulated from the most commonly affected joints from the author’s surgical case reports and are typically cases referred for surgery. The relative incidence of clinical signs vs. radiographic lesions also has been documented in the femoropatellar joint by McIntosh and McIlwraith. The third category of radiographic lesions has become increasingly important because of the common use of pre-sale radiographs of yearlings.

The condition affects the articular (joint) cartilage, and often involves the subchondral bone beneath the cartilage surface (Fig 2A). Generally, a dissecting lesion develops that involves cartilage, or cartilage and bone, and the dissection plane ultimately reaches the joint surface. It is theorized that clinical signs develop when the joint surface is reached by the dissecting lesions. Sometimes the OCD fragments can detach and become a loose body, or joint mouse. In most instances however, the fragments remain loosely attached to the bone of origin, but the debris that is released into the joint from the flap results in synovitis or joint inflammation and the clinical signs of pain and lameness that are seen with the disease. In some instances there is no defect in the subchondral bone, but merely separation of cartilage (normal thickness) from a normal subchondral bone contour (Fig 2B).

Fig. 2. Variation in depth with which OCD lesions can extend on lateral trochlear ridge of femur. (A) This is a typical lesion with fragments within pathologic cartilage in a clear defect in the subchondral bone (this will be easily discernible radiographically). (B) Less commonly (and usually on the medial trochlear ridge of the femur), there can be elevated cartilage, which has no fragments with normal bone contour and no evidence of an endochondral ossification defect. Reproduced with permission from, McIlwraith CW. Lameness in the Young Horse: Osteochondrosis. Chapter 11e. In, Adams and Stashak’s Lameness in Horses, 6th ed, GM Baxter (Ed). Wiley Blackwell 2011.

Osteochondritis dissecans can affect a number of joints, but the most commonly involved are the femoropatellar, tarsocrural and fetlock joints. Shoulder joints also are affected, but less frequently. Each of these entities will be discussed separately.

Osteochondritis Dissecans of the Femoropatellar joint

The femoropatellar joint is one of the principal joints affected with OCD. Although stifle OCD can be diagnosed in almost any breed, it seems to be more common in Thoroughbreds than in other breeds (Table 1). Approximately 60% of affected horses are one year of age or younger when the condition becomes symptomatic, and younger animals that develop clinical signs often have more severe changes within the joint (Table 2). However, radiographic lesions are sometimes identified in older horses in which no clinical signs have ever been observed.

Clinical and Radiographic Signs

Animals usually present with a sudden onset of joint swelling and lameness. A recent increase in the level of exercise is sometimes part of the history. Lameness may be very mild, with a stiff action and shortened stride observed, rather than the horse having a prominent lameness. Severe cases can
sometimes be confused with a neurologic problem due to an inability to flex the stifle, resulting in a circumducting movement of the limb concerned. Joint distention however, is the most consistent sign seen with OCD of the stifle (Fig. 3).

### Table 1. Breed Distribution of 161 Horses Presented for Femoropatellar OCD (Foland et al., 1992).

<table>
<thead>
<tr>
<th>Breed</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thoroughbred</td>
<td>82</td>
<td>50.9</td>
</tr>
<tr>
<td>Quarter Horse</td>
<td>39</td>
<td>24.2</td>
</tr>
<tr>
<td>Arabian</td>
<td>16</td>
<td>9.9</td>
</tr>
<tr>
<td>Warmblood</td>
<td>9</td>
<td>5.6</td>
</tr>
<tr>
<td>Crossbred</td>
<td>5</td>
<td>3.1</td>
</tr>
<tr>
<td>Paint Horse</td>
<td>3</td>
<td>1.9</td>
</tr>
<tr>
<td>Appaloosa</td>
<td>3</td>
<td>1.9</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>2.5</td>
</tr>
</tbody>
</table>

### Table 2. Age Distribution of 161 Horses Presented for Femoropatellar OCD (Foland et al., 1992).

<table>
<thead>
<tr>
<th>Age (year)</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td>22</td>
<td>13.7</td>
</tr>
<tr>
<td>1</td>
<td>68</td>
<td>42.2</td>
</tr>
<tr>
<td>2</td>
<td>36</td>
<td>22.4</td>
</tr>
<tr>
<td>3</td>
<td>21</td>
<td>13.0</td>
</tr>
<tr>
<td>&gt;4</td>
<td>14</td>
<td>8.7</td>
</tr>
</tbody>
</table>

Lateral to medial radiographs provide the most useful information regarding specific lesion location and size (Fig. 4). The most commonly identified defect is a variably sized irregularity or flattening of the lateral trochlear ridge of the femur. The area of the ridge that comes in contact with the distal aspect of the patella is most commonly involved. Partial mineralization of the tissue within the defect or fragment formation is often seen, and free bodies are also occasionally identified. Lesions affecting the patella are seen occasionally.

Generally, the extent of damage to the joint identified at arthroscopic surgery (if it is done) is more extensive than would be predicted from radiographs. Although other joints can be involved concurrently, this is uncommon. In one study of 161 horses with stifle OCD, 5 also had OCD affecting the rear fetlocks, 4 had hock OCD, and 1 had OCD of a shoulder joint.

### Treatment

It is generally accepted that surgical debridement of the lesions using arthroscopic surgery is the treatment of choice. However, smaller lesions identified in younger horses may respond to rest and resolve radiographically. A high percentage of cases of OCD of the femoropatellar joint were identified in Thoroughbred horses in their first year of life over a three year period, all cases were treated conservatively and these horses were followed-up with regard to racing. Horses with smaller lesions and without radiographic fragmentation tended to resolve their clinical signs with confinement and went on to be
successful as racehorses. For this reason, it is possible to tell owners that healing with conservative management is likely, if lesions are <2cm long, <5mm deep and there is no radiographic fragmentation. However, clients that are breeding for sale and racing prefer to do surgery to eliminate the chance of an OCD flap or fragment breaking loose later or being confirmed at sale. It has also been shown in a study with monthly radiographs during the first year of life in a group of Warmblood foals that femoropatellar OCD lesions can develop into obvious lesions radiographically but then resolve.\(^\text{15}\) In the case of the femoropatellar joint, healing is completed (if they are going to heal) by 11 months of age.\(^\text{15}\) These are generally lesions that are not causing severe, or any, clinical signs. If lameness and swelling are prominent and the horse is older than 11 months, arthroscopic surgery is indicated.

As for all joint surgery, the joint is thoroughly explored, and suspicious lesions are probed (Fig 5). Loose or detached tissue is elevated and removed (Fig 5) and loose bodies are removed. The defect site is then debrided down to healthy tissue. Care must be taken to not be overly aggressive with bone debridement in young animals that have soft subchondral bone.

Pin fixation of large OCD fragments has been described in man.\(^\text{16}\) In human cases such fragments have a rigid bony component which is rarely present in the equine case. However, a technique using polydioxonine PDS pins (Arthro OrthoSorb\textsuperscript{\textregistered} Pins, DePuy Ace) has been described for fixing large OCD flaps\(^\text{17}\) and more recently successful long-term results have been reported for this technique.\(^\text{18}\) In this recent series of cases reported, cartilage was reattached when it had persisting perimeter continuity, the surface was not deeply fissured or irregular, and the cartilage was not protuberant or extensively mineralized. Approximately 1-2mm of the pin is left protruding from the cartilage surface to allow for flattening of the pin head level with the articular surface to enhance stabilization and pins are placed 10-15mm apart.

**Results with Surgery**

In a study describing the treatment of OCD using arthroscopic surgery in 250 femoropatellar joints in 161 horses, follow-up information was obtained on 134 horses including 79 racehorses and 59 non-racehorses.\(^\text{12}\) Eighty-six (64\%) of these 134 horses returned to their intended use, 9 (7\%) were in training at the time of publication, 21 (16\%) were unsuccessful and 18 (13\%) were unsuccessful due to other defined reasons. Horses with Grade I lesions (<2cm in length) had a significantly higher success rate (78\%) than did horses with Grade II (2-4cm) or Grade III (>4cm) lesions (63\% and 54\% success rates respectively). A significantly higher success rate was also noted for horses operated on as 3-year-olds compared with the remainder of the study population and a significantly lower success rate was noted for yearlings than for the remainder of the population. However, this age factor was considered to be due to the fact that the most severe lesions were generally identified in the younger horses.

Long-term results were presented for reattachment of OCD lesions with PDS pins in 40/44 joints from 27 horses by Sparks et al.\(^\text{18}\) The radiographic lesion length ranged from 1.5cm-6.3cm. Reattachment alone was used in 32/44 affected joints, a combination of debridement and reattachment in 8 joints and debridement alone in 4 horses. Of 26 horses with follow-up, radiographic resolution of OCD lesions treated with reattachment was significantly improved at 6 months. Twenty horses had long-term performance data in which 19 were sound and had reached intended athletic potential. The overall success rate based upon continued soundness in performing horses was 95\% (19/20), which provided good evidence that salvaging extensive OCD flaps by reattachment in the appropriate case could result in more normal radiographic subchondral bone contour and long-term athletic performance.

**Osteochondritis Dissecans of the Tarsocrural (Hock) Joint**

**Clinical and Radiographic Signs**

The most common clinical sign of hock OCD is effusion of the tarsocrural joint. In a study of 303 joints in which synovial effusion was recorded,\(^\text{19}\) it was the presenting clinical sign in 261 (86.1\%). In racehorses, effusion was present in 166 joints (81\%) and absent in 39 joints. In non-racehorses, effusion was present in 95 joints (96.9\%) and absent in 3 joints. The degree
of lameness was not recorded consistently but was usually
designated as mild. The exception was when a severe lesion was
present on the lateral trochlear ridge of the talus (lesions
involving the entire visible portion when viewed
arthroscopically in the flexed position). Racehorses presented
most often as 2-year-olds, having trained or raced, whereas non-
racehorses presented most often as yearlings prior to training.

On radiographs, lesions, in order of incidence, can occur on the
distal intermediate ridge of the tibia (DIRT) (Fig 6), followed
by the lateral trochlear ridge of talus (Fig 7), and then the medial
malleolus of the tibia (Table 3). Lesions are identified as defects
alone or defects containing fragmentation. The radiographic
appearance often underestimates the extent of damage
identified at surgery, particularly for lateral trochlear ridge
lesions. The tarsocrural joint is also a joint in which
radiographically silent lesions (those identified at surgery and
in which no abnormality was seen on radiographs) occur more
commonly than in other joints.19

![Fig. 6. Radiographic view (A) and arthroscopic view (B) of OCD of the distal intermediate ridge of the tibia (DIRT) in tarsocrural joint. Reproduced with permission from, McIlwraith CW. Lameness in the Young Horse: Osteochondrosis. Chapter 11e. In, Adams and Stashak’s Lameness in Horses, 6th ed, GM Baxter (Ed). Wiley Blackwell 2011.](image)

<table>
<thead>
<tr>
<th>Number of Joints</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>244</td>
<td>Intermediate ridge (dorsal aspect) of distal tibia</td>
</tr>
<tr>
<td>37</td>
<td>Lateral trochlear ridge of talus</td>
</tr>
<tr>
<td>12</td>
<td>Medial malleolus (dorsal aspect) of tibia</td>
</tr>
<tr>
<td>11</td>
<td>Intermediate ridge of tibia plus lateral trochlear ridge of talus</td>
</tr>
<tr>
<td>4</td>
<td>Intermediate ridge of plus medial malleolus of tibia</td>
</tr>
<tr>
<td>3</td>
<td>Intermediate ridge plus medial trochlear ridge of talus</td>
</tr>
<tr>
<td>3</td>
<td>Medial trochlear ridge of talus</td>
</tr>
<tr>
<td>3</td>
<td>Lateral trochlear ridge of talus plus medial malleolus of tibia</td>
</tr>
<tr>
<td>1</td>
<td>Lateral and medial trochlear ridge of talus</td>
</tr>
<tr>
<td>318</td>
<td>Total</td>
</tr>
</tbody>
</table>

![Fig. 7. Radiographic view (A) and arthroscopic view (B) of OCD of the lateral trochlear ridge of talus within the tarsocrural joint. Reproduced with permission from, McIlwraith CW. Lameness in the Young Horse: Osteochondrosis. Chapter 11e. In, Adams and Stashak’s Lameness in Horses, 6th ed, GM Baxter (Ed). Wiley Blackwell 2011.](image)

Table 3. Location of OCD Lesions in 318 Tarsocrural Joints (McIlwraith et al., 1991).

Treatment

When tarsocrural arthrotomy was the method used surgical
intervention was recommended if the patient was an athlete or
when an athletic career was planned.20 On the basis of
experience with arthroscopic surgery, surgery is recommended
in all instances of clinical signs being present and an athletic
career planned. If effusion is present and conservative
management (usually stall confinement) is carried out effusion
will generally return with exercise. Those with small lesions,
minimal effusion, no lameness and a potential career as a
pleasure horse or light use horse may not require surgery.
Sequential radiographs of Dutch Warmblood tarsocrural joints
showed development (and resolution in most cases) of lesions
of the DIRT and lateral trochlear ridge of talus over the first 5
months of life.15 Surgery should be considered early enough in
the course of the disease (but after 5 months of age) so that the
joint capsule is not unduly stretched, which makes resolution of the joint effusion less likely. Arthroscopic surgery with removal of fragments and debridement of defective tissue is recommended.

Prognosis

The results of arthroscopic surgery for the treatment of OCD in 318 tarsocrural joints in 225 horses have been reported. The overall functionality and cosmetic appearance of the limbs were excellent. Postsurgical follow-up information was obtained for 183 horses of which 140 (76.5%) horses raced successfully or performed their intended use following surgery. Of the remaining 43 horses only 11 were still considered to have tarsocrural joint problems. Nineteen horses developed other problems precluding successful performance, 8 horses were considered poor racehorses without any lameness problems, 3 horses were euthanized because of septic arthritis (all associated with the horse getting the bandage off within 24 hours) and 2 died from other causes. The success rate relative to three size groups for DIRT lesions was 27/33 (81.8%) for lesions 1-9mm in width, 86/116 (74.1%) for lesions 10-19mm in width and 41/47 (87.2%) for lesions 20mm or more in width (no significant difference). When success rate was considered relative to the finding of additional lesions at arthroscopy, 16/19 (84.1%) with articular cartilage fibrillation, 5/10 (50%) with articular cartilage erosion or wear lines, 3/5 (60%) with loose fragments, 0/2 with proliferative synovitis and 0/1 for joint capsule mineralization had successful results. There was a significantly poorer outcome in racehorses with articular cartilage degeneration or erosion (P<0.05). The synovial effusion completely resolved in 117/131 racehorse joints (89.3%) and in 64/86 non-racehorse joints (74.4%). The outcome for synovial fluid effusion was significantly inferior (no significant difference). When success rate was considered relative to changes in lameness or joint effusion. There was no significant correlation between the time of follow-up examination and the effect of surgery on lameness and reaction to flexion but an increased time to follow-up was associated with decreased joint effusion.

The author does not routinely inject tarsocrural joints after arthroscopic surgery for tarsocrural OCD and there are no reports in the literature of intraarticular medication following surgical treatment. There is one controlled study with oral hyaluronan following arthroscopic surgery for OCD of the tarsocrural joint and showing significant decrease in post-operative synovial effusion with 30 days of treatment. The author is aware of three cases that were treated with intraarticular corticosteroids to reduce synovial effusion in cases of OCD going to sale that resulted in acute onset of lameness and acute stripping of cartilage. There has been no definitive work in this area in the literature.

Osteochondritis Dissecans of the Fetlock Joint

The most common manifestation of OCD in the fetlock joint is fragmentation and irregularity that occurs on the dorsal aspect of the sagittal ridge and the condyles of the metacarpus or metatarsus (cannon bone). A second manifestation involving the fetlock is fragmentation of the dorsal aspect of the proximal phalanx.

Osteochondritis Dissecans of the Dorsal Aspect of the Distal Metacarpus/Metatarsus

Clinical and Radiographic Signs

Joint swelling (effusion) is the most common clinical sign, with lameness variable in both appearance and severity. Fetlock flexion tests are usually positive. It is not unusual for all four fetlocks to be involved, and bilateral forelimb or hindlimb involvement is quite common. A variety of radiographic presentations are seen with fetlock OCD. Some joints show only flattening or a defect in the sagittal ridge (type I OCD), others will have a fragment in place within the area of flattening (type II OCD), and others have flattening with or without a fragment in place, but also have free or loose bodies within the joint (type III OCD).

Treatment

A conservative approach is initially recommended for type I lesions. The majority of these cases have resolution of clinical signs, as well as improvement or disappearance of radiographic signs; however, surgery is eventually necessary in a small number of these cases. If clinical signs have persisted as the horse approaches a year of age, surgical intervention is
appropriate. One of the problems is that in the type I cases that have persistent clinical signs, secondary OA often develops early and rapidly. Surgical debridement is recommended for type II and III lesions, where fragmentation or loose bodies are present. This recommendation is based on the study where cases of all grades were managed conservatively and clinical signs typically persisted with type II and III lesions. There have been no other reports evaluating conservative vs. surgical treatment of these lesions in the refereed literature up until the time of this publication.

**Prognosis**

The prognosis is quite favorable for type I lesions, but more guarded for type II and type III lesions when surgery is delayed or cases are in the forelimb. In one study involving 42 horses, the success rate was approximately 60%, but with more timely intervention and case selection the author considers that this success rate has improved. Horses with other signs of articular cartilage erosion or wear lines within the joint had a less favorable prognosis. If the lesion extended onto the condyle of the metacarpus/metatarsus from the sagittal ridge, the prognosis was also less favorable. It was determined that clinical signs would persist in approximately 25% of cases.

**OCD Fragments of the Proximal Dorsal Aspect of the Proximal Phalanx**

Joint swelling (effusion) is the most common clinical sign, with lameness being variable in both appearance and severity. Quite often these fragments are identified on survey radiographs and are presented for removal. The fragments are usually rounded in appearance and are off the proximal medial eminence of the proximal phalanx. Arthroscopically they show a typical OCD appearance with separated cartilage and defective cartilage underneath. The author has never managed these cases conservatively. The two situations where these cases are presented for surgery are in young horses with clinical signs and secondary OA is prevented by timely removal of the fragments or secondly, when on survey radiographs one of these fragments is seen in yearlings and removal is requested for sale purposes.

**Osteochondritis Dissecans of the Shoulder Joint**

Osteochondritis dissecans involving the shoulder joint is the most debilitating form of OCD affecting horses. Generally, large areas of the joint surfaces are involved, and secondary joint disease is common. However, it is unusual to have free or loose bodies develop. Osteochondritis dissecans of the shoulder is less common than for the other joints described, and seems to affect Quarter Horses and Thoroughbreds with a similar incidence.

**Clinical and Radiographic Signs**

Most horses with shoulder OCD present at one year of age or younger, with a history of forelimb lameness of variable severity. Many of these horses have prominent lameness, and if lameness has been present for many weeks, shoulder muscle atrophy is also seen. Because of the altered gait and use of the limb, many cases develop an upright or club-footed appearance to the foot, and the foot may appear smaller on the affected limb. Deep pressure over the shoulder joint often causes discomfort, and forced flexion/extension of the limb sometimes accentuates the lameness that is seen. Intra-articular anesthesia improves or eliminates the lameness.

On radiographs, the most common sign is flattening or indentation of the humeral head or a defect in the glenoid. Some degree of bony proliferation (osteoophytosis/enthesitis) is often identified along the caudal border of the glenoid cavity.

**Treatment**

Previously the author has reported that non-surgical treatment of OCD in the equine shoulder has rarely allowed horses to regain athletic activity. However, earlier recognition of problems and early conservative treatment has been successful in resolving cases more recently (L.R. Bramlage personal communication). Figure 8 illustrates a series of sequential radiographs in a yearling from the time of diagnosis of OCD of the glenoid that was treated conservatively with confinement and completely resolved clinical signs as well as achieved healing radiographically and went on to race.

---

**Fig. 8.** Radiographs taken December 31, 2010 (A) showing an obvious osteochondrosis lesion of the glenoid, follow-up radiographs February 1, 2011 (B), March 15, 2011 (C) and April 14, 2011 (D) showing resolution of the defect in the glenoid with some subchondral sclerosis appearing along with the healing process (courtesy of Dr. L.R. Bramlage) (Reproduced from Diagnostic and Surgical Arthroscopy in the Horse 4th ed. In Press).
However, when there is severe involvement, and particularly when both the humerus and glenoid are involved, the author has felt that surgery improves the clinical signs in most affected cases.\textsuperscript{14,27,28} If extensive degenerative arthritic change is present on radiographs at the time of the initial examination, the prognosis for an athletic career is unfavorable, and surgery should only be considered for relative improvement in the degree of lameness. However, for more localized lesions, the prognosis is favorable for a successful outcome. The shoulder is probably the most difficult joint on which to perform arthroscopic surgery, due to the depth of the joint below the muscles in the area - and there is a learning curve.\textsuperscript{14} Surgery is easier on younger animals due to their relative muscle mass. Problems encountered in the shoulder are inaccessibility of lesions due to their location within the joint and extravasation or leakage of fluid outside the joint, which impairs visibility within the joint.

**Prognosis**

A large series of cases having surgery has not yet been reported, although preliminary results from 80 cases compiled at Colorado State University suggest that the overall prognosis is approximately 50\%. The prognosis seems to be less favorable if lesions are present on both the humeral head and the glenoid cavity. In unsuccessful cases, further deterioration of the joint surfaces on radiographs is common. Of the initial series of 11 horses reported following arthroscopic surgery OCD of the shoulder joint,\textsuperscript{29} none of the horses became more lame and all improved clinically from within two weeks of surgery. Nine/11 horses achieved soundness and 8 horses remained sound. Seven horses were completely sound at a jog within 4 months, 5 were athletically sound and were being shown, ridden or raced after 5-20 months. A sixth horse was sound when beginning race training, a seventh horse was pasture sound and was to begin race training at the time of the report, and an eighth horse showed well in halter for 12 months but shoulder lameness returned and the ninth and tenth horses were not completely sound at 11 months. The eleventh horse improved but remained lame and could not be used for athletic performance. Follow-up radiograph assessment revealed improvement and contour of the humeral head and joint space and more even density of articular surfaces on radiographs is common. Of the initial series of 11 horses that have been used more recently, the results of conservative treatment have been recorded but its success rate is considered low and if clinical signs are present this is no longer considered an option.

Since the early descriptions of arthroscopic surgery for this condition a retrospective study of 32 horses concluded that arthroscopic surgery was not superior to conservative management.\textsuperscript{29} In that study 16/32 horses were affected bilaterally. Eleven/16 of these horses underwent arthroscopic surgery but in six cases they just operated the most severely affected shoulder. The conclusions were that while there was improvement in non-racehorses there was no significant difference in success with racing between surgery and conservative management. Eight/16 horses with unilateral shoulder OCD were treated surgically. Two of which, both non-racehorses, were sound for their intended use but there were no superior results between racehorses treated surgically and conservatively.

### III. Subchondral Cystic Lesions

Subchondral cystic lesions (SCLs) have been mentioned previously as a manifestation of osteochondrosis, at least in young horses. The most common location for clinically significant SCLs is within the medial condyle of the femur in the medial femorotibial joint. Other areas of occurrence include the distal metacarpus or metatarsus in the fetlock joint, the distal proximal phalanx in the proximal interphalangeal joint, as well as shoulder, elbow, carpus, distal phalanx and talus.

**Cystic Lesions of the Medial Condyle of the Femur**

**Clinical and Radiographic Signs**

The typical clinical sign is lameness in one or both limbs at the trot. In some horses lameness is subtle and noticeable only during riding. Historically some of these horses can be training for considerable periods of time with clinical signs manifesting only after a certain amount of work has been done. Most horses swing the leg medially and the lameness is accentuated when trotting in the circle with the affected leg inside. It is more common to recognize femoropatellar effusion than femorotibial effusion.\textsuperscript{30} Medial femorotibial analgesia localizes the lesion but a response can also be obtained with IA analgesia of the femoropatellar joint.

Both flexed lateral and caudocranial views are useful to ascertain the location and size of the lesion radiographically. The typical lesion is round or oval with a defect of the articular surface of various sizes. In other cases a small, flattened or concave defect may be present that often is asymptomatic.

Surgical debridement of cystic lesions has been the standard treatment for some time but there are a number of other options that have been used more recently. The results of conservative treatment have been recorded but its success rate is considered low and if clinical signs are present this is no longer considered an option.

Debridement of SCLs was initially described using arthrotomy\textsuperscript{31} and an arthroscopic technique was first described by Lewis.\textsuperscript{32} The technique developed by Lewis is performed with the horse under general anesthesia in dorsal recumbency with the leg flexed such that the stifle is at a 90° angle. A lateral approach to the medial femorotibial joint is done and the instrument portal is cranial and made so that the instrument goes into the cyst perpendicular to the surface of the joint. Howard et al.\textsuperscript{30} reported the results of arthroscopic debridement of SCLs in the MFC in 41 horses. There were 17 Quarter Horses, 15 Arabians, 8 Thoroughbreds and 1 Holstein with 28 (68%) of the horses being 1-3 years of age. Nineteen/27 horses had lesions identified bilaterally at arthroscopic surgery. In addition 13 joints in 11 horses had an OCD lesion on the articular surface of the medial femoral condyle extending from...
the opening of the SCL. Surgical debridement was performed on 37 lesions in 23 horses. Complete follow-up was obtained for 39 horses with 22 (56%) had a successful result and 17 (44%) of horses had an unsuccessful result. In a separate analysis in this study, excluding horses with unsuccessful results because of factors not directly attributed to the SCL (Censored analysis) 23/31 (74%) of horses had a successful result and 8/31 (26%) horses had an unsuccessful result. A poorer result was seen in Quarter Horses. They also noted radiographic enlargement of the cyst associated with drilling of the lesion at the time of surgery when this was done.

A subsequent study of arthroscopic debridement of cystic lesions in the medial femoral condyle in 150 Thoroughbred horses reported a 77% success rate overall for achieving racing soundness. When the debrided defect had a diameter of 15mm or less at the surface the success rate was 60.6% whereas when the diameter of the surface defect was more than 15mm the prognosis dropped to 39.3%. A third study in the UK by Smith et al. that looked at the medical records from 6 equine referral centers 85 horses were identified and of those 39 horses aged 0-3 years, 25 (64%, 95% CI 49-79%) returned to soundness whereas of 46 horses aged greater than 3 years, 16 (35% 95% CI 21-49%) returned to soundness. In addition, cartilage damage at sites other than the MFC negatively affected prognosis and radiographic signs of OA also negatively affected prognosis. There has also been some relatively recent evidence of a potential clinical relationship between debridement of SCLs of MFCs and development of a meniscal lesion. Six horses developed a meniscal lesion subsequent to SCL debridement (and two developed an SCL subsequent to medial meniscal injury).

In 1995 in a text on arthroscopic surgery it was mentioned that this author had treated a number of cases with intralesional injection of corticosteroid (triamcinolone acetonide) under arthroscopic visualization with positive preliminary results. Since then the results of SCLs in the MFC treated with arthroscopic injection of corticosteroids into the lining of the cyst, to counteract osteoclastic resorption by the SCL lining with positive preliminary results. In addition, it was felt that if the procedure was unsuccessful other surgical therapies could be offered such as arthroscopic debridement with or without reconstructive techniques. This surgical technique involves a standard lateral arthroscopic approach to the medial femorotibial joint with exploration of the medial femorotibial joint including probing and evaluation for loose tissue that requires removal through a cranial portal. An 18G spinal needle is then placed into the depth of the cyst and 6-20mg of triamcinolone acetonide injected. Horses can typically return to racing in 60 days (although one author in the Wallis et al study had horses coming back at 30 days). Overall 35/52 (67%) of cases were classified as successful involving 73 SCLs of which 56 (77%) were classified successful; an additional 5 horses were considered sound on veterinary examination but for various reasons were not performing their intended use, giving a total of 40/52 (77%). Significantly more unilateral (28/31; 90%) than bilateral (28/42; 67%) SCLs were classified as successful. There was no significant association between age group (age < 3 years vs. > 3 years) or cyst configuration on outcome. Forty-three/55 (78%) SCLs in horses aged 0-3 years and 13/18 (72%) SCLs in horses > 3 years were classified as successful. Radiographic findings of osteophytes on preoperative radiographs negatively affected prognosis.

Cancellous bone grafting was initially described by Kold and Hickman, but results with this technique, through arthrotomy at least, were not as good as simple debridement. A controlled study since then with cancellous bone grafting and experimentally created 12.7mm diameter and 19mm deep defects of the medial femoral condyle and a six month evaluation period showed that healing was similar in grafted and ungrafted defects. This suggested that surgical debridement alone rather than adjunctive bone grafting of cystic lesions could be superior. Mosaic arthroplasty has been reported to restore articular surfaces of SCLs based on a case series of SCLs in four locations (medial femoral condyle of 5 horses, lateral femoral condyle of 1 horse, distal epiphysis and metacarpus 4 horses, or metatarsus 1 horse). All horses improved postoperatively; 10 had successful outcomes with radiographic evidence of successful graft incorporation and 7 returned to a previous or higher level activity level. In follow-up arthroscopy in 5 horses there was successful reconstitution of a functional gliding surface. The authors of this study recognize the limitations of this technique, which include the often large size and depth of cystic lesions, the fact that harvesting grafts is time consuming and invasive, and that larger grafts carry a considerable risk of donor site morbidity. The technique is technically demanding and inserting a graft at an angle and leaving exposed subchondral bone in the side wall of the recipient hole is an unacceptable technical error.

The potential for implantation of stem cells or chondrocytes or mesenchymal stem cells in fibrin glue has been proposed. Recently the use of chondrocytes cultured from articular cartilage of healthy horses less than 1-year-old at postmortem together with recombinant human IGF-1 was reported. Arthroscopic cyst debridement followed by filling of the bone void by autologous cancellous bone (45 horses) or with tricalcium phosphate granules (4 horses) was performed. A paired syringe containing a fibrinogen and chondrocyte mixture in one syringe and calcium activated bovine thrombin with IGF in the other was used to cover the surface. A successful outcome was achieved in 36/49 (74%) horses. Thirty-three horses had unilateral lesions and 15 bilateral lesions and one had bilateral SCLs of the lateral femoral condyle. Median age of the horses was 3.3 years. Fifteen horses had preoperative radiographic and arthroscopic evidence of OA. Grafting resulted in success for 80% of horses > 3-years-old and 80% of horses with OA. The authors concluded that implantation of allogenic chondrocytes and IGF-1 in arthroscopically debrided SCLs of the equine femoral condyle leads to improved long-term clinical outcome. Also, the technique appeared to be particularly effective in horses that had a poorer prognosis with traditional therapies including mature horses, horses with pre-existing OA and horses with upright limb conformation. They also noted that...
simpler surgical methods including debridement or intralesional corticosteroid injection should be considered for younger, non-arthritic horses. This technique certainly represents an option when either injection of an SCL or curettage alone have failed. Some cases have also been done using injection of bone marrow-derived mesenchymal stem cells (MSCs) in fibrin after debridement of SCLs but there has been no comparison with fibrin alone (Frishie personal communication).

**Subchondral Cystic Lesions in Other Locations**

Subchondral cystic lesions occur in a number of other locations but are less clinically significant than in the MFC. Subchondral cystic lesions occur on the weight bearing surfaces of the condyles of MCIII and MTIII and are diagnosed in horses 1-2-years-of-age. They are easy to recognize radiographically and when clinically significant usually cause lameness. The author is familiar with cases that at the onset of lameness did not have a lesion but in which the lesion progressed radiographically. Surgical debridement has been an effective treatment but corticosteroids administered intralesionally have become a more recent option.42

Similarly, SCLs in the proximal interphalangeal joint may cause lameness at a young age. These SCLs usually manifest as single, discrete, well-defined lesions in the distal condyles of the proximal phalanx. Most clinical problems are associated with multiple SCLs and accompanying OA of the proximal interphalangeal joint. In the latter cases, pastern arthrodesis is usually the only option. Recently, radiographic lucencies in the proximal interphalangeal joint have been examined by looking at repository radiograph reports of Thoroughbred yearlings offered for public auction from 2002-2007. One-hundred-seventy-one affected yearlings and 832 maternal siblings were included in the study. There was no difference in 2- or 3-year-old starts, earnings or earnings per starts for yearlings with condyle or facet luencies. Midline lucencies had decreased starts as a 2-year-old (P<0.0077) as well as earnings and earnings per start during the 2-year-old (P=0.003 and P<0.0001) and 3-year-old years (P<0.001 and P<0.0001). The authors pointed out that midline lucencies being considered insignificant may need to be reconsidered but that horses that were included in the study represented a population of more severe lesions and further definition is needed.

**IV. CONFLICT OF INTEREST STATEMENT**

The author of this paper has no financial or personal relationships with other people or organizations that could inappropriately influence or bias the content of the paper.

**V. ACKNOWLEDGMENTS**

This manuscript is supported by the Gail Holmes Equine Orthopaedic Research Center.

**REFERENCES**


42. Richardson DW. Diagnosis and management of osteochondrosis and osseous cyst-like lesions. In: Ross MW and Dyson SJ, eds. Diagnosis and Management of Lameness in the Horse. Elsevier, 2011;631-638.

