

# Large Animal VETERINARY Rounds®

JANUARY 2007  
Volume 7, Issue 1

AS PRESENTED IN THE ROUNDS OF THE DEPARTMENT OF LARGE ANIMAL CLINICAL SCIENCES  
OF THE WESTERN COLLEGE OF VETERINARY MEDICINE, UNIVERSITY OF SASKATCHEWAN

## Osteochondrosis in the Horse

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**Osteochondrosis is a common orthopedic disease in young horses. While the etiopathogenesis is only partly understood, affected horses are easily identified on the basis of clinical presentation and ancillary diagnostic testing. This issue of *Large Animal Veterinary Rounds* discusses the etiopathogenesis and treatment of osteochondrosis in the horse.**

Developmental orthopedic disease has become the “catch phrase” that encompasses a number of orthopedic conditions affecting the growing horse. Conditions included under this umbrella are angular limb deformities, flexural deformities, and osteochondrosis. While the predisposing factors and underlying pathophysiologic mechanisms for each of these conditions may be interrelated, the management techniques employed are condition specific. Osteochondrosis results from a disorder in the endochondral ossification process. The condition may affect any of the horse's joints; however, certain joints are more prone to develop clinical disease. The following discussion is intended to convey the current understanding of the etiopathogenesis for osteochondrosis, the treatment recommendations for specific joints, and prognostic information for the most commonly affected joints.

### Etiopathogenesis

Osteochondrosis (OC) is a developmental orthopedic disease that is clearly multifactorial, with genetic makeup, biomechanical factors, environmental factors, and possibly unknown factors contributing to the development of lesions. OC has been defined as a failure of endochondral ossification during development of the epiphyseal and metaphyseal growth plates. Capillaries fail to penetrate the hypertrophic zone of the growth plate leading to a failure of cartilage maturation; this failure interrupts endochondral ossification and results in the retention of a thickened layer of cartilage.<sup>1</sup> Through avascular necrosis of the basal layers, the cartilage complex of the growth plate is weakened with lesions manifested as subchondral fractures, subchondral bone cysts, chondromalacia, or the splitting off of cartilage flaps (osteochondritis dissecans) that may initially be stable, but later detach and form joint “mice.” Because the initial lesion occurs in growing cartilage, a more correct term would be dyschondroplasia;<sup>2</sup> however, most of the reports in the literature refer to the condition as osteochondrosis. Despite the recent focus on molecular signaling events and the expression of various growth factors and enzymes, an understanding of OC pathophysiology is still far from complete.

### General diagnostic and treatment recommendations

A diagnosis of osteochondrosis is typically confirmed radiographically, although there are instances where diagnostic arthroscopy is needed to establish a diagnosis. Arthroscopic debridement is the hallmark of treatment regimens and the primary goal is to limit degenerative joint disease. Usually, treatment recommendations and prognostic information are joint specific.

### Tarsocrural joint

In a large study of Standardbred Trotter and Swedish Warmblood horses, osteochondrosis was most frequently observed in the tarsus.<sup>3</sup> In another study, Thoroughbreds represented 57% of the study group and the stifle was the joint most commonly affected.<sup>4</sup>

### Clinical signs

Clinical signs include tarsocrural joint effusion of variable duration and severity. In 225 horses, effusion was present in 261 of 303 tarsocrural joints in which the presence or absence of synovial effusion was recorded.<sup>5</sup> Most horses are not overtly lame, but severe effusion, unstable osteochondral fragments, or



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The Canadian Veterinary Medical Association recognizes the educational value of this publication and provides support to the WCVM for its distribution.

concurrent degenerative joint disease may contribute to lameness. Some horses may resist or be positive to hock/stifle flexion tests. Lameness should be localized to the tarsocrural joint with diagnostic analgesia, since radiographically evident lesions are not always present. Care must be exercised in evaluating potential lesions on the talus in foals, but lesions present radiographically after 5 months of age are unlikely to resolve on their own and surgical treatment is recommended to minimize secondary degenerative osteoarthritic changes.<sup>6</sup>

#### ***Predilection sites and radiographic signs***

The locations where lesions are most frequently seen, in descending order, are the distal intermediate ridge of the tibia (DIRT), the lateral trochlear ridge (LTR) of the talus, the medial malleolus, and the medial trochlear ridge (MTR) of the talus. Lesions of the lateral malleolus are usually fractures.<sup>6</sup> The distal intermediate ridge of the tibia, the most common site of OC lesions, is best imaged with 15° dorsolateral-plantaromedial oblique and 45° dorsomedial-plantarolateral oblique projections (Figure 1). Lateral trochlear ridge lesions (Figure 2) are the second most common and are ideally imaged with lateromedial or 45° dorsomedial-plantarolateral oblique projections. The lateral trochlear ridge of the talus may be more frequently affected in Standardbred and heavy horses.<sup>6</sup>

In a serial radiographic survey of Dutch Warmblood foals, investigators found that foals, radiographically normal at 5 months of age, remained normal and those animals with abnormalities of the DIRT or the LTR at 5 months of age remained abnormal.<sup>7</sup> Some lesions resolved spontaneously between 1 and 5 months of age, while others developed.<sup>7</sup> Only one initially normal horse in each group (DIRT and LTR lesions) became abnormal within the first 5 months.<sup>7</sup>

Lesions of the medial malleolus can be difficult to image. The articulation of the trochlear ridges of the talus with the cochlea of the distal tibia results in a joint that actually articulates in a plane that is 10°-15° lateral to the midsagittal plane.<sup>8</sup> Most medial malleolar lesions are located axially<sup>6</sup> and may be obscured due to superimposition on true dorsoplantar views. These lesions are best imaged with 15° dorsolateral-plantaromedial oblique radiographs to prevent such superimposition. Suspect areas of flattening on the medial trochlear ridge of the talus, especially distally, most often are incidental findings and do not require treatment.<sup>6</sup> Although uncommon, semicircular lytic areas of the most proximal articular margin of the medial trochlear ridge have been reported.<sup>9</sup> These lesions were not initially identified on the standard 4 orthogonal radiographic projections and were diagnosed with nuclear scintigraphy followed by flexed lateromedial projections.<sup>9</sup> Occult subchondral cyst-like lesions have been described on the distal tibia or talus. These lesions probably have traumatic or infectious etiologies.<sup>10</sup>

#### ***Treatment regimen and prognosis***

Arthroscopic removal of osteochondral fragments and debridement of cartilage lesions are recommended in horses with effusion. Most surgeons also recommend surgical management of horses without effusion on the assumption that these clinically silent lesions predispose to the development of degenerative joint disease. Surgical treatment in 183 horses revealed that 140 (76.5%) went on to race at the same or higher level compared to before surgery or were currently per-

**Figure 1: Tarsus, dorsomedial-plantarolateral oblique projection, DIRT lesion.**



forming at their intended level (non-racehorses).<sup>5</sup> Within this group of horses, the success rate in racehorses and non-racehorses was 73% and 83.1%, respectively.<sup>5</sup> Success rate was not significantly influenced by age, sex, limb involved, lesion location, or lesion size (distal intermediate tibial ridge lesions).<sup>5</sup> Only 50% of horses with cartilage degeneration in addition to their OC lesions returned to their intended use.<sup>5</sup> Complete resolution of joint effusion was documented in 181 of 217 joints; however, there was no association between the resolution of effusion and postoperative performance.<sup>5</sup> There is some evidence that persistent effusion is more likely in horses with longstanding preoperative effusion.

Laws and coworkers reported no significant differences in lifetime earnings of Standardbreds between OC-affected individuals and controls, matched by birth year, sex, and sire; however, comparisons between surgically-treated and conservatively-treated groups could not be made.<sup>11</sup> In another study examining outcomes, significantly fewer Thoroughbreds and Standardbreds that received surgery for tarsocrural OC were racing as 2-year-olds compared to age-matched siblings, but no significant difference was noted for 3-year-olds of either group (surgically treated or untreated siblings).<sup>12</sup> Irrespective of the merits of surgical treatment from a performance perspective, there are clear advantages in terms of the affected horse's perceived value at the time of sale. Furthermore, it is easy to argue the benefit of arresting the low-grade degenerative process that exists in the face of the disease.

#### ***Femoropatellar and femorotibial joints***

##### ***Clinical signs***

The stifle joint is the second most common site of OC in horses.<sup>3</sup> In 86 horses with confirmed stifle-origin lameness, OC and subchondral bone cysts (SBCs) collectively accounted for 51% of cases.<sup>13</sup> Common historical information includes difficulty standing from a recumbent position (more common in foals), reluctance to trot, rapid growth, and trauma (more common with SBCs).<sup>13</sup> Clinical signs include mild-to-moder-

**Figure 2: Tarsus, dorsomedial-plantarolateral oblique projection, LTR lesion.**



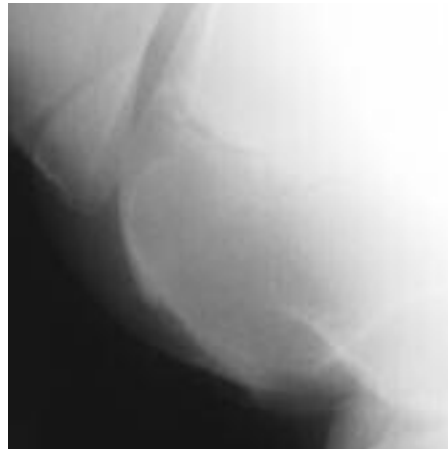
ate lameness, joint effusion, restricted range of stifle flexion,<sup>14</sup> and a shortened cranial phase of the stride.<sup>15</sup>

#### **Predilection sites and radiographic signs**

The anatomical locations where lesions are most commonly found are the middle third of the lateral trochlear ridge of the femur (LTRF) and the medial femoral condyle (MFC). Lesions on the LTRF are typical of osteochondrosis. The pathogenesis of SBCs has been proposed to be developmental in origin and a manifestation of osteochondrosis;<sup>1</sup> however, others suggest the lesions are traumatic in origin.<sup>16</sup> A traumatic etiology for SBCs has been investigated by several researchers. Kold et al, found that by creating a 15-mm long, 1-mm wide linear, full-thickness cartilage defect, they were able to induce the formation of SBCs in the MFC despite the absence of induced damage to the subchondral bone.<sup>17</sup> These results are in stark contrast to the more recent investigation by Ray in which similar full-thickness cartilage lesions failed to induce formation of SBCs, while elliptical cartilage defects in combination with subchondral bone damage (a 5-mm diameter, 4-mm deep hole created using a motorized burr) created SBCs in 5 out of 6 horses.<sup>18</sup> The exact pathogenesis of SBCs is still unclear; however, similar lesions have been reported after intra-articular fracture of the elbow joint<sup>19</sup> lending support to the argument that subchondral bone trauma is a key feature.<sup>18</sup> Interestingly, an investigation of local mediators and neutral metalloproteinases in SBCs showed elevated prostaglandin-E<sub>2</sub> levels in cystic tissue along with the potential to increase recruitment and enhance the function of osteoclasts.<sup>20</sup>

Standard projections include lateromedial, 45° caudolateral-craniomedial oblique, and caudal-10°-proximal-craniodistal oblique views. LTR lesions range in appearance from flat or roughened areas of the middle third (Figure 3) of the ridge to occupying the entire ridge. In some cases, radiographic abnormalities are absent at the onset of lameness, but may develop over time.<sup>15</sup> Dutch Warmblood foals studied by Dik et al, demonstrated radiographic normality of the LTRF in 98% of femoropatellar joints at 1 month of age and a tendency for

**Figure 3: Stifle, lateromedial projection, LTRF lesion.**



abnormalities to appear and then regress, with the radiographic appearance of normal and abnormal becoming fixed after 8 months of age.<sup>7</sup> Clinicians should recognize that the proximal subchondral bone of the lateral and medial femoral trochlear ridges of juvenile horses from birth to 3-5 months of age normally has a roughened, granular appearance. This must not be confused with OC nor should a diagnosis of septic arthritis be missed.<sup>21</sup> Lesions on the medial femoral condyle may manifest as a slight flattening to extensive centrally located SBCs with substantial osteosclerosis (Figure 4). Most cysts communicate with the femorotibial joint. Less commonly, SBCs are also found in the intercondylar eminence of the proximal tibia.<sup>14</sup> Lesions are occasionally identified on the medial femoral trochlear ridge and the articular surface of the patella.

#### **Treatment regimen and prognosis**

Arthroscopic surgical debridement is the treatment of choice for OC lesions involving the trochlear ridges. In one study of 9 horses, 88% were able to fulfill their intended use.<sup>15</sup> In another study of arthroscopic treatment of 252 femoropatellar joints, lesions were confined to the LTRF in 161 joints and the overall success rate was 64% -71% (outcomes had not been determined for 7% at time of publication).<sup>22</sup> Interestingly, there was a lower success rate for the procedure in horses that were ≤ 1 year of age and in animals with osteochondral lesions > 2 cm.<sup>22</sup>

Recently, reattachment of osteochondral defects using resorbable polydioxanone pins has been reported in 12 horses.<sup>23</sup> This procedure requires that the cartilage flaps be greater than 2 cm in length, lack mineralization, have residual attachments to adjacent articular cartilage along at least 180° of their circumference, and be relatively smooth. Radiographic resolution of the OC lesion occurred in 14 of 16 joints and 75% of horses were sound and in training.<sup>23</sup>

Treatment options for horses with SBCs of the medial femoral condyle include rest, surgical debridement, joint resurfacing techniques and, more recently, cyst injection with corticosteroids. While lameness may resolve with prolonged periods of rest, recurrence is common with the resumption of exercise.

With the development of arthroscopic approaches to the medial femorotibial joint, debridement became the recom-

**Figure 4: Stifle, caudoproximal-craniodistal oblique projection, MFC lesion.**



mended treatment of SBCs. One study, examining the effect of surgical curettage of lesions in 51 horses, revealed that 42 of the animals were improved or sound at follow-up, 3- to 12-months postoperatively.<sup>24</sup> Howard reported similar results with an overall success rate of 74%; however, the prognosis for Quarterhorses was lower.<sup>25</sup>

Joint resurfacing (mosaic arthroplasty) of femoral condyles (5 MFC, 1 LFC) with SBCs, using osteochondral grafts from the abaxial border of the contralateral medial trochlear ridge, has been reported with a 50% success rate.<sup>26</sup> Two of the three successful outcomes were in horses 3 years of age.<sup>26</sup>

Observation of meniscal kissing lesions subsequent to cyst debridement<sup>27</sup> has caused many surgeons to abandon wholesale cyst debridement in favour of arthroscopic or ultrasound facilitated injection of the cyst with corticosteroids. Early results suggest a success rate of about 60%.<sup>28</sup>

### **Metacarpo/metatarsophalangeal joints**

#### **Clinical signs**

Horses with OC lesions of the metacarpophalangeal (MCPJ) or metatarsophalangeal joints (MTPJ) frequently have variable joint effusion and lameness that is exacerbated by distal limb flexion or upon entering training.<sup>29,30</sup> Frequently, multiple MCPJ/MTPJs are involved. In all cases, lameness is localized with perineural or intra-articular analgesia.

#### **Predilection sites and radiographic signs**

The most common manifestation of OC in the MCPJ/MTPJ is variable flattening of the dorsal aspect of the midsagittal ridge with changes ranging from subtle flattening to severe irregularity of the subchondral bone.<sup>29</sup> Occasionally, lesions will extend further onto the articular surface or even the palmar/plantar border of the sagittal ridge.<sup>6</sup> Midsagittal ridge lesions may be more commonly seen on the third metatarsal bone (MTIII) compared with the third metacarpal bone (MCIII).<sup>6</sup> Cyst-like lesions, in contrast, more commonly affect the MCIII (Figure 5); specifically, the medial condyle, but are also infrequently observed on the lateral condyle or the midsagittal ridge.<sup>30</sup> The optimal radiographic projections for viewing these lesions are the flexed lateromedial (sagittal

**Figure 5: Metacarpophalangeal joint, latero-medial projection, medial condylar lesion.**



ridge lesions)<sup>6</sup> and dorsopalmar (condylar cyst-like lesions) views (Figure 6).<sup>30</sup> Radiographic evidence of cyst-like lesions may not be present in some foals with lameness localized to the MCPJ, but repeated radiographic examinations 6-8 weeks later may reveal development of a cyst-like lesion.<sup>6</sup>

#### **Treatment regimen and prognosis**

OC lesions of the midsagittal ridge have been treated conservatively with enforced rest or by arthroscopically removing osteochondral fragments.<sup>29</sup> In most cases, the radiographic signs remain unchanged or show minimal progression.<sup>29</sup> One investigator has suggested that the long-term radiographic appearance of sagittal ridge lesions treated arthroscopically is inferior to those allowed to heal conservatively and, therefore, animals < 18 months of age *without* lameness should be conservatively treated before pursuing surgical intervention.<sup>6</sup> It is estimated that 90% of horses with dorsal midsagittal ridge lesions go on to be used athletically, while those with lesions of the

**Figure 6: Metacarpophalangeal joint, dorso-palmar projection, medial condylar lesion.**



weight-bearing portion of the midsagittal ridge do not fare quite as well.<sup>6</sup> In 15 horses surgically treated for cyst-like lesions of the MCIII condyles (14 horses), and midsagittal ridge (1 horse), 80% were sound 4–6 months after surgery.<sup>30</sup> Recently, injection of these cysts with corticosteroids has been recommended.<sup>31</sup>

### **Scapulohumeral joint**

#### **Clinical signs**

Lameness due to OC in the shoulder can vary considerably between subtle and intermittent to severe and persistent, and may manifest later, with some horses showing no clinical signs until 2–5 years of age.<sup>32</sup> Concurrent degenerative joint disease is common. Intra-articular anesthesia is often needed to confirm the origin of the lameness.

#### **Predilection sites and radiographic signs**

In a study of 38 horses diagnosed with shoulder OC, lesions were identified in 54 shoulder joints; the most common individual radiographic lesion was the alteration in the contour of the caudal articular margin of the humeral head (41/54 joints). Other lesions included osteophytes on the caudal (30/54) or cranial (21/54) aspects of the glenoid cavity or abnormal contour of the glenoid cavity (21/54).<sup>33</sup> Single- or double-contrast arthrography may also be used to better demonstrate cartilage defects.<sup>34</sup> A recent study reported that small glenoid cysts were the most commonly identified lesions in 15 horses with unilateral shoulder-origin lameness and subtle radiographic changes.<sup>35</sup>

#### **Treatment regimen and prognosis**

In 13 shoulder joints of 11 horses arthroscopically treated for OC, 8 of 11 horses were in training or “pasture sound” at follow-up, 5–20 months after surgery; however, only 5 of 11 horses (45%) were actually working under saddle at the time of study completion.<sup>36</sup> In another study, 12 of 15 horses with subtle radiographic lesions returned to their previous level of performance after surgical debridement.<sup>35</sup> Unfortunately, the prognosis for soundness is guarded if there is evidence of degenerative joint disease at the time of presentation.

### **Proximal interphalangeal joint**

#### **Clinical signs**

Lameness appears to be progressive in nature and accompanied by firm periarticular swelling and severe degenerative joint disease. The age at time of onset varies; some horses are affected as weanlings,<sup>6</sup> while others only become clinically lame at 2 or 3 years of age.<sup>37</sup> Hindlimbs are more frequently affected than forelimbs and lameness is exacerbated by distal limb flexion.<sup>37</sup>

#### **Predilection sites and radiographic signs**

Lesions are typically cyst-like and affect the distal condyles of the proximal phalanx<sup>6</sup> with a concurrent bony proliferation over the dorsal aspect of the joint and/or the presence of multiple marginal osteophytes.<sup>37</sup> Osteochondral fragments originating from the central,

dorsoproximal aspect of the middle phalanx, with no evidence of significant osteoarthritis, were reported in a yearling Standardbred colt exhibiting classic OC in several other joints (bilateral DIRT, MTPJ), although this was not confirmed histologically as osteochondrosis.<sup>38</sup>

#### **Treatment regimen and prognosis**

Limited numbers of cases have been reported in the literature; however, the few that have been treated nonsurgically have either remained lame, were sound enough to be used as breeding animals, or were humanely destroyed.<sup>37</sup> The extensive osteoarthritis that accompanies pastern joint osteochondrosis suggests that arthrodesis is the treatment of choice.<sup>37</sup> Arthrodesis of the proximal interphalangeal joint, especially the pelvic limb, carries an excellent prognosis for soundness and a return to athletic function.<sup>39</sup> This is fortunate given the predilection for osteochondrosis to occur in the pelvic interphalangeal joints over the thoracic interphalangeal joints.

### **Summary**

While this review has focused on the common locations for OC, it is also found in the humeroradial, coxofemoral, cervical facet, and atlanto-occipital joints, among others and, conceivably, can affect any joint. Generally, OC of the tarsocrural, femoropatellar, and metacarpo-/metatarsophalangeal joints respond favourably to treatment with a reasonable prognosis for return to athletic activity. Proximal interphalangeal joint OC can be treated successfully with arthrodesis. Cyst-like lesions of the medial femoral condyle have a fair to guarded prognosis and ideal treatment regimens remain to be determined. Scapulohumeral joint OC with concurrent osteoarthritis carries a guarded prognosis for return to athletic function.

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## Upcoming Meetings

18 – 22 February 2007

### Western Veterinary Conference

Las Vegas, Nevada

CONTACT: Website: <http://www.wvc.org/>

3 – 6 March 2007

### American Association of Swine Veterinarians

Orlando, Florida

CONTACT: Website: [www.aasv.org](http://www.aasv.org)

3 – 10 March 2007

### Veterinary Orthopedic Conference

Sun Valley, Idaho

CONTACT: Website: [www.vosdvm.org](http://www.vosdvm.org)

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*Dr. Wolker has stated that he has no disclosures to announce in association with the contents of this issue.*

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This publication is made possible by an educational grant from

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