Hypertrophic osteodystrophy (HOD) is a bone disease of growing, usually large-breed dogs that causes pain and lameness. Its cause is unknown, but proposed causes include vitamin over-supplementation, vascular abnormalities, immune-mediated reactions to vaccination, and bacterial and viral infections (e.g., canine distemper).

HOD develops in the metaphysis adjacent to the physis, where the blood vessels turn 180° until skeletal maturation. Hemorrhage and necrosis of the adjacent trabeculae take place, which become visible on radiographs as a radiolucent line, also known as a pseudophysis, which is pathognomonic. Eventually, subperiosteal hemorrhage can become apparent as widening of the metaphysis as the periosteum deposits new bone.

**DIAGNOSTIC CRITERIA**

**Historical Information**
- Malaise.
- Acute-onset lameness and reluctance to walk.
- Recent (1 to 4 weeks) immunization in genetically predisposed animals (e.g., Weimaraners). Recommended immunization protocols for Weimaraners include using killed viruses and separate vaccines instead of combination vaccines.

**Gender Predisposition**
- Males may be at increased risk, but reports have been conflicting.

**Age Predisposition**
- 2 to 8 months of age with a peak from 3 to 5 months of age.

**Breed Predisposition**
- Odds ratio >5.3, from highest (189.8) to lowest: Great Danes, Weimaraners, boxers, Irish setters, German shepherds, Labrador retrievers, golden retrievers.

**Owner Observations**
- Lameness or reluctance to move, lethargy, anorexia.
- Swollen, warm, and painful areas around the joints (metaphyseal regions of the long bones). Areas most often affected are the distal radius and ulna and the tibia. Less commonly affected are the femurs, ribs, mandible, scapula, and metacarpal bones.

**Other Historical Considerations/Predispositions**
- Rapid growth.
- Large breed.
- Nutritional supplementation.

**Physical Examination Findings**
- Pain on palpation of the metaphyses of the long bones (swollen areas).
- Soft swelling over the distal forelimbs and possibly the distal hind limbs.
- In rare cases, the patient has pain in the temporomandibular joint.
- Lameness.
- Lesions are usually bilateral and symmetrical.
- Fever.
- A unique syndrome has been described in unrelated Weimaraners that also includes gastrointestinal signs, such as vomiting and diarrhea, and ocular and nasal discharge.

**Laboratory Findings**
- Leukocytosis.

**Other Diagnostic Findings**

**Radiography**
- Confirmatory radiographic changes include:
  - **Early stages**: Radiolucent region parallel to the physis in the metaphyseal region of the long bone (double physeal line). The metaphyses may enlarge and appear irregular or sclerotic. The pseudophyseal line is pathognomonic.
  - **Progressive disease**: Subperiosteal and extraperiosteal new bone formation that appears as a cuff around the metaphysis.
- Dogs with severe disease may have soft tissue mineralization.

**Summary of Diagnostic Criteria**
- Swollen, firm, warm, very painful metaphyseal regions of the long bones.
- Radiographs of affected areas confirm a radiolucent region parallel to the physis in the metaphyseal region of the long bone.
- Lameness.
- Fever may be present or absent.
Diagnostic Differentials
For further details, refer to the article on panosteitis (pp. 8 to 9).
- Musculoskeletal pain without fever: Polyostotic bone cysts, osteopetrosis.
- Musculoskeletal pain with fever:
  - Epiphysitis or osteomyelitis.
  - Infectious diseases:
    - Laboratory findings include thrombocytopenia (most common), leukocytosis or leukopenia, pancytopenia, elevated alkaline phosphatase or alanine aminotransferase level, hyperglobulinemia, hypoalbuminemia, proteinuria.
  - Diagnosis is made by serial antibody titers. Seroconversion occurs 7 to 28 days after infection.
  - Septic polyarthritis.
- Immunodeficiency disorders (reported in Weimaraners, Irish setters, and border collies): Rare.
  - Severe signs are often accompanied by systemic signs of illness.
  - Neutrophil phagocyte dysfunction with low serum IgG concentrations.
  - Leukocyte adhesion disorder.
  - Myelokathexis (inability of neutrophils to enter the peripheral circulation).
  - Can progress to a systemic inflammatory response syndrome.

TREATMENT RECOMMENDATIONS

Initial Treatment
For dogs with mild to moderate signs (majority of cases): $•
- Nonsteroidal antiinflammatory drugs (NSAIDs): Different NSAIDs or corticosteroids should not be given concurrently. See the panosteitis article (p. 9) for recommendations and dosages.
- Dietary imbalances should be corrected.
For dogs with severe signs: $–$$
- NSAIDs.
- Dietary imbalances should be corrected.
- Blood and urine cultures should be conducted and appropriate antibiotics given if the patient has a positive test result for bacterial growth.

Alternative/Optional Treatments/Therapy
- Corticosteroids have been recommended in patients that are nonresponsive to NSAIDs (this is controversial). $•

Supportive Treatment
Refer to the article on panosteitis (p. 9).

Patient Monitoring
- Closure of growth plates is possible, which can result in angular limb deformities in rare cases. Younger patients (<6 months of age) have a higher risk of developing this condition. Monthly examinations should be conducted until the patient’s growth has leveled off. If physical examination suggests that angulation is occurring, radiographs are indicated for evaluation and possible surgical intervention. $–$$
- Recurring episodes are possible and should be monitored. Most often, these episodes decrease in severity.

Home Management
- Adequate nutritional intake and hydration status should be ensured.
- The patient should be monitored for progressive angulation of the limbs.

Milestones/Recovery Time Frames
- Growth plate closures and development of angular limb deformities should be monitored. Early correction of asynchronous growth improves long-term functional prognosis.

Treatment Contraindications
- Patients with hypovolemia should be rehydrated before NSAID administration.
- Renal function should be monitored carefully during NSAID administration in patients with underlying renal disease.

CHECKPOINTS
- Opinions differ about whether patients with HOD should be treated with corticosteroids. Corticosteroids have a deleterious effect on patients with infectious organisms. Some cases have been reported with evidence an autoimmune response to which corticosteroids may be of benefit. It is most likely that the broad spectrum of cases that are identified as HOD may have multiple inciting causes, and only the identification of the underlying cause in each case predicts the best form of treatment.
- Many case reports of craniomandibular osteopathy include history of lesions similar to those seen in patients with HOD. Likewise, many HOD case reports include a history of lesions similar to those seen in patients with craniomandibular osteopathy. A published review of the Veterinary Medical Database did not find evidence that the two diseases were linked. However, because of the methods of data collection and the retrospective nature of the study, the validity of the conclusion should be tested by a prospective study with more extensive data.
• Corticosteroids are contraindicated in the presence of positive blood or urine cultures.
• Supplementation with vitamins or minerals should be avoided, and the patient should be kept on a balanced diet. Rapid-growth diets may be a contributory factor.

PROGNOSIS

**Favorable Criteria**
• Minimal signs that respond well to treatment.

**Unfavorable Criteria**
• Severe signs that do not respond to treatment.
• Sustained and unresponsive systemic signs.
• Repeated episodes, especially if they increase in severity.
• Secondary bacterial infection.
• Angular limb deformities.
• Immune deficiencies.

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**RECOMMENDED READING**


