



CASE REPORT

Pulsed Electromagnetic Field for the Treatment of Canine Legg-Calvé-Perthes Disease

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ABSTRACT

The purpose of this paper is to report the results achieved with the biophysical stimulation in the conservative treatment of Legg-Calvé-Perthes (LCP) disease in dogs. Three female Portuguese Podengo puppies, from the same parents were presented for investigation of right hind limb lameness in different times. The clinical and radiographic exams of the hip revealed the LCP disease in different stages in all puppies. External coaptation was applied in one of them, while biophysical stimulation was applied in another one, both of them in early stage of disease. Surgical treatment was performed only in the advanced stage one. The present report signals the improvements of clinical findings and of radiographic signs of LCP disease treated with pulsed electromagnetic field (PEMF). It induces to consider this treatment in more dogs with LCP in early stage, investigating on PEMF effectiveness. Furthermore, it leads to suppose the LCP disease as a hereditary condition, not previously studied in this breed.

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INTRODUCTION

Legg-Calvé-Perthes (LCP), or avascular necrosis, is a non-inflammatory aseptic necrosis of the femoral head and neck which occurs in both young children and miniature breed dogs between 3 and 13 months of age. The etiology of LCP disease is currently unknown. Various causes have been considered, such as trauma, infection, metabolic and hormonal imbalances, as well as hereditary factors. One or more of these causes are followed by a vascular damage. Ischemia, necrosis and collapse of the femoral head and neck are the main changes of the LCP disease, and various stages of revascularization and repair of the proximal femoral epiphysis and metaphysis have been noticed (Mickelson *et al.*, 1981).

The clinical findings are pain and lameness, but radiography is required to confirm the disease. The radiographic signs of the affected hip joint change with the chronicity of the LCP, such as widened joint space, foci of radiolucency in the proximal femoral epiphysis, irregular density of the femoral metaphyseal region, flattening and irregularity of the dorsal surface of the femoral head and various degrees of secondary degenerative joint disease. In advanced stage, fragmentation of the femoral head and/or pathologic

fracture of the femoral neck may occur. Nevertheless, the radiographic evidences are pathognomonic in nearly all cases, and currently they are classified into five patterns according to Ljunggren in 1967 (Jankovits *et al.*, 2012).

Conservative and surgical treatments have been suggested for LCP disease in dogs. The conservative therapy with restricted exercise, or with non-weight-bearing exercise, exercise such as swimming, the use of Ehmer sling, appropriate nutrition, analgesics, steroids and NSAIDs, is indicated to relief pain and lameness but only a small percentage of success has been reported (Gibson *et al.*, 1990; Piek *et al.*, 1996). Surgical therapy by excision of the femoral head and neck is recommended for better results along with a much shorter recovery period (Jankovits *et al.*, 2012). It has been reported that excision of the femoral head and neck is an effective treatment of LCP disease for a rapid relief of pain and for good functional results in about 67 to 84% of the affected dogs, while, with conservative treatment, in only 25 to 30% of the dogs a good recovery has been obtained in three to four weeks (Piek *et al.*, 1996). Recently, the micro total hip replacement has been successfully proposed for the treatment of LCP (Jankovits *et al.*, 2012), and the injection of autologous bone marrow mononuclear cells and cultured bone marrow stromal cells, directly into the femoral head

lesions, has been described in 4 dogs with LCP disease (Crovace *et al.*, 2008).

In human medicine, conservative management is always attempted in children and young adults with LCP disease in early stage. Recently, in order to prevent or delay the progression of LCP, the stimulation with pulsed electromagnetic field (PEMF) has been proposed, since it preserves bone or it promotes osteogenesis and angiogenesis (Massari *et al.*, 2009). In the dog, PEMF has been successfully applied for the treatment of osteoarthritis (Pinna *et al.*, 2013).

Clinical cases: Three Portuguese Podengo dog puppies, between 6-8 months of age, 2.5-3.8 kg, from the same parents were presented for investigation of hind limb lameness to the Clinical Hospital of the University of Bologna, Italy, in different times. Orthopedic and radiographic examinations were performed.

The case No.1 showed grade 4 (out of 4) lameness, severe pain, and radiographic features of extensive fragmentation of the right femoral head. Advanced stage of LCP was diagnosed (grade 5), consequently the excision arthroplasty, or osteotomy, of the femoral head and neck (FHO) was performed (Fig. 1a) (Off and Matis, 2010).

The cases No.2 and No.3 showed grade 1 (out of 4) lameness of the right hind limb and moderate hip pain. Radiographic exam of the pelvis revealed changes of density in proximal femoral epiphysis and metaphysis, except for the contour of the femoral head and neck that was normal (Figs. 1b and 1c). Radiographic images confirmed the diagnosis of grade 1 avascular necrosis of the femoral head, and medical treatments were elected in

both cases. At the right hip of the case No.2, the Ehmer sling was applied and maintained for 6 weeks (Gibson *et al.*, 1990). While the case No.3 was treated with biophysical stimulation, getting the therapy from human treatment (Massari *et al.*, 2009). The dog was firstly laid on a PEMF mat and the stimulation was applied at a cyclic frequency of 3-22-250-500 Hz, 7.5 μ T intensity for 10 minutes. Then, a small pad was used on the affected joint, 0.3-1.5-3 Hz cyclic frequency, 0.75 μ T intensity for 8 minutes. The treatments were applied 5 times per week for 60 days.

RESULTS

The case No.1 was re-evaluated one month after FHO, it did not show lameness either pain upon palpation, while the muscle of the hind limb was still slightly atrophic. Radiograph image confirmed the correct direction of the femoral neck resection (Fig. 2a). The dog had a full two months' recovery time of after surgery.

In the case No.2, after the sling removal, the lameness was grade 3 (out of 4), with persistent pain especially in abduction, while the x-ray images revealed an obvious worsening of the LCP disease classified as grade 3 (Fig. 2b). The FHO was proposed as definitive/most suitable treatment.

The case No.3 was re-examined at 2, 4, and 6 months after diagnosis. At 2 months the owner reported an improvement of walk and behavior of the dog. At 4 months, lameness was not present and manipulation of hip did not elicit pain. At 6 months the dog showed a full recovery, and the pelvic radiography revealed normal trabecular pattern (Fig. 2c).

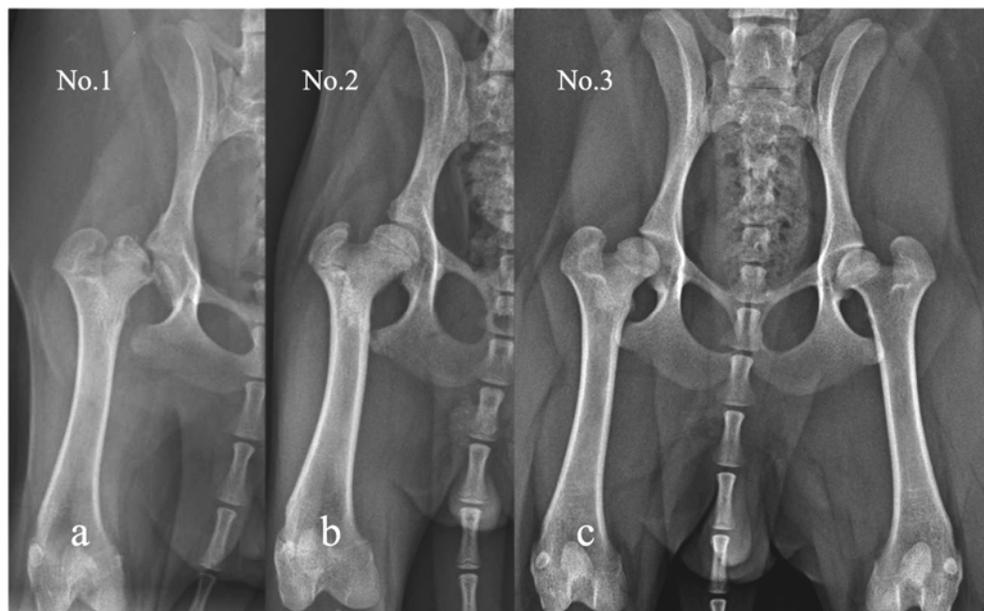


Fig. 1: Dog No.1: Ventrodorsal X-rays view of the right hip joint of a 7-month-old, female, 3.6 kg, Portuguese Podengo. Extensive fragmentation of the femoral head, discontinuity of the articular surface, and diffuse increase of density of the femoral head and neck are evident. Dogs No.2 and No.3: Comparable radiographic appearances in a 6-month-old, female, 2.1 kg and a 8-month-old, female, 3.8 kg. The contour of the femoral head and neck is normal without any evidence of collapse and flattening of head. Multiple foci of radiolucency are present in the femoral neck (No.2), or a single focus in the femoral head (No.3), and a large area of increased density occurred in the proximal femoral metaphysis. The joint space is widened and there is a moderate joint incongruence. In the case No.2 the growth plates are still visible.

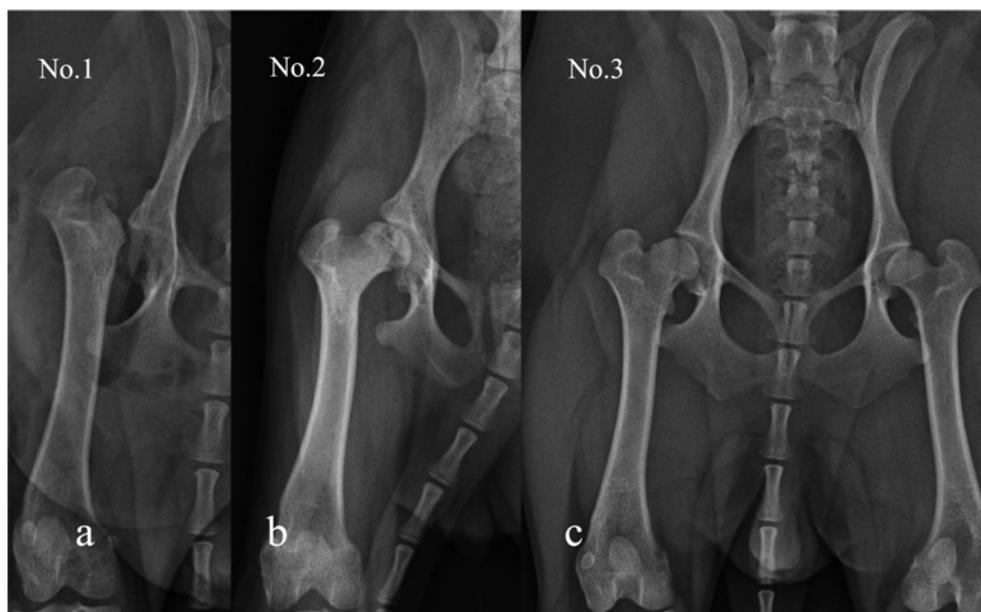


Fig. 2: Dog No.1: Postoperative X-rays image of osteotomy performed from the base of trochanter major across the neck to the medial cortex of the femur; Dog No.2: After Ehmer sling removal, multiple enlarged foci of decreased density and flattening of the femoral head are the X-ray changes; Dog No.3: After biophysical stimulation X-rays image reveals a normal trabecular pattern of the head and of the bone density of proximal femoral metaphysis. Degenerative changes are barely visible, but joint incongruence is still slightly evident.

DISCUSSION

A vascular damage which occurs during the development of the femoral epiphysis seems to be responsible for LCP disease. Ischemia might result from insufficient oxygen supply caused by a reduced number of afferent arterial vessels or infarction and obstruction of the efferent venous vessels. PEMF could be suggested as a choice of conservative management in order to improve blood perfusion. The cellular membrane is a primary target of the electromagnetic fields that stimulate normal cellular ion exchange and oxygen utilization, and promote generalized healing of tissues (Pinna *et al.*, 2013). In humans, the electromagnetic stimulation has been successfully applied on patients with different stages of LCP, thus delaying the need of early joint arthroplasty (Massari *et al.*, 2009).

This report describes for the first time the PEMF therapy as a conservative treatment for canine LCP. The early diagnosis aids the prognosis and may prevent severe disability, but it is rare in dogs because of a lack of symptoms early in the disease process that delays the treatment (Mickelson *et al.*, 1981). Unfortunately, radiography has less sensitivity in the early evaluation of LCP disease than magnetic resonance (Bowlus *et al.*, 2008).

Unlike Gibson's report (1990) using the Ehmer sling, we did not obtain the healing of LCP. Besides, Portuguese Podengo is a small breed dog which has never been mentioned in epidemiology reports, and unlike Vasseur (1989), all three of our study's dogs were females and the hindlimbs affected were the right leg.

Concluding, a study of heredity might be interesting, as we didn't notice the LCP in other puppies from different matings. In this report it might be supposed that the success obtained in clinical signs and radiological

images is a result of the effects of stimulation by pulsed electromagnetic fields. Therefore, PEMF therapy could be considered in further studies in order to evaluate its effectiveness in canine avascular necrosis diagnosed in the early stage.

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