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# Effects of Cold Compression, Bandaging, and Microcurrent Electrical Therapy after Cranial Cruciate Ligament Repair in Dogs

JOSH REXING, DVM, DIANNE DUNNING, DVM, MS, Diplomate ACVS, ARTHUR M. SIEGEL, DVM, PhD, KIM KNAP, BS, CVT, CCRP, and BOBBIE WERBE, RVT

**Objective**—To compare 4 therapeutic techniques to reduce soft tissue swelling after cranial cruciate ligament repair in the dog.
**Study Design**—Prospective study.
**Animals**—Twenty-four dogs with cranial cruciate ligament rupture (CCLR).
**Methods**—Dogs with naturally occurring CCLR, were surgically repaired by an extracapsular technique and randomly divided into 4 treatment groups (cold compression [CC], modified Robert Jones bandage [B], cold compression and bandage [CCB], and microcurrent electrical therapy and bandage [METB]) each with 6 dogs. Data were collected at 2 time points, the morning after surgery before the 1st treatment and 72 hours later after the last treatment. Limb girth was measured at 3 anatomic locations to assess soft tissue swelling and all affected limbs were evaluated for presence (or absence) of pitting edema and bruising. Analysis of covariance was used to determine effect of treatment on the percent change in circumference. Duncan's multiple-range test was used to determine differences in treatment groups circumferential percent change over 72 hours. Statistical significance was set at $P < .05$.
**Results**—Use of a Robert Jones bandage had the least effect on reducing postoperative soft tissue swelling with CC, METB, and CCB being equally effective in reducing swelling by 72 hours after surgery.
**Conclusion**—Use of cold compresses alone or with a bandage, or using microcurrent electrical therapy in combination with a bandage decreases soft tissue swelling over 72 hours more than a bandaging alone after extracapsular repair of CCLR.
**Clinical Relevance**—CC, METB, and CCB should be considered as viable options to limit soft tissue swelling after extracapsular repair of CCLR in dogs.


## INTRODUCTION

CRANIAL CRUCIATE ligament rupture (CCLR) is a common injury in athletic and working dogs, and also in household pets. Regardless of the cause of CCLR, stifle instability results, and secondary osteoarthritis inevitably occurs.[1] Surgical and medical treatments for CCLR are based on the size and activity level of the dog, chronicity of injury, and degree of stifle joint instability.[2,3] Dogs $<25$ kg may be treated conservatively[4]; however, most affected dogs are medium-to-large breed dogs, and surgery is indicated.[5,6]

Despite fundamental differences in the surgical techniques for repair of CCLR, all have a fair to excellent clinical outcome.[6,7] In an effort to minimize postoperative complications and to optimize healing, veterinarians are now reexamining their postoperative treatment regimes. Most clinicians use a postoperative treatment regimen consisting of a variable combination of bandaging, cold packing, and/or cold compress application. Studies

From the Veterinary Teaching Hospital, University of Illinois, Urbana, IL.
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Corresponding Author: Dr. Josh Rexing, DVM, 3936 Beaverbrook Dr, Fort Wayne, IN 46815. E-mail: jfrexing@hotmail.com.
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comparing cyrotherapy with and without compression have shown that cold packs alone caused local hypothermia, which peaked by 20 minutes and the resultant analgesic effects lasted up to 1 hour. These results were amplified by compression.[8] Intraarticular temperatures are also lowered by cold compress application without significant core body temperature change.[9] Application of the cold compress is recommended 2–4 times daily to help minimize soft tissue swelling and pain.[10]

In addition to the conventional forms of postoperative management of CCLR repair, microcurrent electrical therapy (MET), delivered by Alpha-Stim® (Electromedical Products International Inc.) has been proposed as an innovative technique to reduce postoperative pitting edema and soft tissue swelling. MET is used to stabilize cell membranes that have been disrupted after surgical procedures.[11] MET has been used in human medicine for a number of clinical applications with positive results.[12,13]

Our objective was to evaluate the efficacy of 4 treatments (cold compression [CC], modified Robert Jones bandage [B], cold compression and bandage [CCB], and microcurrent electrical therapy and bandage [METB]), 3 of which are in current use for postoperative management of soft tissue swelling, pitting edema, and bruising in dogs recovering from stifle surgery. Our hypotheses were that the CCB group should have the least amount of swelling because of their combined effect. The CC only and B only groups should be fairly similar although, bandaging may be preferred because of the constant pressure being applied to the limb. Finally, we wished to investigate the efficacy of MET for reducing postoperative soft tissue swelling. To accomplish this we evaluated these 4 treatments in dogs that had repair of CCLR by an extracapsular technique by measuring pelvic limb circumference in 3 locations (femoral region, stifle, and hock) the morning after surgery and 72 hours later after daily treatments.

## MATERIALS AND METHODS

### *Animals*

Twenty-four dogs (mean age, 6.2 years; range, 2–11 years; mean weight, 28 kg; range, 4.5–46 kg) with naturally occurring CCLR, had extracapsular repair, and were randomly divided into 4 groups of 6 dogs each using a spreadsheet where groups were randomly listed in the left hand column. As dogs were enrolled they were sequentially listed in the adjacent column to determine group assignment. Data were collected at 2 time points: (1) initial measurements obtained the morning after surgery and (2) final measurements obtained after the last treatment on day 3. Soft tissue swelling, pitting edema, and bruising were assessed in each dog.

### *Treatment Groups*

*Group 1 (B)* had a standard modified Robert Jones bandage applied to the limb. The bandage was changed once every 24 hours, unless otherwise soiled or defective.

*Group 2 (CCB)* had cold compression once daily in the morning after removal of a standard modified Robert Jones bandage. A modified Robert Jones bandage was reapplied until the following morning treatment. Cold compression consisted of a large cold pack wrapped around the leg from stifle to hock and held in place with 2 reusable elastic bandages for 20 minutes. The cold pack was stored at 30°F.

*Group 3 (CC)* had cold compression only, performed for 20 minutes 3 times/day as described for group CCB.

*Group 4 (METB)* had daily MET treatment and a standard modified Robert Jones bandage. MET was performed once daily after the morning bandage removal. Another modified Robert Jones bandage was reapplied after treatment.

### *Microcurrent Electrical Stimulation*

The Alpha-Stim® unit (Electromedical Products International Inc., Mineral Wells, TX), used to supply the microcurrent electrical stimulation, was aligned along the affected stifle, using a lower extremity treatment protocol recommended by the manufacturer (Fig 1). The current was set at 600 μA and

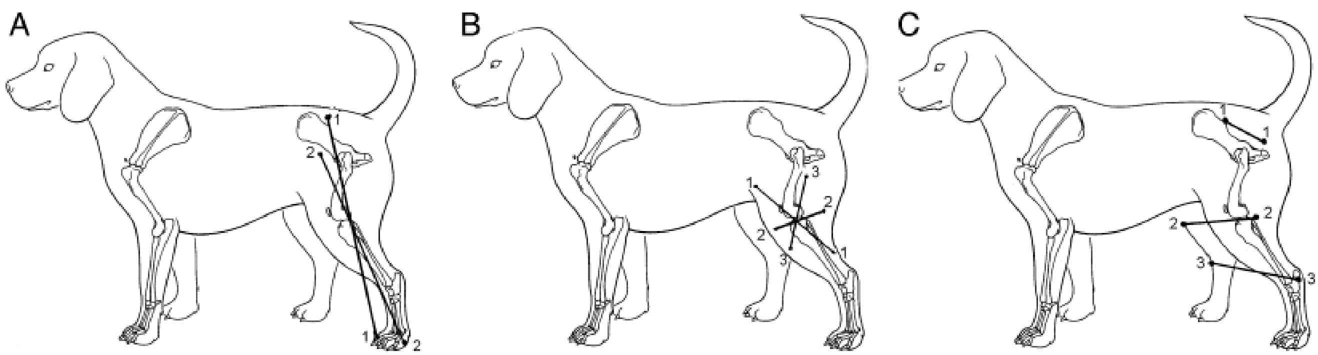


**Fig 1. Placing of Alpha-Stim® unit in: (A) a large "X" crossing at the affected area; (B) a small "x" crossing at the affected area; and (C) across the limbs as suggested by the manufacturer. This is part of the lower extremity treatment protocol.**

adjusted depending upon patient comfort level. The frequency was set at 0.5 Hz and the current waveform was preset as a bipolar asymmetrical rectangular wave, with a 50% duty cycle, 0 net current. Treatment started with a large "X" configuration (Fig 1A), then a small "x" configuration (Fig 1B), and finally an across the body configuration (Fig 1C). Treatments lasted 30–45 seconds for each component at each site and this was based upon the manufacturer's recommendations and calmness of the dog. For the large X configuration there were 2 components, for the small x (Fig 2) and across the body configurations, 3 components each resulting in a total treatment time of $\sim$ 5–7 minutes.

### *Pitting Edema, Bruising, and Soft Tissue Swelling Assessment*

Bruising and pitting edema were assessed on each dog as present or absent. Soft tissue swelling was determined by measuring muscle mass circumference in centimeters at 3 different anatomic landmarks (Fig 3). The femur was divided into quarter sections using the greater trochanter as the proximal landmark and distal patella as the distal landmark. A flexible measuring tape encircled the proximal quarter of the femur, at the stifle using the distal patella and tibial crest as anatomic landmarks and around the hock. The exact location was denoted with a permanent marker to ensure reproducibility of measurement. Measurements were made by the same individual to eliminate interobserver variability.

### *Statistical Analysis*

Descriptive statistics were calculated for age and weight for each of the 4 treatments. Between treatment group effects for continuous variables (the percent change in circumference at the 3 anatomic sites after 72 hours of therapy) were evaluated using ANCOVA; covariates included initial circumference measurement and body weight. Duncan's multiple-range test was used to determine differences in treatment groups circumferential percent change over 72 hours. A resulting *P*-value of $\leq .05$ was considered statistically significant.

## RESULTS

One dog in the cold compress group was unable to tolerate the treatment and was removed from the study because of severe soft tissue swelling and pain 24–36 hours postoperatively. Two other dogs were removed from the statistical model because they were a 2nd side surgery that at the time of statistical evaluation were deemed not to qualify. Therefore there were 5 dogs each in the bandage only, cold compress only, and cold compress and bandage groups and 6 dogs in the Alpha-Stim® and bandaging treatment group.

### *Pitting Edema and Bruising*

Pitting edema and bruising were assessed daily and were observed in each dog in every treatment group.

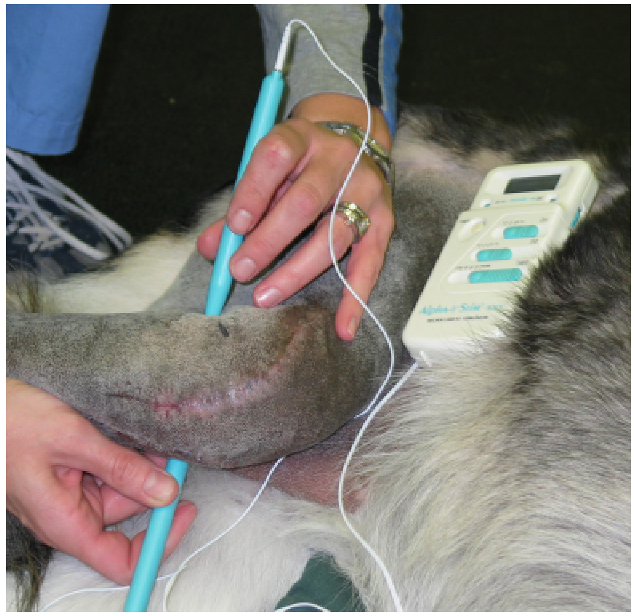

**Fig 2. Photograph depicting the Alpha-Stim® unit being used in the small "x" crossing pattern around the stifle.**

### *Femoral Swelling*

Bandaging alone had the least effect on soft tissue swelling in the femoral region (Table 1). The other 3 techniques all resulted in a significant reduction in swelling compared with bandaging alone but were not significantly different from each other (Table 1).

### *Stifle Swelling*

Similar to the femoral region, bandaging alone had the least effect in reducing stifle swelling whereas the other techniques while not significantly different from each other, resulted in a significant reduction in swelling compared with bandaging alone (Table 1). Cold compress only had the greatest mean percent reduction in stifle swelling over 72 hours (Table 1).

### *Hock Swelling*

Although bandaging alone had the least effect on reducing swelling in the hock region, the effect was not significantly different from the effects of cold compress combined with bandaging and cold compress alone (Table 1). There was no significant difference in swelling reduction between cold compress alone and combined Alpha-Stim® and bandaging (Table 1).

## DISCUSSION

Techniques for controlling postoperative soft tissue swelling, pitting edema, and ultimately pain are used by

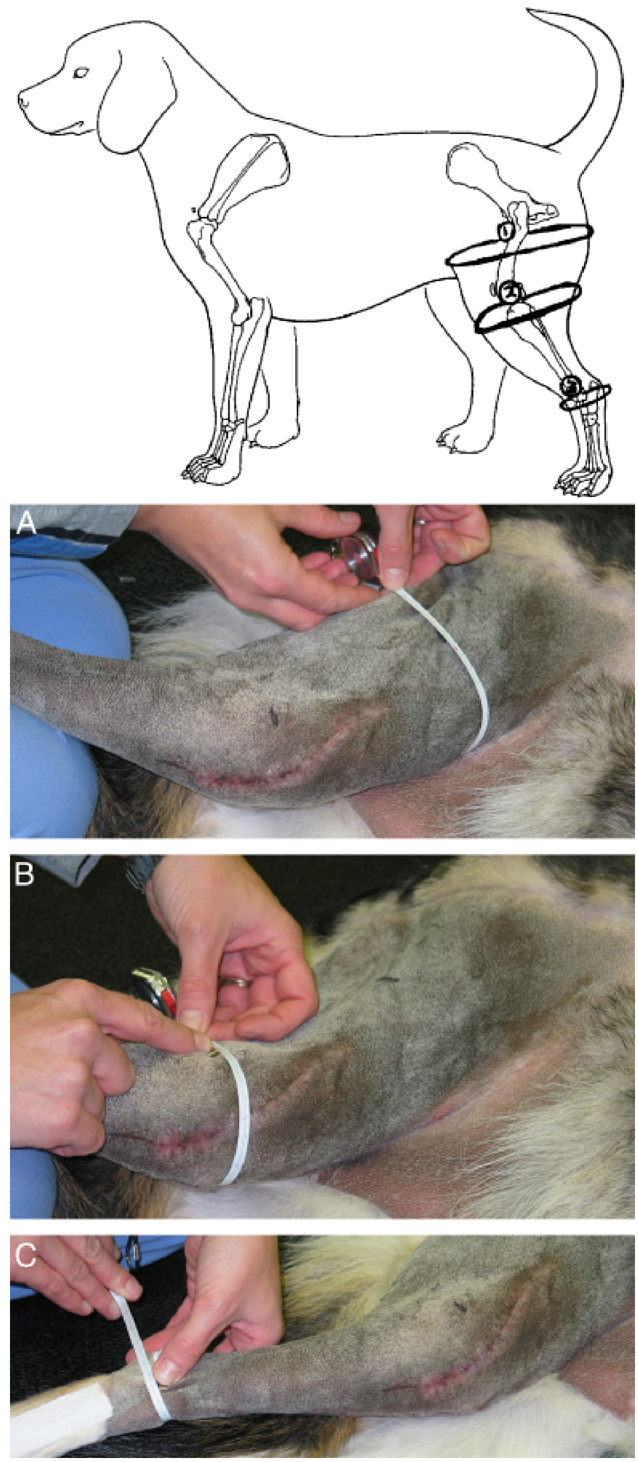


**Fig 3. Anatomic locations for femoral (1, A), stifle (2, B), and hock (3, C) circumferential measurements of swelling.**

many clinicians. Postoperative decisions are largely predicated by individual biases and to our knowledge there are no controlled studies with data supporting benefits of different techniques in dogs after repair of a CCLR. We examined the efficacy of some commonly used techniques and a more conventional mode of therapy for decreasing soft tissue swelling after CCLR repair by extracapsular stabilization.

Table 1. Mean ( ± SD) Percent Change in Swelling after 72 hours at each Anatomic Location

| Group | Femur | Stifle | Hock |
|---|---|---|---|
| (1) Bandage only | −4.64 ± 6.18$^{a}$ | −4.59 ± 4.02$^{a}$ | −3.58 ± 6.87$^{a}$ |
| (2) Ice and bandage | 4.59 ± 5.84$^{b}$ | 4.26 ± 2.37$^{b}$ | 2.58 ± 4.01$^{a,b}$ |
| (3) Ice only | 3.45 ± 4.61$^{b}$ | 7.43 ± 5.77$^{b}$ | 1.33 ± 2.98$^{a,b}$ |
| (4) Alpha-Stim® and bandage | 2.79 ± 5.60$^{b}$ | 5.78 ± 8.05$^{b}$ | 4.67 ± 7.30$^{b}$ |

Means with the same superscript letter are not significantly different.

Pitting edema and bruising occurred in all dogs except a very small dog in the CC only group. This led us to use the percent change as a means of assessing differences between groups.

Our results show that postoperative management with a modified Robert Jones alone had the least effect on reducing soft tissue swelling of the pelvic limb for 72 hours after extracapsular repair for CCLR. Although specific outcomes were slightly different for the 3 limb regions, in general, use of a cold compress alone or combined with a modified Robert Jones bandage, or use of Alpha-Stim® in combination with bandaging decreased soft tissue swelling more than bandaging alone during the 1st 72 hours after surgery.

At the femur, the CCB group had the greatest percent change, the CC group had the greatest percent change at the stifle, whereas the METB group had the largest percent change at the hock. At each anatomic location there was significant difference between these last 3 groups suggesting that any 1 of these 3 modalities (CCB, CC, and METB) would be acceptable ways to control postoperative swelling in the acute phase after CCLR surgery although the efficacy of each individual treatment varied. Because the stifle and hock are the most clinically relevant areas (incision location) and where the swelling migrates, this would lead us to believe that CC and METB would be best in these 2 regions, respectively. A limitation of our study is the lack of a control group for comparison but no treatment is not a standard of care, so we compared standard of care protocols.

The bandage only group actually had more soft tissue swelling after 72 hours and this could be attributed to the bandage being insufficiently tight. We did not note whether the bandage had slipped over night, which could have rendered it ineffective. One could consider adding a Robert Jones bandage group to observe if that would control soft tissue swelling more efficiently. A group that included MET plus cryotherapy could also be included to further differentiate the efficacy of MET. Another study limitation was that only the acute phase of inflammation was assessed postoperatively and only 1 variable was evaluated. The lack of dogs eligible for recruitment contributed to small sample size and a lower study power than desirable. MET decreased postoperative pain because of better sodium and calcium control at the cellular level and increases ATP production in the rat.[11] Assessing postoperative pain and return to function after surgery may be another way to evaluate patients postoperatively.[14,15] This could be accomplished using lameness scores, pressure mat analysis, force plate analysis, or dual energy X-ray absorptiometry analysis. Evaluating dogs for a longer period may improve understanding of long-term patient recovery.

We concluded that in the acute postoperative period after fixation of CCLR, that bandaging only did not limit soft tissue swelling as well as the other methods. The addition of cold compresses and MET to the bandaging group limited soft tissue swelling better and cold compression only also offered a legitimate means of controlling acute phase swelling.

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