

Radiographic Healing Following Stabilization of Cranial Cruciate Ligament Deficient Stifles with a CORA-Based Leveling Osteotomy (CBLO), Bone Plate/Headless Compression Screw Construct Augmented with a Tension Band



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PURPOSE

The purpose of our prospective case series was to evaluate TPA shift and time to complete osseous bridging following stabilization of cranial cruciate ligament (CrCL) deficient stifles, with a CBLO and bone plate/headless compression screw (HCS) construct augmented with a tension band in 49 stifles (47 dogs). We hypothesized that augmentation with a tension band wire fixation will improve osseous union and prevent TPA shift.

INTRODUCTION

CrCL injury leads to stifle instability and is a primary cause of hind limb lameness in dogs.¹⁻⁵ Two commonly used procedures for management of the CrCL deficient stifle are the Tibial Plateau Leveling Osteotomy (TPLO) and CORA Based Leveling Osteotomy (CBLO). The CBLO procedure involves a proximal tibial leveling osteotomy based on the center of rotation of angulation (CORA). When the osteotomy is centered at the CORA, correction of the CORA magnitude results in the desired tibial plateau angle (TPA) through alignment of the proximal and distal longitudinal axes.¹⁻² A complication that has been reported after TPLO and CBLO is a shift in TPA during healing, resulting in an increase in the tibial plateau slope and delayed healing.¹⁻³ Postoperative TPA shift is thought to be secondary to quadriceps muscle contraction and can lead to instability of the osteotomy and delayed healing. To our knowledge, there are no previous studies evaluating radiographic osteotomy site healing by 5 weeks postoperatively for the CBLO or TPLO procedures. The typical recommendation for radiograph assessment is 8-12 weeks following surgery.¹⁻⁵ Conkling et. al. evaluated osteotomies using the same grading scale utilized in our study. This study showed that TPLO performed using locking screws had significantly more complete healing than TPLO with conventional screws. At 8 weeks postoperatively, osteotomy healing for the 64 cases that used locking screws, showed that 34/64 (53%) were grade 4 (76-100% osseous bridging), 25/64 (39%) grade 3, and 5/64 (8%) grade 2.⁴ Following stabilization of the CBLO with a bone plate/HCS construct, Kishi et. al. showed that at a mean time of 107 days following surgery, 69% of dogs showed Grade 4 osseous bridging of the osteotomy site.² Improved stabilization of the osteotomy would decrease time for osseous union and be beneficial in preventing TPA shift.

METHODS

Medical records from May 2017 to February 2018 of 47 dogs (49 stifles) diagnosed with CrCL injury and managed with a bone plate/HCS combination augmented with a tension band wire fixation were reviewed. To be included in the study, preoperative TPA (PreTPA), postoperative TPA (PostTPA), and TPA at final evaluation (FinalTPA) 5 weeks postoperatively, were required. Degree of osteotomy site healing was graded based on a previously described 5-point grading system (4 = 76-100%; 3 = 51-75%; 2 = 26-50%; 1 = 1-25%; and 0 = no osseous bridging).⁵ Breed, age, and weight were recorded for each case as well as evaluation of the integrity of the CrCL, CaCL, medial and lateral menisci, and appearance of articular cartilage.

All cases included had a proximal curvilinear radial osteotomy stabilized with a CBLO DCP locking plate and screws (Veterinary Orthopedic Implants, St. Augustine, FL), a cranially positioned HCS, positional screw or K-wire, and tension band with single loop cerclage wire. Mediolateral and craniocaudal radiographic projections of the affected stifle joint were obtained pre- and postoperatively, as well as 5 weeks postoperatively. Mediolateral radiographs were used to evaluate the osteotomy site for osseous bridging. Craniocaudal radiographs were not used to assess healing, as the radial shape of the tibial osteotomy and cranial rotation of the proximal segment interfered with the interpretation of osseous healing. Osteotomy site healing, and measurements of PreTPA, PostTPA, and FinalTPA were each calculated by four observers using the same technique for each measurement. Radiographic osteotomy site healing for each stifle was graded by five evaluators and the mean for each stifle was recorded. The observers were blinded to identifiers of the case and to the previous assessments of radiographic healing and TPA measurements. The difference between PostTPA and FinalTPA were reported as TPA shift.

RESULTS

All dogs (49 stifles) managed with a bone plate/HCS combination augmented with a tension band met the inclusion criteria. There were 26 spayed females, 19 neutered males and 2 intact male. Thirteen breeds were represented: 10 Labrador Retrievers (21.3%), 5 mixed breeds, 5 Pit bulls and 5 Boxers, 4 German Shorthaired Pointers, 3 German Shepherds, 2 Labradoodles, 2 Cane Corsos, 2 Blue Heelers, and 1 each of the following: Golden Retriever, Cavalier King Charles Spaniel, Yorkshire Terrier, Siberian Husky, Black Mouth Cur, Wirehaired Pointing Griffon, Goldendoodle, English Bulldog, and Border Collie. Mean age was 6 years (1.5 – 11 years) and mean body weight 32 kg (5.2 – 53.6 kg). Of 49 stifles, 25 were right and 24 left. All dogs had a complete CrCL tear postoperatively. Twenty-five stifles (51%) had a normal medial meniscus, 19 (39%) had a bucket handle tear, and 5 (10%) had a degenerative caudal horn. Forty-seven (96%) had a normal lateral meniscus and 2 (4%) had a radial tears of the caudal horn. All dogs had a normal CaCL and cartilage surfaces. Mean pre TPA was 30° (20° – 44°), mean post TPA was 9° (5° – 14°), and mean final TPA was 9° (5° – 14°). Osseous bridging of the osteotomy, at a mean time of 35 days, was a mean of grade 4 in 38 stifles (77.6%) and a mean of grade 3 in 11 stifles (22.4%). Standing mediolateral radiographs showed that the femoral condyles are centered over the tibial eminences, without detectable caudal subluxation (figures 1-3).

CONCLUSIONS

We concluded that stabilization of a CBLO using a bone plate/HCS combination augmented with a tension band wire fixation decreased healing time of the osteotomy and effectively maintained TPA as compared to previous studies.¹⁻⁵

- ❖ The CBLO technique allows for ancillary stabilization because of the configuration of the osteotomy. The location of the anatomic CORA is such that an osteotomy can be performed which preserves the anatomy of the proximal tibial epiphysis. The radial shape of the osteotomy coupled with the axis of correction being located at the CORA creates maximum bone contact without secondary translation.
- ❖ Placement of the HCS allows for compression of the osteotomy. The addition of a K-wire or position screw and tension band wire fixation, increases stability and counteracts the pull of the quadriceps. This mechanism neutralizes forces that can delay osteotomy site healing and provides a more stable fixation for healing.
- ❖ In our study, the degree of osseous bridging was judged to be Grade 4 in the majority of dogs (38 of 49 stifles) by a mean of 35 days (25 – 40 days) following surgery. The eleven dogs judged to be grade 3 at 5 weeks postoperatively were radiographed again by a mean of 48 days (42 – 51 days) and determined to be grade 4.
- ❖ CBLO using a bone plate/HCS augmented tension band wire fixation effectively maintains the TPA, as no change in TPA was noted between post TPA and final TPA.
- ❖ All dogs were also reported to have a pronounced improvement in weight bearing and limb function at the time of re-evaluation.
- ❖ **Clinical Significance:** We can allow for quicker return to normal activity and help prevent catastrophic implant failures due to patient's over-activity. Based on the results of our study, we have decreased recovery times and activity restrictions and as such, improved owner compliance and aptitude to pursue surgical intervention.

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DISCLOSURE

There was no proprietary interest or funding for this project.

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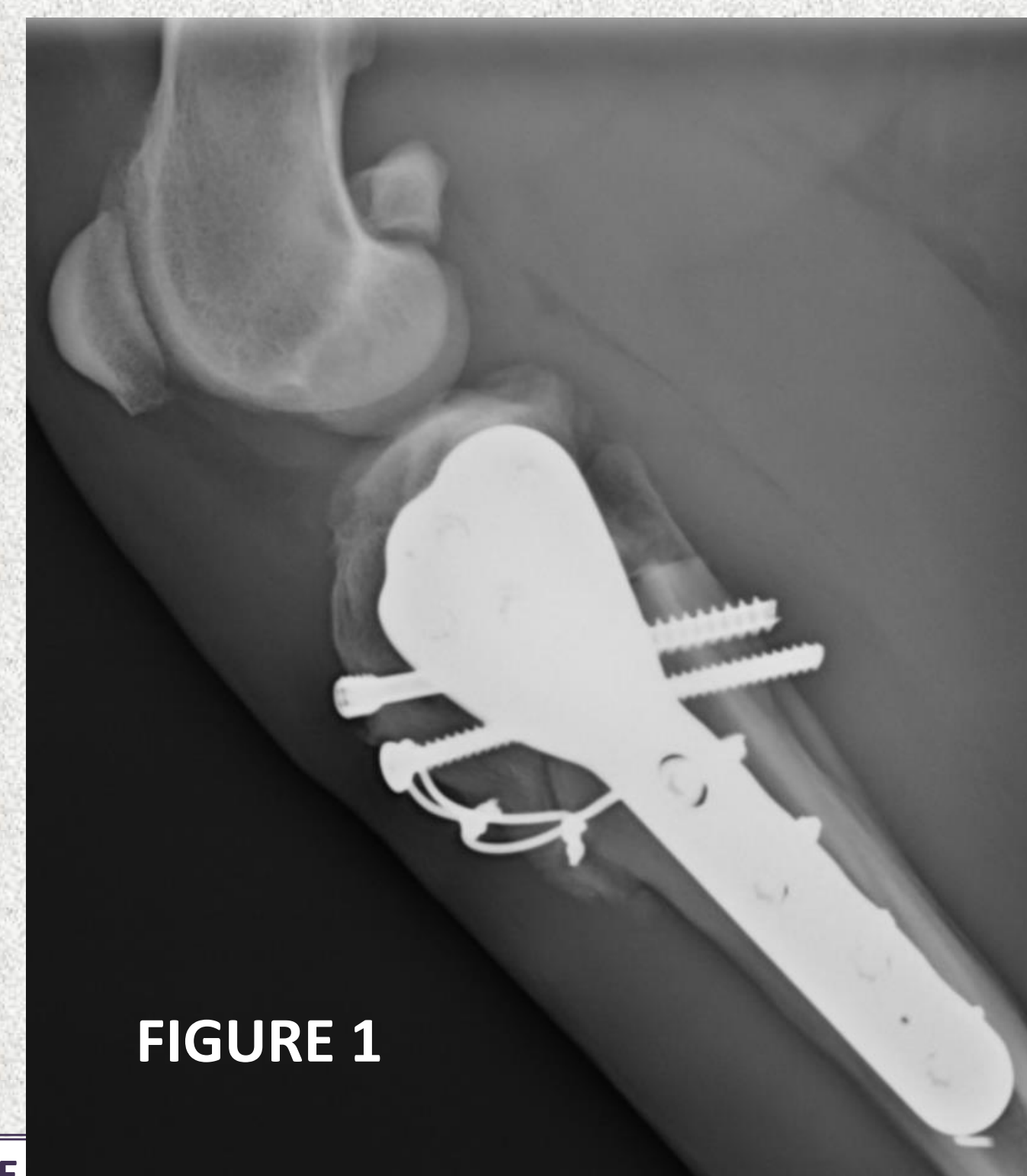


FIGURE 1

FIGURE 1: Mediolateral radiograph 5 weeks postoperative CBLO stabilized with a bone plate/HCS augmented with a position screw and tension band showing no TPA shift and grade 3 healing. Immediate PostTPA 9°; 33 days postoperative Final TPA 9° and grade 3 (51-75%) healing.



FIGURE 2

FIGURE 2: Mediolateral radiograph 5 weeks postoperative CBLO stabilized with a bone plate/HCS augmented with a position screw and tension band showing no TPA shift and grade 4 healing. Immediate Post TPA 11°; 36 days postoperative Final TPA 11° and grade 4 (76-100%) healing.



FIGURE 3
 STANDING LATERAL