Effects of postoperative administration of ketoprofen or carprofen on short- and long-term results of femoral head and neck excision in dogs

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Objective—To determine whether postoperative administration of ketoprofen or carprofen had any effects on short- or long-term results of femoral head and neck excision (FHNE) in dogs.

Design—Prospective randomized controlled trial.

Animals—40 client-owned, large-breed dogs undergoing FHNE and 15 healthy large-breed dogs used as controls for hip joint angle measurements and force plate analyses.

Procedure—Dogs undergoing FHNE were treated with ketoprofen, carprofen, or a placebo for 21 days after surgery. Hip joint abduction and extension angles were measured at the end of surgery and 120 days later. Lameness scores were assigned, and force plate analyses were performed on days 3, 15, and 120.

Results—There were no significant differences among treatment groups in regard to hip joint angles or lameness scores. Force plate analysis revealed that dogs in all 3 treatment groups bore consistently less weight on the operated limb than did control dogs for the duration of the study. Dogs receiving ketoprofen had greater peak propulsive force at a walk on day 3 and greater peak vertical force at a walk on day 15 than did dogs receiving the placebo. Treatment of an acute condition and preservation of the lesser trochanter, but not postoperative analgesic administration, were positively associated with ground reaction forces on day 120. Owners of 12 of 31 dogs indicated that the dog’s gait worsened for a few days after discontinuation of analgesic administration.

Conclusions and Clinical Relevance—Administration of ketoprofen or carprofen after surgery was not associated with long-term results of FHNE, probably because of the impact of other factors. Because some owners noticed worsening of the lameness following cessation of analgesic administration in the present study, it is possible that longer administration would have improved long-term results.

Femoral head and neck excision (FHNE) is a common procedure in dogs. The main indications are aseptic necrosis of the femoral head (Legg-Calvé-Perthes disease), irreparable fractures of the femoral head or acetabulum, recurrent hip joint luxation, and severe hip dysplasia with secondary degenerative joint disease.12

Despite the common use of FHNE, confusion persists concerning the prognosis and ideal postoperative management. It is important, therefore, to study factors that may be involved in the outcome of dogs undergoing FHNE, not only to identify factors that may be useful in refining the prognosis but also to identify those that may be used to improve results. Previous studies have shown that speed of recovery and long-term results after FHNE are highly variable, depending on surgical technique, patient characteristics, and postoperative care. Early passive and active physical therapy is recommended to guide fibrous tissue healing at the surgical site and prevent loss of range of motion of the hip joint, poor limb use, and muscle atrophy.13 However, postoperative pain associated with the surgery itself and with nociceptors in bone, periosteum, joint capsule, muscles, and tendons may cause patients to avoid using the limb, delaying the return to function. Many surgical techniques have been developed in an attempt to reduce postoperative pain, but results have been variable and controversial. To our knowledge, the effects of analgesic administration during the first weeks after surgery have not yet been studied.

Ketoprofen and carprofen are 2 nonsteroidal anti-inflammatory drugs (NSAIDs) approved in North America for the treatment of dogs with pain secondary to degenerative joint disease. Ketoprofen is a potent inhibitor of cyclooxygenase with some action against lipooxygenase in vitro. Ketoprofen also provides central analgesia by acting at the supraspinal level.14,15 Its efficacy in the management of pain in humans with degenerative joint disease has been well demonstrated for a long time.16,17 Carprofen is a weak inhibitor of cyclooxygenase but has well-demonstrated analgesic properties. A central action is also presumed. Several studies have reported the therapeutic efficacy of carprofen in the treatment of dogs with degenerative joint disease.

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The purpose of the study reported here was to determine the effects of postoperative administration of ketoprofen or carprofen on short- and long-term results of FHNE in dogs. We also wanted to identify pre- and intraoperative factors associated with outcome.

Material and Methods

Dogs—Forty large-breed dogs (ie, dogs expected to weigh >20 kg [44 lb] when adult) undergoing FHNE at the veterinary teaching hospital of the University of Montreal were included in the study. Dogs with lameness associated with a neurologic, neoplastic, infectious, or immunologic disease; concomitant dysfunction of the knee or tarsal joint; forelimb lameness; hepatic or renal insufficiency; gastrointestinal tract disease; or a bleeding disorder and dogs that were pregnant were excluded from the study. Fifteen clinically normal adult large-breed dogs were also included in the study as controls for measurement of hip extension and abduction angles and force plate analyses. These dogs were determined to not have any orthopedic problems on the basis of results of clinical and radiographic examinations and force plate analyses.

Preoperative evaluations—Medical history of each dog was recorded, and complete physical, orthopedic, and neurologic examinations were conducted by 1 of 5 experienced veterinarians (diplomates of the American College of Veterinary Surgeons or clinicians at the veterinary teaching hospital). A lameness score ranging from 0 to 5 was assigned by a single individual (JD), with 0 (no lameness) indicating a normal gait at the walk and trot, 1 (minimal lameness) indicating use of the limb but slight lameness, 2 (marked lameness) indicating use of the limb but obvious lameness, 3 (minimal limb use) indicating obvious lameness at a walk and no use of the limb at a trot, 4 (rare limb use) indicating no use of the limb most of the time but weight-bearing on the limb while at rest, and 5 (no use of the limb) indicating no use of the limb and unwillingness to bear weight on the limb even at rest. In all dogs, forelimb lameness was ruled out on the basis of results of clinical and radiographic examination and force plate analyses of gait; radiography was performed as necessary.

For dogs included in the study, a CBC and serum biochemical profile were performed to evaluate general health and provide baseline values. Feces were tested for occult blood. Radiographs of the hip joints and pelvis were obtained. Preoperative radiographs to confirm the absence of orthopedic problems. The hip joint was exposed through a craniolateral approach.22 Radiographs of the hip joints and pelvis were obtained. On days 3, 15, and 120, gait analysis was performed by means of manual goniometry at the end of surgery and 120 days after surgery. For evaluation 120 days after surgery, dogs were premedicated with butorphanol (0.1 mg/kg, IM), acepromazine (0.1 mg/kg, IM), and glycopyrrolate (0.01 mg/kg, IM), and anesthesia was induced with sodium thiopental (10 mg/kg, IV) and maintained with isoflurane in oxygen. Cefazolin (22 mg/kg, IV) was administered 30 minutes prior to surgery.

Postoperative management—Dogs were examined every hour for the first 12 hours after surgery, and a pain score from 0 to 13 was assigned (Appendix). Dogs assigned a pain score ≥7 were given oxymorphone (0.05 mg/kg, IM) as often as needed. Five dogs in the placebo and carprofen groups and 2 dogs in the ketoprofen group were given 1 to 3 doses of oxymorphone. Details of the protocol have been previously published.23

The day after surgery, oral administration of ketoprofen (1 mg/kg [0.45 mg/lb], q 24 h), carprofen (2 mg/kg [0.9 mg/lb], q 12 h), or a placebo was initiated. The placebo consisted of lactose tablets and was administered every 12 hours. Dogs in the ketoprofen group were given ketoprofen in the morning and the placebo in the evening so that dogs in all 3 groups were treated twice a day. The attending clinician did not see which caplets were given to any individual dog at any time.

All dogs were discharged from the hospital 2 days after surgery. Owners were instructed to continue to administer the medication for a total of 21 days. In addition, all owners were given a standard letter explaining the importance of postoperative rehabilitation to optimize results of surgery. Owners were instructed to walk their dogs slowly on a short leash for 5 to 10 minutes at least 2 times a day and perform passive physical therapy (5 to 10 minutes of flexion and extension of the hip joint twice a day) if tolerated by the dog. Owners were informed that during the first 6 weeks after surgery, the amount of activity should be increased by increasing duration (ie, distance or number of walks) but not intensity. Swimming was allowed after healing of the surgical wound.

Abduction and extension angles of the hip joint were measured by means of manual goniometry at the end of surgery and 120 days after surgery. For evaluation 120 days after surgery, dogs were premedicated with butorphanol (0.1 mg/kg, IM), acepromazine (0.1 mg/kg, IM), and glycopyrrolate (0.01 mg/kg, IM), and anesthesia was induced with sodium thiopental (10 mg/kg, IV) and maintained with isoflurane. For the control dogs, abduction and extension angles of the hip joint were measured while dogs were anesthetized for radiography to confirm the absence of orthopedic problems.

For dogs undergoing FHNE, a lameness score was assigned by the attending surgeon 2, 15, and 120 days after surgery. On days 15 and 120, owners were asked to complete a questionnaire concerning recovery and gait of their dogs. Owners were asked how long after surgery their dogs began to use the limb and whether they were satisfied with results of the surgery. In addition, they were asked to assign a score for the percentage of time the dog used the limb during normal activity (0 = never, 1 = 25% of the time, 2 = 50% of the time, 3 = 70 to 80% of the time, and 4 = 90 to 100% of the time), whether the dog used the limb when running (0 = no and 1 = yes), whether the dog was lame when walking (0 = yes and 1 = no), and whether the dog was lame when running (0 = yes and 1 = no). A recovery score from 0 to 7 was calculated on the basis of the owner evaluations. Owners were telephoned 30 days after surgery to inquire about alterations in the dog's gait following the cessation of oral treatment.

On days 3, 15, and 120, gait analysis was performed with a force plate' and standard software. Dogs were led by a
handler on a 15-m walkway at a walk (approx 1.4 m/s) and a trot (approx 2 m/s). An observer determined whether each trial was valid; a trial was deemed valid when the operated limb landed completely on the force plate and velocity was between 1.3 and 1.5 m/s (walk) or between 1.8 and 2.1 m/s (trot), as calculated with a chronometer. Trials with distracting head or body motions or gait irregularities were discarded. The peak and impulse of vertical (Fz) and propulsive (Fy) forces were calculated and recorded. A value of 0 was attributed to the ground reaction forces for dogs walking or trotting at the predetermined velocity without bearing weight on their operated limb while passing over the force plate. Data from at least 6 valid trials of the operated limb were recorded and then averaged.

To detect adverse effects associated with the medication, a clinical examination, CBC, serum biochemical profile, and fecal occult blood test were carried out on day 15.

Statistical analyses—Data were expressed as mean ± SEM. Ground reaction forces were normalized as a percentage of body weight for comparison between dogs. Proportions were analyzed by use of Fisher exact tests. Recovery and lameness scores were compared between groups with the nonparametric Kruskal-Wallis test. Angle measurements and force plate results were compared among groups by means of a 1-way ANOVA. A repeated-measures ANOVA followed by the Fisher pairwise procedure was used to assess the effect of treatment and time on hip extension and abduction angles and ground reaction forces. Factors thought to be associated with vertical and propulsive forces on day 120 were examined by means of stepwise linear regression analysis to determine whether they were significantly associated with long-term results of FHNE. For all analyses, values of P < 0.05 were considered significant.

Results

The 40 dogs that underwent FHNE were between 5 and 77 months old and weighed between 12 and 41 kg (26 and 90 lb) at the time of surgery. Six dogs underwent FHNE on both hind limbs 4 months apart and were included in the study twice. Therefore, data were collected for 46 hind limbs. One dog was lost to follow-up at day 120 and was not used for analysis of lameness scores, force plate results, or angle measurements. Thirty-three dogs had a chronic condition, mainly bilateral degenerative joint disease (27 dogs). Other chronic conditions included unilateral dysplasia (n = 1), plasmocytic synovitis (1), chronic hip joint luxation (1), and chronic fractures that had not been repaired (3). Seven dogs had an acute condition, including hip joint luxation alone (n = 2) or in association with acetabular and greater trochanter fractures (1) and fracture of the femoral neck and greater trochanter (1), acetabulum (1), femoral neck (1), and femoral head (1). There were no significant differences among the 3 treatment groups in regard to the distribution of acute versus chronic or unilateral versus bilateral conditions, distribution of dogs that underwent bilateral FHNE, or distribution of whether the lesser trochanter was or was not resected during surgery.

Significant differences were not detected among groups in regard to results of the owner questionnaire administered 15 and 120 days after surgery. According to the owners, 31 of 46 (67%) dogs were using the operated limb at the time of discharge from the hospital, including 9 of 16 dogs in the ketoprofen group, 12 of 15 dogs in the carprofen group, and 10 of 15 dogs in the placebo group. Owners reported that all 46 dogs were using the operated limb by 15 days after surgery. Recovery scores calculated from questionnaires were similar among groups on day 15 (ketoprofen group, 3.63 ± 0.43 [mean ± SEM]; carprofen group, 4.2 ± 0.31; placebo group, 3.07 ± 0.40) and day 120 (ketoprofen group, 5.94 ± 0.35; carprofen group, 6.07 ± 0.27; placebo group, 6.31 ± 0.21). On day 120, all owners indicated that they were satisfied with results of the surgery. However, owners of 8 of the 15 dogs receiving carprofen indicated (when contacted 30 days after surgery) that they noticed that their dog’s gait had worsened for a few days after discontinuation of the medication, compared with owners of 4 of 16 dogs in the ketoprofen group and 2 of 15 dogs in the placebo group. This difference was not significant (P = 0.072).

Measurements of hip abduction and extension angles on days 1 and 120 were not significantly different among groups (P = 0.15 and 0.78, respectively). However, angles obtained on day 120 for dogs that underwent FHNE were significantly (P = 0.007 for abduction angle and 0.003 for extension angle) less than angles obtained for control dogs (Fig 1 and 2). There were no significant differences among groups in regard to lameness score on days 3, 15, and 120.

Figure 1—Mean maximum hip joint extension angles immediately (day 1) and 120 days after femoral head and neck excision (FHNE) in dogs treated with ketoprofen (n = 15), carprofen (15), or a placebo (15) for 21 days after surgery and in 15 healthy control dogs without orthopedic abnormalities. Error bars represent SEM. *Significantly (P < 0.05) different from the value for control dogs.

Figure 2—Mean maximum hip joint abduction angles immediately (day 1) and 120 days after FHNE in dogs treated with ketoprofen (n = 15), carprofen (15), or a placebo (15) for 21 days after surgery and in 15 healthy dogs without orthopedic abnormalities. See Figure 1 for key.
Force plate analysis revealed that dogs in all 3 treatment groups bore consistently less weight on the operated limb than did control dogs for the duration of the study. For dogs that underwent FHNE, only peak vertical force at a walk on day 120 was not significantly different from values obtained for control dogs (Fig 3–6). Dogs receiving ketoprofen had greater peak propulsive force at a walk on day 3 and greater peak vertical force at a walk on day 15 than did dogs receiving the placebo. Values for dogs receiving carprofen were not significantly different from values for dogs receiving ketoprofen or values for dogs receiving the placebo at any time. No significant differences were detected among treatment groups on day 120 in regard to peak and impulse vertical and propulsive forces at a walk. Values for vertical and propulsive forces at a trot were not significantly different among groups at any time.

Six factors were tested in a stepwise linear regression analysis to determine whether they were associated with the long-term outcome of FHNE (ie, ground reaction forces on the operated limb at day 120): age, weight, type of condition (chronic vs acute), surgeon (each surgeon was entered as a variable coded as 0 [did not operate on the dog] or 1 [operated on the dog]), extent of resection of the lesser trochanter (complete or partial resection vs no resection), and analgesic treatment (placebo, carprofen, or ketoprofen). Impulse vertical force at a walk on day 120 was positively correlated with preservation of the lesser trochanter, treatment of an acute condition, and weight of the dog ($R^2 = 0.29$). A factorial ANOVA was used to compare ground reaction forces of dogs in which the lesser trochanter was preserved, partially resected, or completely resected. Impulse vertical force at a walk and peak vertical force at a trot were significantly lower when the lesser trochanter was completely resected than when it was preserved or partially resected. No significant difference could be detected between partial resection and preservation of the lesser trochanter. At a trot, there was a positive correlation between treatment of an acute condition and impulse vertical force, peak propulsive force, and impulse propulsive force ($R^2 = 0.17$, $0.31$, and $0.26$, respectively). Long-term results did not appear to be significantly correlated with analgesic treatment.

Results of CBCs and serum biochemical profiles performed on day 15 were not significantly different from preoperative results. Three of 13 dogs treated with ketoprofen that were initially negative for fecal occult blood had positive test results on day 15, compared with 1 of 12 dogs treated with carprofen that were initially negative for fecal occult blood.
9 dogs in the placebo group. Thirteen dogs were positive for fecal occult blood prior to surgery; results were still positive on day 15 for 3 dogs but were negative for the remaining 10. One dog in the placebo group developed anorexia and profuse diarrhea after 7 days of treatment; signs lasted for 8 days until cessation of treatment.

Discussion

In this study, postoperative analgesic administration improved short-term rehabilitation after FHNE, but only treatment of an acute condition and preservation of the lesser trochanter were positively associated with long-term outcome of FHNE (ie, ground reaction forces on day 120).

Previous clinical impressions have suggested that young dogs recover more rapidly after FHNE than do adult dogs. In contrast, results of the present study were in agreement with results of a previous study in which age was not associated with postoperative results of this surgery.

To our knowledge, the present study was the first to use multiple linear regression analysis to assess whether body weight was associated with the outcome of FHNE. In many studies, large-breed dogs seemed to recover less rapidly than smaller dogs and had a higher incidence of lameness and difficulties in running, jumping, and climbing stairs. However, these conclusions were not based on statistical analysis of the results and are in contrast to results of other studies that reported no effect of weight on outcome of FHNE. In the present study, a positive correlation between impulse vertical force on day 120 and body weight was found, but this should not be interpreted as a positive influence of weight on outcome of FHNE. Indeed, Budsberg et al demonstrated that stance phase and vertical impulses correlate directly with body weight and humeral, femoral, and limb lengths in healthy dogs. Impulse increases with greater physical size, because at a given velocity, dogs with longer limbs spend more time in the stance phase. A direct association between body weight and outcome of FHNE cannot, therefore, be proven, because it could be masked by this normal correlation between morphometric measurements and impulse. In the present study, weight did not appear to be significantly associated with the outcome of FHNE. Dogs included in the study weighed between 12 and 41 kg at the time of surgery. Additional studies are needed to assess the outcome of FHNE in dogs larger and smaller than this.

Time between the onset of clinical signs and surgery has been mentioned in study as being associated with the outcome of FHNE, but statistical analyses were not performed. Authors of that study found that dogs with poor results had a history of lameness lasting > 6 months, while dogs with excellent results had an average duration of clinical signs lasting only 1 month. This tendency was confirmed in the present study, in which there were positive correlations between treatment of an acute condition and impulse vertical force, peak propulsive force, and impulse propulsive force. Atrophy of muscles and reduced joint mobility occur with a greater duration of clinical signs, and this may explain the poorer outcome for dogs with chronic conditions. Dogs undergoing FHNE because of an acute condition, such as a fracture of the femoral head or neck, and dogs with only mild muscular atrophy at the time of surgery could be expected to respond better. However, dogs with more severe muscular atrophy may simply recover more slowly and continue to improve even > 4 months after surgery, although this was not evaluated in the present study.

Although FHNE is a salvage procedure that can be performed at any time, it may be preferable to perform surgery before dogs develop marked muscular atrophy.

In dogs undergoing FHNE, the surgical technique should be as atraumatic as possible to minimize postoperative pain and allow early rehabilitation of the operated limb. Experience of the surgeon may therefore influence postoperative results; but in the present study, stepwise linear regression analysis did not reveal any association between any particular surgeon and the long-term results. However, all procedures were performed by experienced surgeons. Bone-to-bone contact during weight-bearing may be the major reason for postoperative pain and an unsatisfactory result. Therefore, complete removal of the femoral head and neck is important and was confirmed in this study by examining radiographs obtained immediately after surgery.

Gendreau and Cawley recommended resection of the lesser trochanter, but doing so removes the insertion of the quadratus femoris muscle and a portion of the insertion of the iliopsoas muscle and may, therefore, impair postoperative limb mobility and stability. In the present study, the lesser trochanter was partially (10/46 dogs; 22%) or completely (18/46 dogs; 39%) resected in 61% of the dogs. Impulse vertical force at a walk and peak vertical force at a trot were significantly higher when the lesser trochanter was intact or only partially resected. Therefore, we recommend that at least a portion of the lesser trochanter and its muscle insertions be preserved to optimize postoperative rehabilitation.

For dogs that have undergone FHNE, postoperative management is directed at promoting and hastening return to use of the operated limb. Ankylosis of the pseudoarthrosis and muscular atrophy can be decreased by aggressive passive and active physical therapy. This depends on the commitment of the owners and the dog's temperament and willingness to exercise, which may be discouraged by pain.

Although precise instructions and encouragement were given to owners, we had no control on how well individual owners followed instructions for postoperative management of their dogs. Therefore, there may have been great variation in the amount and nature of physical therapy among dogs in the study. We expected, however, that random assignment of dogs to the treatment groups would have minimized this factor, allowing for an objective comparison among the effects of placebo, carprofen, and ketoprofen. We believe that best results are obtained with dogs that have a compliant temperament and are owned by conscientious individuals who consistently follow instructions for postoperative management; however, this study was not
designed to assess these criteria, and future studies are needed to analyze these considerations.

In the present study, results of force plate analyses were better for dogs receiving ketoprofen 3 (peak propulsive force) and 15 (peak vertical force) days after surgery than for dogs receiving placebo. Although results of force plate analyses were not significantly different between dogs given carprofen and dogs given the placebo, owners of 8 of 15 dogs receiving carprofen reported seeing decreased use of the operated limb for a few days following cessation of the medication. Carprofen, therefore, seemed to improve the dogs’ gait when administered during the first weeks after surgery. Surprisingly, owners of only 4 of 16 dogs receiving ketoprofen reported seeing decreased use of the operated limb following cessation of treatment. This could be explained by the prolonged anti-inflammatory effect of ketoprofen,\(^\text{[8,17]}\) compared with carprofen.\(^\text{[19]}\)

Lameness scores assigned by the attending surgeon were not significantly different among groups in the present study. This was probably attributable to a lack of sensitivity of the scoring system. Three and 15 days after surgery, lameness was still severe for most of the dogs, regardless of whether they did or did not receive an analgesic. This emphasizes the importance of objective and sensitive tools for gait evaluation, such as force plate analysis of ground reaction forces.\(^\text{[28]}\)

We were surprised that with force plate analyses, differences between groups could be detected only at a walk and not at a trot. This can be explained by the tendency of dogs to use the operated limb only at slow velocity during the first weeks after surgery. All dogs were non–weight-bearing lame when trotting on day 3, and weight-bearing on the operated limb during trotting on day 15 was minimal for most of the dogs, regardless of treatment. In this study, force plate analysis was more useful at a walk than at a trot, but this may be different for other studies, depending on the degree of lameness.\(^\text{[29-32]}\) Most often, force plate analysis in dogs is performed at a trot.\(^\text{[30,33]}\)

In this study, we hypothesized that administration of ketoprofen or carprofen during the first 3 weeks after FHNE would help dogs bear more weight on the operated limb and that this early use of the operated limb would improve the long-term results of FHNE. However, we could not demonstrate any difference between groups in regard to any of the variables studied. Longer administration of the analgesic drugs may have been necessary to adequately control postoperative pain, which may have persisted for weeks or months. Although all owners expressed complete satisfaction with results of surgery at the end of the study, operated dogs still had significantly lower peak vertical, peak propulsive, and impulse propulsive forces and lower angles of hip joint abduction and extension than did control dogs at day 120. It is difficult to know whether these gait abnormalities represent definitive results of FHNE or whether a later reevaluation would have shown better results. Maximal recovery is reported to occur between 2 months\(^\text{[1]}\) and 3 to 4 months for walking or between 4 and 5 months for trotting.\(^\text{[1]}\) However, most of the hind limbs treated by excision arthroplasty are unable to regain normal function and muscle mass even many years after surgery.\(^\text{[31,32]}\)

Hip abduction and extension angles decreased between the day of surgery and day 120 in the present study, probably because of formation of a fibrous pseudoarthrosis that limited movement of the limb.\(^\text{[3]}\) This will probably not improve with time and may even worsen. We believe that regular active physical therapy may be a life-long necessity for dogs undergoing FHNE.

Impulse vertical and propulsive forces for dogs undergoing FHNE in the present study were significantly less than values for control dogs. This was related to a shorter stance time, probably caused by shortening of the operated limb.\(^\text{[1]}\) A second explanation for the decrease in impulse propulsive force is fibrous anklyosis of the pseudoarthrosis.\(^\text{[33,40]}\) We hypothesized that promotion of active physical therapy during the first postoperative weeks combined with administration of an NSAID would minimize this reduction of mobility and, therefore, result in treated dogs having greater impulse propulsive forces and hip joint abduction and extension angles than dogs receiving the placebo. This could not be demonstrated, because many other factors also affect long-term results, such as chronicity of the condition, muscular status, resection of the lesser trochanter, compliance of the owners with recommendations for physical therapy, and temperament of the dog.

Because a proportion of owners noticed worsening of the lameness following cessation of NSAID administration in the present study, it is possible that longer administration would have improved the long-term result of FHNE. No adverse effects of NSAID administration were detected by means of clinical examination, clinicopathologic testing, or examination of feces for occult blood. The diarrhea observed in 1 control dog was attributed to intolerance of the lactose contained in the placebo tablets or to another unknown pathologic problem. The 13 dogs with occult blood in the feces before analgesic treatment were not included in the statistical analysis of results of fecal occult blood tests performed on day 15. Considering that results of initial clinical examinations and clinicopathologic testing were not consistent with occult gastric or intestinal bleeding, these positive results were attributed to administration of the dogs (ie, feeding of an iron-rich or raw meat diet). Three of 13 dogs that did not have fecal occult blood at the time of initiation of the study had positive test results after treatment with ketoprofen for 15 days. Ketoprofen is not approved for long-term administration and should always be used carefully and for short periods. Carprofen is a less potent inhibitor of cyclooxygenase than ketoprofen\(^\text{[30]}\) and is approved for long-term administration.

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**References**


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\(^\text{[1]}\) Hematest, Bayer Corp, Etobicoke, ON, Canada.

\(^\text{[2]}\) Anafen, Merial, Athens, Ga.

\(^\text{[3]}\) Zenecarp, C-Vet Ltd, Bury St-Edmunds, UK.

\(^\text{[4]}\) Maxon, USS&DG sutures, Tyco Healthcare, Gosport, UK.

\(^\text{[5]}\) Model OR6-6, Advanced Mechanical Technologies Inc, Watertown, Mass.

\(^\text{[6]}\) Vetforce, Sharon Software Inc, Dewitt, Mich.


Appendix

Scoring system for assessing severity of postoperative pain in dogs undergoing femoral head and neck excision

<table>
<thead>
<tr>
<th>Variable</th>
<th>Criteria</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate</td>
<td>≤ 10% greater than preoperative value</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>11 to 20% greater than preoperative value</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>21 to 50% greater than preoperative value</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>&gt; 50% greater than preoperative value</td>
<td>3</td>
</tr>
<tr>
<td>Respiratory pattern</td>
<td>Mild abdominal assistance</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Marked abdominal assistance</td>
<td>2</td>
</tr>
<tr>
<td>Vocalization</td>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Crying; responds to calm voice</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Crying; does not respond to calm voice</td>
<td>2</td>
</tr>
<tr>
<td>Agitation</td>
<td>Asleep or calm</td>
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</tr>
<tr>
<td></td>
<td>Mild agitation</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Moderate agitation</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Severe agitation</td>
<td>3</td>
</tr>
<tr>
<td>Response to manipulation</td>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Minimal response; tries to move away</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Turns head toward site; slight vocalization</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Turns head; tries to bite; howls</td>
<td>3</td>
</tr>
</tbody>
</table>