Simultaneous Bilateral Modified Tibial Tuberosity Advancement in Fifteen Overweight Dogs

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ABSTRACT

Tibial tuberosity advancement (TTA) is one of the surgical techniques used to stabilize the cranial cruciate ligament deficient (CCL) canine stifle joint. However, tibial tuberosity fractures have been reported to occur as one of the possible complications associated with TTA. Tension band wiring (TBW) is the gold standard to repair avulsion fractures. This is based on a previous in vitro study confirming that TBW increases resistance of the TTA fixation failure. Simultaneous bilateral procedure in 15 large-breed and overweigh dogs >48 kg was carried out prospectively. In this clinical case series, 93% of dogs recovered with only minor issues after the bilateral CCL rupture repair, showing only some infrequent or intermittent lameness. One dog required cage removal. This study has shown that the use of a tension band wire technique for TTA is an effective technique for bilateral simultaneous repair on large obese dogs. This novel configuration has the advantage of allowing removal the cage more easily later if needed and avoids any possibility of fracturing the dorsal tip of the tibial tuberosity under the patella ligament. The results of this preliminary clinical study are encouraging and warrant further investigation.

INTRODUCTION

Cranial cruciate ligament rupture (CCL) is one of the most common causes of lameness in dogs, with a particularly predisposition in some breeds such as Labrador Retriever.[1,2,3,4] Cranial advancement of the tibial tuberosity performed in tibial tuberosity advancement (TTA) renders stability to the stifle joint,[5,6] and satisfactory limb function has been proven both in biomechanical in vitro studies and in vivo.[7]

In the conventional TTA technique description, after having performed an osteotomy, the fixation is by plate screws/ forks and titanium cages.[6,7] Conversely, tension band wiring (TBW) technique is one of the most common surgical methods used to treat an avulsion fracture.[8,9,10,11]

To our knowledge, this is the first clinical report of a simultaneous bilateral CCL

Figure 1. *Postoperative view showing implant position*

repair in large overweight dog breeds. We have shown previously that using TBW was the most resistant to failure TTA procedure.[12] In this clinical case study, we use TBW as a modification of TTA to repair bilateral CCL rupture.

MATERIALS AND METHODS

All dogs presented with clinical bilateral CCL, and owners have signed consent for surgery. Before surgery, dogs were pre-medicated with medetomidine hydrochloride (10 mg/kg) (Domitor, Vetoquinol, Northamptonshire, UK) and methadone hydrochloride (0.5 mg/kg) (Methadone, Alcami Corporation, Charleston, USA). General anaesthesia was induced with propofol (2 mg/kg) (Propofol-Lipuro, B. Braun Melsungen, Germany), and maintained on isoflurane (Isofane, Piramal Healthcare, Morpeth, UK). Intravenous amoxycillin/clavulanic acid (8.75 mg/kg) (Augmentin, GlaxoSmithKline, Middlesex, UK) was administered at induction. Analgesia was provided by meloxicam (0.2 mg/kg) (Metacam, Vetmedica GmbH, Boehringer Ingelheim, Germany) preoperatively and methadone hydrochloride (0.5 mg/kg) (Methadone, Alcami Corporation, Charleston, USA).

The surgical approach was performed as for standard TTA. Following osteotomy, the distal attachment of the tibial crest was left intact. The tibial tuberosity was distracted and the appropriate size cage inserted. The decision on what size of TTA cage to use was based on the original standard radiographic assessment with the practice of choosing the larger size cage if there was a mid-range assessment found.

The cage was positioned as far dorsally as possible, and verified by using a scalpel to locate the upper bone margins of the dorsal aspect of the tuberosity underneath the patella ligament and tibia. Once the cage was positioned in the further possible dorsal position, two arthrodesis wires ranging in diameter from 1.4 to 2 mm were inserted into the tuberosity above the distal line on insertion of the patella ligament, aiming to pass just under the cage exiting at the caudal tibia. Orthopaedic wire in size range 18 or 16 gauge was then passed over the two pins and through a hole distal to the end of the osteotomy line. The wire was tightened to lie over the tuberosity evenly, and the twisted end made flush to the medial tibia. The two pins were then bent down to lie level with the patellar ligament (Fig 1).

Another pin of 1.1 mm diameter was inserted in some cases into the distal portion of the osteotomy exiting at the caudal tibial cortex as an extra option, especially if the distal attachment of the tuberosity osteotomy had broken. Implants were then covered by the retinaculum and routinely closed. A bandage was applied for 4-5 days. The dogs

were discharged on amoxycillin/clavulanic acid (8.75 mg/kg) (Noroclav, Norbrook® Laboratories Limited, Newry, Northern Ireland) for 5 days, either meloxicam (0.2 mg/kg) (Metacam, Vetmedica GmbH, Boehringer Ingelheim, Germany) or carprofen (4mg/kg) (Rimadyl, Zoetis, Dublin, Ireland) for 10 days and gabapentin (10 mg/kg) (Gabapentin, Devon, UK) for 7 days. The owners were advised to use a lift aid to help the dogs get up and walk for 3-4 weeks. Dogs were kept in a small area (2mx 2m) for 8 weeks, followed by a gradually controlled period of increasing exercise for 8 weeks.

RESULTS

The ages of animals ranged from 3 to 10 years, and the weight between 48 and 97 kg, with all of them overweight to obese. Over half of the dogs were giant breeds with Newfoundland (2), Mastiff (2), Akita (3), and Dogue de Bordeuax(1), whilst the remainder were large breed that were obese--Labrador Retriever (3), Golden Retriever (1), Rottweiler (3).

There were nine females (75% neutered) and six males (83 % neutered). Three animals (20%) experience minor wound issues, five suffered (33.3%) minor complications, i.e, pin migration, and one animal (6%) endured infection that required implant removal.

Regarding the recovery and outcome of surgical repair, a grading scale from 0 to 6 was used based on clinical examination and telephone questionnaire, with clients at 4, 6, 12, 16, and 24 weeks. One case that required cage removal was further assessed at final check at 32 weeks. The final questionnaire by phone or examination at 24 weeks was used as the final outcome measurement. Outcome grading was as follows.

- Grade 0: normal
- Grade 1: infrequent/stiffness lameness
- Grade 2: intermittent stiffness/lameness
- Grade 3: frequent stiffness
- Grade 4: frequent lameness and stiffness
- Grade 5: poor-always lame
- Grade 6: fail.

Nine of the cases were grade 2, and six grade 3. No cases were grade 1 ,4, or 6. The one case that had to have the cage removed became a grade 3 once all the healing was complete.

DISCUSSION

Based on our previous ex vivo study that showed TBW provided greater resistance to fixation failure than any other TTA surgical procedure used for treating CCL,[12] we have used this TBW modified technique using pins and wire in overweight large-breed dogs to repair simultaneous bilateral CCL rupture. The increased resistance to failure with this technique shows it to be particularly suitable for large overweight dogs and/or bilateral cases, where the loading is going to be very high. To our knowledge, this is the first time that simultaneous treatment of bilateral rupture has been described using a modified TBW for TTA.

Kim et al.[13] demonstrated the benefits of tibial osteotomy techniques in the improvement of limb function in dogs with CCL deficiency, while TTA technique improved the lameness, activity level,[14] and limb function,[15] with similar complication rate to other tibial osteotomies. It has been reported that dogs undergoing TTA using either a fork-based or a screw-based implant system can experienced major complications [16] due to stress riser phenomenon and technique.[17] .

Simultaneous bilateral CCl repair has been mentioned before in the literature within larger studies.[18,15] There were mixed results for increased risk of complications from doing simultaneous bilateral procedures using TPLO and TTA techniques in these studies, although the case selection was not focused on large or very obese dogs. Kiefer et al.[19] indicated that single-stage bilateral tibial tuberosity advancement procedures are associated with an increased risk of major complications compared to unilateral procedures. In a study of Danielson et al.[18] overall radiographic complication rate of single-session bilateral tibial tuberosity advancements was 17.6%. Bergh et al.[20] found that there was a 12 times in-

creased risk of tibia fracture when performing bilateral TPLO. It has been stated in the literature that the risk for complications even in unilateral TTA increased significantly in dogs weighing over 50kg, and the surgical site infection (SSI) was the most common major complication in mentioned study.[21] These findings are not exactly correlated by another study comparing use of locking plates in bilateral TPLO cases in that weight was not deemed to be a factor.[22] In comparison, our study indicates much lower complications rates for bilateral cases. Furthermore the outcome in this case series is similar or better than other studies.[14]

The use of a tension band wire technique in this small case series focused soley on large overweight dogs, and was very effective in repair of bilateral simultaneous cases. Very little modification is required to original principles of the TTA procedure except that the cage must be at the dorsal limit to allow pins to pass from above the patella insertion line and into the caudal tibial cortex. This configuration has the advantage that the cage can be removed more easily later if needed and avoids any possibility of fracture the most dorsal tip of the tibial tuberosity under the patella ligament. The major limitation of this study is the low case numbers and no very long-term follow-up. The results of this preliminary clinical study are encouraging and warrant further investigation.

CONFLICT OF INTEREST STATEMENT

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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