Does a fabella-tibial suture alter the outcome for dogs with cranial cruciate ligament insufficiency undergoing arthrotomy and caudal pole medial meniscectomy?

A retrospective owner assessment

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Keywords
Medial meniscus, cranial cruciate ligament insufficiency, questionnaire, VAS, fabella-tibial suture.

Summary
Objectives: The objective of this study was to evaluate the effects of fabella-tibial suture (FTS) on long-term outcome in dogs with cranial cruciate ligament (CCL) insufficiency and concurrent medial meniscal tear (MMT) that were managed by an open, caudal pole medial meniscectomy (CPMM).

Methods: A retrospective review was performed of the clinical records of dogs treated for CCL insufficiency with concurrent MMT by open CPMM, with or without the non-random addition of a nylon FTS according to surgeon preference, during the period of 2001 to 2004. The Bristol Osteoarthritis in Dogs questionnaire was modified for owner assessment of outcome using a visual analogue scale based on several criteria: level of activity, disability, severity of lameness and frequency of lameness before and after surgery.

Results: Completed questionnaires from 31 dog owners were received. A FTS was used after CPMM in 22 dogs (FTS group), but in nine dogs (control group) only a CPMM was performed. The median time to follow up was longer in the FTS group (25 months) than the control group (16 months) (P=0.03). There were not any significant differences between the two groups before and after surgery for the following: disability, activity, frequency of lameness, severity of lameness, ability to climb stairs and ability to sit down.

Clinical Significance: The placement of a FTS following stifle joint arthrotomy and CPMM in dogs with CCL deficiency and concurrent MMT may not be a significant factor affecting the ultimate surgical outcome, although our study is limited by the non-randomised study design.

Introduction
Rupture of the cranial cruciate ligament (CCL) is one of the most common causes of canine pelvic limb lameness (1, 2). There is a wide variety of different surgical techniques recommended for the management of this condition, and despite a wealth of literature on the subject, there is insufficient evidence to support the use of one technique over another (3). All surgical techniques are associated with some degree of postoperative morbidity and a gradual return to function, with many dogs not achieving a recovery equivalent to pre-diseased state (4–9). Regardless of surgical technique, a large proportion of dogs suffer from progressive stifle osteoarthritis (5, 7, 9–13).

Injury to the medial meniscus is reported in 49–70% of dogs in association with CCL insufficiency (9, 14–17). Meniscal injuries may cause debilitating lameness associated with osteoarthritis in both humans and dogs (14, 18–20). Furthermore, meniscal injury can occur in the form of ‘late’ meniscal tears in 6.3–13.8% of dogs after standard surgical techniques for the management of CCL insufficiency (14, 21). Thus meniscal injury contributes to the pre and postoperative morbidity associated with CCL insufficiency.

Established techniques for the management of CCL insufficiency aim to restore the cranio-caudal stability of the stifle which is lost following CCL rupture. A number of strategies are employed to achieve this goal including: intracapsular stabilisation, extracapsular stabilisation and tibial osteotomy techniques. However, there is not any correlation between cranio-caudal stifle stability...
and limb function in dogs treated with fabella-tibial suture (FTS), intra-articular stabilisation, conservative management or fibular head transposition (5, 7, 22, 23).

Historically, dogs suffering from CCL insufficiency were treated at the University of Bristol Veterinary School with a stabilising FTS. The dissection of extra-articular tissues required for placement and anchorage of the FTS probably contributed additional surgical morbidity, over and above that associated with the arthroscopy required for meniscal inspection and resection. In order to reduce the morbidity of surgery for CCL insufficiency with associated medial meniscal tear (MMT), we modified our standard surgical protocol so that we simply resected the damaged portion of the medial meniscus by caudal pole medial meniscectomy (CPMM) without performing any additional stifle stabilisation. This was intended to reduce the morbidity associated with placement of the FTS.

The aim of this retrospective study was to use owner evaluations collected via questionnaire in order to compare the postoperative outcome of dogs managed surgically for CCL insufficiency and associated MMT by either open CPMM alone, or CPMM combined with FTS. We hypothesised that there would not be any difference in outcome between the two surgical techniques.

Materials and methods

Case selection

The clinical records for dogs treated for CCL insufficiency at the University of Bristol Veterinary School between September 2001 and December 2004 were reviewed retrospectively. Inclusion criteria were MMT of the entire caudal horn identified at arthroscopy treated by CPMM. These dogs were divided into two groups; FTS group: dogs treated with CPMM and FTS, and control group: dogs treated with CPMM only (without stifle stabilisation). Data recorded from the patient records included age, breed, gender, weight, affected limb, degree of lameness (graded from 1–10, based on hospital practice), degree of cranio-caudal instability assessed qualitatively using the cranial tibial thrust test (stable, mild instability, unstable), degree of CCL rupture (partial or complete) observed intra-operatively, duration of lameness and postoperative complications. Postoperative follow-up was obtained initially by telephone and then via a postal questionnaire.

Surgical technique

All dogs had a preliminary diagnosis of CCL insufficiency based on physical examination findings (pelvic limb lameness, joint effusion, quadriiceps muscle atrophy and medial buttress), and cranio-caudal stifle instability determined by a positive tibial thrust test and radiographic findings (osteoophytes and joint effusion). This diagnosis was confirmed upon exploratory arthroscopy. A lateral parapatellar arthroscopy (24) was performed and the menisci were inspected with the aid of a stifle distractor and Hohmann retractor, as necessary. The CCL (or remnants of the CCL) was resected and a CPMM was performed to remove the damaged portion of the meniscus in all dogs. Additional meniscal release was not performed in any dog. The joint was flushed with sterile saline, and the synovium was closed routinely with simple interrupted or continuous sutures of 3 or 3.5 metric polydioxanone. The fascia lata was closed separately with simple interrupted or simple continuous sutures of 3 or 3.5 metric polydioxanone. In dogs in the FTS group, a lateral FTS of one or two strands of monofilament, nylon leader line of appropriate breaking strain according to patient body mass (CCL system) also was placed prior to closure of the lateral retinaculum. The suture was passed around the lateral fabella, underneath the patellar ligament and back through a single hole in the proximal tibial crest before being secured with an appropriate crimp tube (25–27). For dogs in the control group, an FTS was not placed. The decision to place an FTS or not, was made according to surgeon preference and was not randomised. All dogs were discharged from the hospital with a course of NSAID, and with a standardised postoperative exercise regimen. All dogs were re-examined six to eight weeks postoperatively, and then subsequently if necessary.

Follow-up questionnaire

Owners were contacted by telephone and invited to participate in the study. Participating owners were sent a questionnaire by post. Our questionnaire was modified from the Bristol Osteoarthritis in Dogs (BrOAD) questionnaire (28). The questionnaire enabled owners to retrospectively score a variety of parameters for their dog’s activity and function before surgery, and at the time of follow-up using a 100 mm long visual analogue scale (VAS) (Supplementary Table. 1, available online at www.VCOT-online.com). Each parameter was scored out of 100 to the nearest 0.5 value. For each parameter, the difference in VAS score after surgery compared with that before surgery was calculated to assess the change in that parameter. A positive score indicated a positive change or improvement, and a negative score indicated a negative change or deterioration. The larger the positive score the greater the improvement, and the larger the negative score the greater the deterioration.

Statistical analysis

Statistical analysis was performed using commercial computer software. Changes in measured parameters before and after surgery were compared between the two groups. The data were tested for normality prior to performing statistical analysis. Mann Whitney U tests were performed to determine whether the patients’ age, weight, degree of lameness, duration of lameness and time to follow up were equivalent between the two groups. Fisher Exact tests were performed to determine whether there was a significant difference between the two groups for degree of CCL rupture, the degree of preoperative stability, the use of NSAID, the incidence of postoperative infection and the ability to use the leg when first home. Mann Whitney U tests were also performed to determine if there were significant differences between the two treatment groups comparing preoperative and postoperative function for the following variables: changes in activity, frequency of lameness, severity of lameness, difficulty in climbing stairs and difficulty in sitting down.

Veterinary Instrumentation, Sheffield UK
PDS II, Ethicon: Johnson & Johnson, Livingston, UK
SPSS 14.0: SPSS Inc., Chicago, IL
A Kruskal-Wallis Test (nonparametric ANOVA) was used to determine the effect of the surgical technique on change in disability immediately postoperatively, one week postoperatively and at time of final follow-up. Mann Whitney U tests were performed to determine whether there was a significant difference between the two groups for the degree of function regained and owner satisfaction. For all tests, significance level was set at \( p < 0.05 \).

### Results

Thirty-four dogs met the inclusion criteria. Thirty-two owners were sent questionnaires (two owners were not contactable). Completed questionnaires were received for 31 dogs; a 96.9% return rate. Of these, 22 dogs were in the FTS group and nine were in the control group.

#### Results of patient record review

The results of the review of the patient records are summarised in detail in the supplementary Table 1 (available online at www.vcot-online.com). A summary of the results is presented in Table 1.

The FTS group consisted of three entire males, seven neutered males, two entire females and 10 neutered females. The control group consisted of three entire males, four neutered males and two neutered females.

Preoperative assessment of cranial-caudal stability by cranial tibial thrust test for the FTS group was recorded as stable in four, mild instability in seven and unstable in 11 dogs. For the control group, stability was recorded as stable in three, mild instability in one and unstable in four dogs. There was not a significant difference between the two groups in the degree of instability.

The FTS procedure was performed for seven dogs with partial CCL ruptures and 15 with complete CCL ruptures. In the control group, there were two dogs with partial CCL ruptures and seven with complete CCL ruptures. There was not a significant difference in degree of CCL rupture between the two groups.

During the follow-up period, five dogs in the FTS group and three dogs in the control group were regularly treated with NSAID on one or more occasions. There was not a significant difference in the frequency of NSAID use between the two groups.

There were not any major complications in either treatment group, but minor complications were seen in six cases; two in the FTS group (one wound infection and one joint in-

#### Table 1: Table showing the results of the patients’ records review.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Fabella-tibial suture group: median + range</th>
<th>Control group: median + range</th>
<th>Difference between groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (months)</td>
<td>53.5 (15 - 120)</td>
<td>48 (24 - 60)</td>
<td>NS</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>34.6 (22 - 75)</td>
<td>40 (18.5 - 63)</td>
<td>NS</td>
</tr>
<tr>
<td>Severity of pre-operative lameness (0-10)</td>
<td>4 (0-9)</td>
<td>4 (2 - 10)</td>
<td>NS</td>
</tr>
<tr>
<td>Duration of pre-operative lameness (months)</td>
<td>2 (0.5 - 15)</td>
<td>7 (1 - 24)</td>
<td>SD ( P = 0.019 )</td>
</tr>
<tr>
<td>Time to follow-up (months)</td>
<td>25 (9 - 44)</td>
<td>16 (8 - 28)</td>
<td>SD ( P = 0.03 )</td>
</tr>
</tbody>
</table>

SD = Statistically significant difference between groups.

#### Table 2: Table summarising the results of the owner questionnaire.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Fabella-tibial suture group: median + range</th>
<th>Control group: median + range</th>
<th>Difference between groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in activity</td>
<td>-2.5 (-65 to 29)</td>
<td>-1 (-25 to 80)</td>
<td>NS</td>
</tr>
<tr>
<td>Change in disability when first home following surgery</td>
<td>-5.0 (-59.0 to 30.5)</td>
<td>0 (-43.5 to 40.5)</td>
<td>NS</td>
</tr>
<tr>
<td>Change in disability one week post-surgery</td>
<td>9.75 (-49.5 to 59.5)</td>
<td>17 (-39.0 to 45.5)</td>
<td>NS</td>
</tr>
<tr>
<td>Change in disability at time of follow-up</td>
<td>49.25 (0.0 to 81.5)</td>
<td>52 (25.5 to 87.5)</td>
<td>NS</td>
</tr>
<tr>
<td>Change in frequency of lameness</td>
<td>61.5 (0.0 to 95.5)</td>
<td>73 (1 to 100)</td>
<td>NS</td>
</tr>
<tr>
<td>Change in severity of lameness</td>
<td>51.5 (-5.5 to 98.0)</td>
<td>76.5 (5.5 to 100)</td>
<td>NS</td>
</tr>
<tr>
<td>Change in difficulty climbing stairs*</td>
<td>47.5 (-9.0 to 95.5)</td>
<td>50.25 (32 to 100)</td>
<td>NS</td>
</tr>
<tr>
<td>Change in difficulty sitting down</td>
<td>33.5 (-24 to 96)</td>
<td>39.5 (0 to 64.5)</td>
<td>NS</td>
</tr>
<tr>
<td>Degree of function obtained post-operatively</td>
<td>84.5 (52.5 to 100.0)</td>
<td>94 (53.5 to 100)</td>
<td>NS</td>
</tr>
<tr>
<td>Owner satisfaction</td>
<td>94 (19 to 100)</td>
<td>98 (39 to 100)</td>
<td>NS</td>
</tr>
</tbody>
</table>

NS = No statistically significant difference between groups.  
* Four owners did not answer this question as they stated that their dog did not climb stairs.
Does a fabella tibial suture alter the outcome for dogs following cruciate surgery?

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Results of questionnaire

The results of the owner questionnaires are detailed in ► Supplementary Table 2 (available online as www.VCOT-online.com). A summary of the results is presented in ►Table 2. Owners were also asked whether their dog was using the leg at all when they first returned home. Of the 22 FTS group dogs, 13 were using the leg compared with eight of the nine control group dogs. These values were not significantly different.

Discussion

This paper describes a novel approach to the management of CCL insufficiency with associated MMT in dogs by performing CPMM alone in order to reduce the anticipated surgical morbidity associated with the addition of a FTS. All surgical techniques are associated with some degree of postoperative morbidity (4, 5, 8, 29). Dogs treated by extra-articular stabilisation techniques for CCL insufficiency, such as FTS, are typically more disabled immediately postoperatively than before the surgery, and there is a period of recovery before the preoperative level of limb function is restored (4,9), prior to any improvement in lameness beyond the pre-operative state. However, despite these considerations, the results of our study did not disprove our null hypothesis. In other words, the addition of the FTS resulted in an outcome that was not significantly better or worse, than was obtained by solely performing an open arthrotomy and CPMM in these dogs. These findings may lead one to question the value of FTS for achieving intra-operative cranio-caudal stifle stability when a concurrent MMT is treated by open CPMM.

The rationale behind the ‘CPMM alone’ technique is based on several considerations. Studies have shown that cranio-caudal stifle stability is not related to outcome, with many dogs having a good clinical result despite some degree of cranio-caudal instability at re-examination (5, 7, 22, 23). One study divided dogs into two groups based on their outcomes (22), and those with unsatisfactory outcomes had less cranial draw than those with a satisfactory outcome, whilst dogs with satisfactory outcomes had detectable cranio-caudal instability of the stifle joint. It is important to note that the dogs with unsatisfactory outcomes also had greater pain on manipulation of the stifle and a reduced range of motion. It is possible that the dogs with more stable stifles had more severe osteoarthritis and this accounted for their poor outcome. Nevertheless these findings suggest that dogs can do well, even with detectable stifle instability. These authors concluded that elimination of cranio-caudal instability of the stifle does not appear to be a major determinant of clinical success of a surgical procedure for CCL insufficiency. Postoperative instability remains a concern in dogs with a normal medial meniscus or with a substantial portion of the caudal medial meniscus still intact due to the risk of ‘late meniscal injury’ (30).

Fabella-tibial sutures provide only temporary cranio-caudal stability since fatigue, stretch or breakage of the suture occurs in the majority of cases within a few weeks of surgery (31). A variety of materials have been used for the FTS, including orthopaedic wire (26), monofilament nylon fishing line, or leader line (32). These wires and sutures break or stretch within approximately two to 12 months, during which time the formation of periarticular fibrosis may provide cranio-caudal joint stability (26, 32). One study demonstrated that 20% of lateral extra-capsular wire sutures broke by three weeks postoperatively, and that 82% had broken by six weeks postoperatively (31). Therefore, the precise role of the stabilising suture is unclear. Many CCL-insufficient dogs have a degree of periarticular fibrosis prior to surgery, and it is likely that this progresses with time, thus increasing the cranio-caudal stability of the stifle joint with time following loss of CCL integrity. This probably occurs independently of FTS placement. Furthermore, one study has suggested that the clinical success of surgical intervention for the CCL deficient stifle may depend on the ability of the thigh muscles to actively stabilise the joint when the limb is loaded during locomotion (22).

There is evidence to suggest that restoration of cranio-caudal stability occurs independently of specific surgical stabilisation. In a study of eleven, albeit smaller, dogs treated conservatively for CCL rupture, only two had instability to cranial draw at an average follow-up of 49.1 months (23). Experimental studies also support the concept that clinical function and adequate cranio-caudal stability of the stifle can be restored following CCL rupture without the use of a surgical ‘stabilising’ technique. In one such study in dogs, peak vertical impulse of limbs with CCL deficient stifles returned to 76% of limbs treated with a ‘sham’ surgery (33). Several other studies in dogs and in goats have shown a decrease in cranio-caudal stifle instability with time following initiation of CCL insufficiency, and these studies have suggested that decreased instability results from adaptive soft tissue changes, in particular thickening of the joint capsule (33–36). This suggests that degrees of stifle stability are restored without performing specific stabilising procedures and this likely occurs in stifles managed with open CPMM alone.

Although our study failed to find any significant differences between procedures in outcome, this result may be due to the study being under-powered due to small group sizes. Furthermore, there were some important shortcomings in our study design because the dogs were assigned to the treatment groups at the discretion of the surgeon rather than randomly. Additionally, there were significant differences in the length of time to final follow-up, and in the duration of lameness prior to surgical treatment. The difference in the follow-up times was not surprising because of the retrospective nature of this study. Placement of an FTS suture was the preferred surgical technique performed for CCL insufficiency with associated MMT prior to the adoption of the ‘CPMM alone’ technique. Thus the population of FTS dogs was histori- cally older and longer follow-up times were inevitable as follow-up data was obtained retrospectively at a single time point. The difference in duration of lameness prior to treatment between the two groups is harder to explain, and this is most likely to be the result of a type II statistical error due to the small number of patients studied. This difference could have resulted in more debilitation due to a greater progression of osteoarthritis in the control group. However this was not supported by the pre-operative lameness scores.
A potential criticism of the CPMM technique would be concern regarding the development of osteoarthritis. Stifle instability is associated with the development of osteoarthritis in man (37). There is considerable evidence to suggest that progression of osteoarthritis continues despite seemingly satisfactory stifle stabilisation (5, 7, 9–13). In addition, dogs with unstable stifles can have good outcomes (5, 7, 22) which would suggest that progression of osteoarthritis is no worse in these dogs, or that the osteoarthritis is not having a measurably deleterious effect. In a study of conservatively managed CCL-insufficient dogs, the presence of a cranial draw movement was not consistent with the severity of radiographic signs of osteoarthritis or the degree of lameness (23). In these dogs, stability was restored without surgery (23) and thus dogs which lack a stabilisation technique do not necessarily have an increased risk of developing osteoarthritis simply due to untreated stifle instability. Radiographic evidence of stifle osteoarthritis, while indicative of pathology, is not correlated with clinical function (38). In an experimental study of partial and complete meniscectomy, although affected stifles demonstrated signs of osteoarthritis, radiographically these findings were not associated with joint pain as measured using a force plate at 16 weeks post-surgery (20). Although follow-up times were short, our study showed that only a minority of dogs managed with CPMM alone were given continued NSAID treatment. It may be expected that dogs with significant progression of osteoarthritis would be more likely to require long-term NSAID treatment.

A variety of techniques have been employed to assess outcome following treatment of CCL rupture. These include subjective assessments including veterinary assessment and owner assessment, as well as objective assessments such as kinetic or kinematic gait analysis. Due to retrospective nature of this study, owner assessment was deemed to be the most appropriate and useful method. Kinetic and kinematic gait analyses are the ‘gold standard’ for assessing canine lameness as they provide objective data for gait assessment (39). Gait analysis was not possible in this study due to its retrospective nature. Owner questionnaires have been used for the scoring of pain or lameness in the veterinary literature (28). The questionnaire used in this study was based on the BrOAD questionnaire (28). This questionnaire has been shown to be a reliable, responsive and sensitive tool for the assessment of outcome following treatment of CCL rupture (28). Three other studies also support the use of a questionnaire to assess outcome following treatment for orthopaedic disease (40–42). One of these studies compared the questionnaire with force plate analysis, and confirmed that the questionnaire was reliable and valid in assessing pain and lameness in dogs (41).

When drawing conclusions from this study, several limitations are recognised. The retrospective nature of the study has an effect on the quality of the information gathered. The information provided is subjective and reliant on the owners’ perspective. However owner assessment has been shown to be a reliable and responsive method for evaluating outcome of treatment for CCL rupture (28). The small number of dogs in each treatment group may have affected the results. Greater numbers may have revealed a significant difference between the two groups. The length of time to follow-up was significantly different between the two groups, which could be a result of the way in which these cases were managed. However a difference in outcome between the two groups may have been evident if the follow-up times were the same. A randomised prospective study using objective measures of outcome, including force plate analysis, would provide more reliable evidence supporting the use of the ‘CPMM alone’ technique.

As previously stated, there are a wide variety of techniques for managing CCL insufficiency, and this study has only compared ‘CPMM alone’ to FTS and CPMM. We did not compare ‘CPMM alone’ with a tibial osteotomy technique such as a tibial plateau levelling osteotomy, principally because these techniques were not employed at our institute at the time of the study. Prospective comparison of open CPMM with a tibial osteotomy technique would provide invaluable information on the usefulness of this technique.

In summary, this pilot study provides some evidence to support the use of open CPMM alone for dogs affected by CCL insufficiency with MMT. It has also raised some questions regarding the value of the FTS in managing short-term cranio-caudal stifle instability in dogs with CCL insufficiency and concurrent MMT.

References

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